JOURNAL AND PROCEEDINGS

OF THE

Hamilton Scientific Association

SESSION 1901-1902.

NUMBER XVIII.

CONTENTS.

AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR STATEMENTS MADE AND OPINIONS EXPRESSED THEREIN.

PRINTED FOR THE HAMILTON SCIENTIFIC ASSOCIATION
BY TIMES PRINTING COMPANY.

1902

Journal and Proceedings

OF THE

HAMILTON SCIENTIFIC ASSOCIATION

FOR SESSION OF 1901-1902.

NUMBER XVIII.

AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR STATEMENTS MADE AND OPINIONS EXPRESSED THEREIN.

PRINTED FOR THE HAMILTON ASSOCIATION
BY TIMES PRINTING CO.

1902.

OFFICERS FOR 1901-1902.

President.

S. A. MORGAN, B. A., D. PÆD.

1st Vice-President.

J. M. DICKSON.

2nd Vice-President.

ROBERT CAMPBELL.

Corresponding Secretary.

F. F. MACPHERSON, B. A.

Recording Secretary.

G. L. JOHNSTON, B. A.

Treasurer.

P. L. SCRIVEN.

Curator.

ALEX. GAVILLER.

Assistant Librarian.

J. SCHULER.

Council.

W. A. CHILDS, M. A.

GEO. BLACK.

J. F. BALLARD.

J. H. LONG, M. A., LL.B.

J. R. HEDDLE.

Auditors.

H. S. MOORE.

F. HANSEL, D. D. S.

OFFICE-

	President.	First Vice-Pres.	Second Vice-Pres.
1857	Rev. W. Ormiston, D. D..	John Rae, M.D., F.R.G.S.	J. B. Hurlburt, M.A., LL.D.
1858	John Rae, M.D., F.R.G.S.	Rev. W. Ormiston, D. D.	J. B. Hurlburt, M.A., LL.D.
1859	Rev. W. Ormiston, D. D..	J. B. Hurlburt, M.A., LL.D.	Charles Robb............
1860	Rev. W. Inglis, D. D.....	T. McIlwraith..........	Rev. W. Ormiston, D. D..
1861	Rev. W. Ormiston, D. D..	J. B. Hurlburt, M.A., LL.D.	Rev. W. Inglis, D. D.....
1871	W. Proudfoot............	Judge Logie.............	Richard Bull............
1872	Judge Logie............	H. B. Witton, M. P.....	Richard Bull............
1873	H. B. Witton, M. P......	J. M. Buchan, M. A.....	A. T. Freed............
1874	H. B. Witton, M. P......	J. M. Buchan, M. A.....	A. T. Freed............
1875	H. B. Witton............	J. M. Buchan, M. A.....	W. H. Mills............
1880	T. McIlwraith..........	Rev. W. P. Wright, M. A.	H. B. Witton............
1881	J. D. Macdonald, M. D...	R. B. Hare, Ph.D.......	B. E. Charlton..........
1882	J. D. Macdonald, M. D...	B. E. Charlton..........	J. A. Mullin, M. D......
1883	J. D. Macdonald, M. D...	B. E. Charlton..........	H. B. Witton............
1884	J. D. Macdonald, M. D...	H. B. Witton...........	Rev. C. H. Mockridge, M. A., D. D.
1885	Rev. C. H. Mockridge, M. A., D. D.	Rev. S. Lyle..........	W. Kennedy............
1886	Rev. C. H. Mockridge, M. A., D. D.	Rev. S. Lyle...........	Matthew Leggat.........
1887	Rev. S. Lyle, B. D.....	B. E. Charlton.........	W. A. Childs, M. A.....
1888	Rev. S. Lyle, B. D......	T. J. W. Burgess, M. B., F. R. S. C.	W. A. Childs, M. A.....
1889	B. E. Charlton..........	T. J. W. Burgess, M. B., F. R. S. C.	J. Alston Moffat.........
1890	B. E. Charlton..........	J. Alston Moffat.........	A. T. Neill.............
1891	A. Alexander, F. S. Sc..	A. T. Neill.............	S. Briggs..............
1892	A. Alexander, F. S. Sc..	A. T. Neill.............	S. Briggs...............
1893	A. Alexander, F. S. Sc..	A. T. Neill.............	T. W. Reynolds, M. D..
1894	S. Briggs...............	A. T. Neill.............	T. W. Reynolds, M. D..
1895	A. T. Neill.............	T. W. Reynolds, M. D..	A. E. Walker..........
1896	A. T. Neill...........	T. W. Reynolds, M. D..	A. E. Walker..........
1897	A. Alexander, F. S. Sc..	T. W. Reynolds, M. D..	A. E. Walker..........
1898	T. W. Reynolds, M. D..	A. E. Walker..........	J. M. Dickson..........
1899	T. W. Reynolds, M. D..	A. E. Walker...........	J. M. Dickson..........
1900	S. A. Morgan, B. A., D. Pæd.	J. M. Dickson..........	Wm. C. Herriman, M. D.
1901	S. A. Morgan, B. A., D. Paed.	J. M. Dickson..........	Robt. Campbell.........

BEARERS.

Cor. Sec.	Rec. Sec.	Treas.	Lib. and Cur.
T. C. Keefer, C. E...	Wm. Craigie, M. D .	W. H. Park.........	A. Harvey.
T. C. Keefer, C. E..	Wm. Craigie, M. D..	W. H. Park.........	A. Harvey.
T. C. Keefer, C. E...	Wm. Craigie, M. D..	W. H. Park.........	A. Harvey.
Wm. Craigie, M. D..	Wm. Craigie, M. D..	W. H. Park....	Chas. Robb.
Wm. Craigie, M. D..	Wm. Craigie, M. D..	W. H. Park.........	T. McIlwraith.
J. M. Buchan, M. A..	I. B. McQuesten, M.A	W. G. Crawford....	T. McIlwraith.
J. M. Buchan, M. A..	I. B. McQuesten, M.A	W. G. Crawford.....	T. McIlwraith.
Geo. Dickson, M. A..	Geo. Dickson, M. A..	Richard Bull.........	T. McIlwraith.
Geo. Dickson, M. A..	Geo. Dickson, M. A..	Richard Bull.........	T. McIlwraith.
Geo. Dickson, M. A..	Geo. Dickson, M. A..	A. Macallum, M. A..	T. McIlwraith.
R. B. Hare, Ph. B...	Geo. Dickson, M. A..	Richard Bull.........	A. T. Freed.
Geo. Dickson, M. A..	A. Robinson, M. D..	Richard Bull.........	W. H. Ballard, M. A.
Geo. Dickson, M. A..	Wm. Kennedy.......	Richard Bull.........	W. H. Ballard, M. A.
Geo. Dickson, M. A..	Wm. Kennedy.......	Richard Bull.........	W. H. Ballard, M. A.
Geo. Dickson, M. A..	A. Alexander........	Richard Bull.........	Wm. Turnbull.
Geo. Dickson, M. A..	A. Alexander........	Richard Bull.........	A. Gaviller.
Geo. Dickson, M. A..	A. Alexander, F.S.Sc.	Richard Bull.........	A. Gaviller.
H. B. Witton, B. A..	A. Alexander, F.S.Sc.	Richard Bull.........	A. Gaviller.
H. B. Witton, B. A..	A. Alexander, F.S.Sc.	Richard Bull.........	A. Gaviller.
H. B. Witton, B. A..	A. Alexander, F.S.Sc.	Richard Bull.........	A. Gaviller.
H. B. Witton, B. A..	A. Alexander, F.S.Sc.	Richard Bull.......	A. Gaviller.
Thos. S. Morris......	A. W. Stratton, B. A.	Richard Bull.........	A. Gaviller and G. M. Leslie.
Thos. S. Morris......	C. R. McCullough....	Richard Bull...	A. Gaviller and G. M. Leslie.
W. McG. Logan, B.A.	S. A. Morgan, B. A..	Thos. S. Morris......	A. Gaviller and W. Chapman.
W. McG. Logan, B.A.	S. A. Morgan, B. A..	Thos. S. Morris......	A. Gaviller and W. Chapman.
Rev. J. H. Long, M.A. LL. D.	S. A. Morgan, B. A..	J. M. Burns.........	A. Gaviller and W. Chapman.
Rev. J. H. Long, M.A. LL. D.	S. A. Morgan, B. A., B. Pæd.	P. L. Scriven........	A. Gaviller and H. S. Moore.
Wm. C. Herriman, M. D.	S. A. Morgan, B. A., B. Pæd.	P. L. Scriven........	A. Gaviller and H. S. Moore.
Thos. S. Morris......	S. A. Morgan, B. A., B. Pæd.	P. L. Scriven........	A. Gaviller.
Thos. S. Morris......	S. A. Morgan, B. A., D. Pæd.	P. L. Scriven........	A. Gaviller and J. Schuler.
Thos. S. Morris......	G. L. Johnston, B. A.	P. L. Scriven........	A. Gaviller and J. Schuler.
F. F. Macpherson, B.A.	G. L. Johnston, B. A.	P. L. Scriven........	A. Gaviller and J. Schuler.

MEMBERS OF COUNCIL.

1857—Judge Logie; Geo. L. Reid, C. E.; A. Baird; C. Freeland.

1858—Judge Logie; C. Freeland; Rev. W. Inglis, D. D.; Adam Brown; C. Robb.

1859—Rev. D. Inglis, D. D.; Adam Brown; Judge Logie; C. Freeland; Richard Bull.

1860—J. B. Hurlburt, M. A., LL. D.; C. Freeland; Judge Logie; Richard Bull; Wm. Boultbee; Dr. Laing.

1871—Geo. Lowe Reid, C. E.; Rev. W. P. Wright, M. A.; A. Macallum, M. A.; A. Strange, M. D.; Rev. A. B. Simpson.

1872—Judge Proudfoot; Rev. W. P. Wright, M. A.; John Seath, M. A.; H. D. Cameron; A. T. Freed.

1873—Judge Logie; T. McIlwraith; Rev. W. P. Wright, M. A.; A. Alexander; I. B. McQuesten, M. A.

1874—Judge Logie; T. McIlwraith; Rev. W. P. Wright, M. A.; A. Alexander; I. B. McQuesten, M. A.

1875—Judge Logie; T. McIlwraith; Rev. W. P. Wright, M. A.; A. Alexander; I. B. McQuesten, M. A.

1880—M. Leggat; I. B. McQuesten, M. A.; A. Alexander; Rev. A. Burns, M. A., LL. D., D. D.

1881—T. McIlwraith; H. B. Witton; A. T. Freed; Rev. W. P. Wright, M. A.; A. F. Forbes.

1882—T. McIlwraith; H. B. Witton; A. T. Freed; A. F. Forbes; Rev. C. H. Mockridge, M. A., D. D.

1883—A. Alexander; A. Gaviller; A. F. Forbes; T. McIlwraith; R. Hinchcliffe.

1884—A. Gaviller; A. F. Forbes; T. McIlwraith; R. Hinchcliffe; W. A. Robinson.

1885—W. A. Robinson; S. Briggs; G. M. Barton; J. Alston Moffat; A. F. Forbes.

1886—J. Alston Moffat; Samuel Slater; Wm. Milne; James Leslie, M. D.; C. S. Chittenden.

1887—J. Alston Moffat; James Leslie, M. D.; P. L. Scriven; Wm. Milne; C. S. Chittenden

1888—J. Alston Moffat; B. E. Charlton; T. W. Reynolds, M. D.; S. J. Ireland; Wm. Kennedy.

1889—T. W. Reynolds, M. D.; S. J. Ireland; William Turnbull; A. W. Hanham; Lieut.-Col. Grant.

1890—Col. Grant; A. W. Hanham; W. A. Robinson; A. E. Walker; Thomas S. Morris.

1891—Col. Grant; W. A. Robinson; J. F. McLaughlin, B.A.; T. W. Reynolds, M. D.; Wm. Turnbull.

1892—T. W. Reynolds, M. D.; W. A. Robinson; P. L. Scriven; Wm. Turnbull; Wm. White.

1893—James Ferres; A. E. Walker; P. L. Scriven; Wm. White; W. H. Elliott, Ph. B.

1894—James Ferres; A. E. Walker; P. L. Scriven; J. H. Long, M. A., LL. B.; W. H. Elliott, B. A., Ph. B.

1895—J. E. P. Aldous, B. A.; Thomas S. Morris; W. H. Elliott, B. A., Ph. B.; P. L. Scriven; Major McLaren.

1896—J. E. P. Aldous, B. A.; Thomas S. Morris; W. H. Elliott, B. A., Ph. B.; George Black; J. M. Burns.

1897—W. H. Elliott, B. A.; Thomas S. Morris; Robert Campbell; J. R. Moodie; Wm. White.

1898—W. H. Elliott, B. A.; Robt. Campbell; W. A. Childs, M. A.; Wm. C. Herriman, M. D.; W. A. Robinson.

1899—W. H. Elliott, B. A.; Robt. Campbell; W. A. Childs, M. A.; Wm. C. Herriman, M. D.; W. A. Robinson.

1900—Robt. Campbell; W. A. Childs, M. A.; George Black; J. F. Ballard; J. H. Long, M. A., LL. B.

1901—W. A. Childs, M. A.; George Black; J. F. Ballard; J. H. Long, M. A., LL. B; J. R. Heddle.

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF

The Hamilton Association

DURING THE

SESSION OF 1901-1902.

NOVEMBER 14th, 1901.

The opening meeting held, with the President, Dr. Morgan, in the chair.

After some musical numbers by the orchestra, the President delivered his inaugural address, dealing with the events of the past year in a scientific spirit.

The Photographic Section provided a most extensive and beautiful exhibit of their work during the preceding season. An interesting collection of ferns from Australia and New Zealand was also on exhibition.

DECEMBER 5th, 1901.

The regular meeting held, with Dr. Morgan in the chair. Nine new members were elected members of the Association. Mrs. S. E. Carry presented two stacks of drawers for holding specimens to the Association.

Dr. D. V. Lucas gave a most instructive and interesting talk on "The Birds of New Zealand," illustrating his lecture with picture-plates.

JANUARY 16th, 1902.

The regular meeting held, with Dr. Morgan in the chair.

Prof. Ami, of the Geological Survey, Ottawa, was elected a corresponding member of the Association.

Mr. E. B. Biggar, of Toronto, gave a lecture on The Metric System of Weights and Measures. English measurements mostly taken from length of parts of the human body, such as foot, cubit, fathom, etc. The metric system was an outcome of the French revolutionary times. The metre was fixed at one millionth part of the distance from the Equator to the North Pole, being equal to 39.37 inches. Its great merit is simplicity, and is now in use by forty-four nations. The British people are very conservative, and because of not having adopted this system are losing much trade with such countries as those of South America where the system is in use. The use of this system would effect a saving of two or three years in a business man's life in the matter of making calculations.

FEBRUARY 13th, 1902.

The regular meeting held, with Dr. Morgan in the chair.

Applications for membership were received from thirty new members, twenty-nine being members of the Astronomical Society, which desired to become a Section of this Association. Voting was proceeded with at once, and they were all declared elected.

The lecturer of the evening, Prof. Lang, of Toronto University, delivered an address on "Matter at Low Temperatures." An historical account was given of the apparatus used for the liquefaction of what were formerly considered the permanent gases. One experiment showed carbonic acid gas converted into a solid, resembling snow, at a temperature of —78°C. This remained a solid for more than an hour before disappearing by evaporation. The principle of solidification was explained to be that of rapid expansion, the gas being liberated from a cylinder under a pressure of about sixty atmospheres. Afterwards, by means of this solid carbonic acid and ether, a temperature of —112°C was produced, by means of which a tube of mercury was solidified. The "Critical Point" of a gas was explained to be that point of temperature above which it was impossible to liquefy the gas, no matter how much pressure was applied. The fractional distillation of Air was also explained.

MARCH 13th, 1902.

On invitation, our members attended a meeting of the Canadian Association of Stationary Engineers, when a paper was read on "The Manufacture of Iron," by Mr. C. Fox, Chemist and Superintendent of the Hamilton Blast Furnace.

Iron ore consists of iron plus oxygen in chemical union. The O. is taken away by means of C. O. gas. This gas is always produced when there is an excess of fuel and a deficiency of air. In the H. B. F. 3,000,000 gallons of water a day are used for cooling purposes. A section of one of the stoves was shown and explained. From it air at a temperature of 1400° is blown into the Furnace. This in contact with white-hot coke makes a most intense heat. By means of a diagram the parts and working of a furnace were fully explained. In the H. B. F. 300 tons a day are produced. For each ton 5.8 tons of air and 3.1 tons of coke, ore and limestone are used. About 30,000 cubic feet of air a minute is blown into the furnace by a force of 2000 horse power. About 3000 tons of gas goes out of the chimney in 24 hours, and by means of piping this is taken down to the stoves and used for fuel. The use of limestone was explained. The chief impurity in ore is Silica. This unites with the limestone to form a fusible slag. The various classes of pig iron were described.

APRIL 17th, 1902.

The regular meeting held, with Dr. Morgan in the Chair.

Prof. Fletcher, of Ottawa, was appointed our representative at meeting of Royal Society, to be held in Toronto, May 26 to 31.

Mr. A. H. Baker, President of the Camera Section, then gave an illustrated lecture on Kingsley's Country of North Devon. The lecture proved extremely interesting, and called forth a hearty vote of thanks.

MAY 1st, 1902.

A special meeting held, with Dr. Morgan in the chair.

Prof. MacCallum, of Toronto University, lectured on "Life and Culture of Pre-historic Man."

The term pre-historic would vary with different regions of the earth. The different strata of the earth's crust make a thickness of some 80,000 feet, showing the earth to be perhaps 20 million years old. No relics of man are found in the Eocene period, one or two in the Miocene.

In the south of England a bit of rib marked in such a way as to show intelligence above that of the Ape was found. Belonging to the Pliocene period in Tuscany, one or two objects have been found. In 1894 in Java a series of bones, the top of a skull, thigh bones and a number of teeth, belonging, it is supposed, to the Anthropoid Ape, showing that it walked erect and had limbs resembling the human. This form of Ape is now extinct. The Anthropoid Ape is not the progenitor of man, but he may have known more than the ordinary Ape. Then follows the Pleistocene period, characterised by glacial drifts, ice covering all the northern part of Europe. In those times Great Britain and Ireland were joined with the Continent, and Italy was joined with Africa. France seems to have been the centre of civilization of this period, because its 300 or more caves that have been explored have furnished most of our pre-historic records. In Africa, also Somaliland, and the country stretching southwards, have proved a great storehouse of relics, such as flint axes of beautiful workmanship and showing extraordinary skill. The drifting ice cut deep grooves in the soil, which were afterwards filled in with alluvial soil, so that relics have been found buried 40 or 50 feet deep. The principal relics have been found in the Dardogne region. In a cave at the foot of the Pyrenees were found at the bottom chipped stone implements and a skull. Overlying this was a great depth of limestone deposit which had gradually fallen from the roof, whilst high up in the cave were found polished stone implements and other skulls. And so we speak of the Paleolithic age and the Neolithic age, the advancement in skill in making the stone implements being very marked in the latter. In one cave was found an indication that man had reached a high state of civilization—a stone lamp with tarry material in it, which on analysis proved to be animal fat. The spout of the lamp was blackened by use. Earthenware vessels were also found.

The Paleolithic man in some way was swept out of existence and succeeded by the Neolithic man, who came from the Somali region and crossed the Mediterranean into Europe. In the caves scrapers are found supposed to have been used for removing hair from skins, suggesting the use of clothing, and also of animal food. Ash-heaps and charred bones and flesh indicate the use of fire for heat and for cooking purposes. Drawings on ivory and horn represent the mastodon, the horse, the reindeer, etc. The horse is represented with a covering on, indicating that it was domesticated. The drawing of the reindeer corresponds exactly to what we see at the present day. The use of burial places shows affectionate regard and suggests family life. That they were organized into communities was indicated by the Baton of authority.

MAY 8th, 1902.

The regular meeting held, with Dr. Morgan in the chair.

Thirteen new members were elected.

Messrs. Dickson and Alexander referred in eulogistic terms to the work of the late A. E. Walker, recently deceased.

Natural History Notes by Mr. Wm. Yates were read by Mr. Alexander.

On motion we then resolved ourselves into the annual meeting, and reports were received from the various sections. The election of officers was then proceeded with.

REPORT OF COUNCIL.

Your Council take pleasure in submitting their report for the session 1901-1902.

During this session there have been held four meetings of Council and eight meetings of the general Association, at which the following papers and addresses were given:

1901

NOV. 14th—"Inaugural Address"—President S. A. Morgan, B. A., D. Pæd.

DEC. 5th—"Birds of New Zealand"—Rev. D. V. Lucas, D. D.

1902

JAN. 16th—"The Metric System of Weights and Measures"—E. B. Biggar, Esq.

FEB. 13th—"Matter at Low Temperatures"—Prof. Lang, Toronto University.

MAR. 13th—"The Manufacture of Iron"—C. Fox, Esq.

APRIL 17th—"Kingsley's Country of North Devon"—A. H. Baker, Esq.

MAY 1st—"Life and Culture of Pre-historic Man"—Prof. MaCallum, Toronto University.

MAY 8th—"Natural History Notes"—Wm. Yates, Esq.

Prof. Fletcher, of the Central Experimental Farm, Ottawa, was appointed to represent this Association at the coming meeting of Royal Society.

Your Council is pleased again to recognize the valuable assistance given to the meetings of the Association by the Camera Section, not only by the exhibition of work at the opening meeting, but by the operation of the lantern for illustrated lectures during the year; also to record the formation of a new section—the Astronomical Section—the members of which we will always welcome to the general meetings.

During the year we have been called upon to mourn the death of an old and valued member, Mr. A. E. Walker. May the inspiration of his faithful service raise up others to follow in his steps.

The meetings held during the year have been of a high standard of excellence; the various sections are full of life and vigor; the membership of the Association has been increased by an addition of 51 new members. The prospects for the future of the Association, therefore, seems very bright and encouraging.

All of which is respectfully submitted.

S. A. MORGAN,
President.

G. L. JOHNSTON,
Secretary.

INAUGURAL ADDRESS.

Delivered Nov. 14th, 1901.

BY S. A. MORGAN, D. PÆD.

LADIES AND GENTLEMEN :

When I consider how extensive and varied an exhibit of the work of our members is awaiting your inspection, and how much more interesting these must prove than the weighing of abstract speculations, I feel it a duty as well as a privilege to make my remarks on this occasion as brief as possible. I cannot, however, omit the opportunity of conveying to you my appreciation of the honor you have conferred upon me in re-electing me to the high office of President of this Association, and of expressing the hope that the same kindly consideration and loyal support granted me by one and all during the past year, will also be extended through the present encumbancy. During the past year our Association has done much, not only to awaken and advance the scientific spirit within our own locality, but to furnish information and data for the assistance of scientists in other parts. Through the untiring efforts of our Geological Section, under the leadership of Col. C. C. Grant, we are credited with having made large additions to the leading Museums of America and England, including the Dominion Museum at Ottawa, the Washington Museum and the British Museum of Natural History. Of the excellent work being done by the members of our Camera Section, it is scarcely necessary for me at this time to make mention—*Si monumentum quæris, circumspice.*

While not wishing to detain you with any lengthy remarks, I may, perhaps, be pardoned if I ask you for a few minutes to review the more important events of the past year, which appeal to us as members of a scientific organization. As a society, we have been called on to mourn the loss of two of our most esteemed and honored past-presidents, in the persons of Dr. J. D. MacDonald and Mr.

B. E. Charlton. The kindly voice and the helping hand have departed never to return, but the influence and example of their noble lives and actions remain as an undying heritage.

Early in the present year, as subjects and citizens of the British Empire, we, in common with our brethren throughout the world, were startled with the sad news of the death of that great Queen and beloved Sovereign, whose wise administration had been excelled only by the virtues of her womanly character. To such an extent had her name and person become associated with the permanence of our national life and the progress of the century that we had refused to believe her mortal. We loved and served her in life as becometh a free people to serve a wise and noble ruler; we reverence her memory in death, and shall bestow upon her illustrious son that homage to which his inherited virtues are justly entitled.

In common also with the other parts of our Empire, we are still called upon to extend aid and sympathy to our Colonial brethren in South Africa, whose homes have been violated by a semi-barbarous invader. We unite in the hope that peace may soon crown the efforts of our arms, and that the blessings of Anglo-Saxon enlightenment and justice shall have free scope to remove whatever of blind hatred the past may have engendered. While, however, lamenting the protraction of the war, we, of this country, who can form some conception of the difficulties of the present war from considering the extent of our own Dominions, cannot but be amused at the unreasoning attitude of so many of our arm-chair critics. The struggle which gave the Anglo-Saxon supremacy in America was measured not by years but by decades, or I might even say by centuries. The spirit of determination which animated our fathers will not, I trust, be found wanting in the present generation.

A more pleasing feature of our national history of the present year was the opportunity afforded us, in common with the other portions of the Empire situated beyond the seas, to join in welcoming among us the heir-apparent to the Imperial Throne. No stronger proof of the solidarity of our people and of the deep affection which they hold toward the reigning house could be required than the uniform expressions of devotion with which in every part of the Empire Their Royal Highnesses have been greeted. Their triumphal tour has now become a portion of our national history, but who can attempt to measure the mighty influence which it must wield in cementing even more closely the bonds of loyalty and affection within which our Empire is contained?

Another event of the present year, to which I would briefly allude, is the celebration of the one thousandth anniversary of the death of King Alfred the Great. This event, which took place at Winchester, in July, should interest us not only as students but as members of the great Anglo-Saxon race. In none of our early kings can we find so truely depicted these cardinal virtues which have since become synonymous with the Anglo-Saxon character. Himself a scholar, he thus early taught us that the light of education and of religion is essential to our national well-being. The founder of so much that is valuable is our legal and political institutions, he lived out in his own life that love for even and impartial justice for which the Saxon race have ever since been famous.

Among the important events of the present year, we must also make mention of the Pan-American Exposition, held at Buffalo. This important event transpiring so near our doors, we are the more likely to overlook its significance. The holding of such an exposition, limited to the two Americas, must do much to awaken in their peoples a truer conception of the mighty resources they possess and aid much in facilitating trade and commerce between them. But it is not, I fear, on account of its contributions to commerce and art that this exposition will best be known to posterity. Within its confines, on Friday, Sept. 6th, was committed one of the most awful crimes against our common civilization which has stained the annals of history. When we contemplate all that is implied in the assassination of President McKinley, we surely must be oppressed with the thought of how great forces of evil lie slumbering within our body politic, and how weak is the chain of our social fabric if its power is to be judged by the strength of its weakest link. When we view these awful lessons of social depravity, are we not justified in concluding, that notwithstanding the boasted advances of our present generation, animal rather than moral forces still sway the destines of human life and action?

To many students of sociology there will no doubt seem to exist at least an indirect causal connection between this awful crime and another most striking occurrence of the present year. I refer to the formation of that gigantic industrial combination which centres itself about the name of J. Pierpont Morgan.

The formation of a billion dollar trust, which seeks even to secure control of our great international highways, will by many be viewed as another step in the widening process between labor and capital, through which the few rich are ever becoming more rich and the many poor becoming yet poorer. Be this as it may, the event itself is of sufficient importance for the thoughtful student to look about for an explanation of its causes and probable effects. With many, a sufficient cause for the present tendency toward consolidation is to be found in our partial industrial laws, which are held to favor unduly the combining process. There can be no doubt that the privilege of entering such combinations with a limited liability, and of watering the stock of a company to such an extent that a ten thousand dollar manufactory may be converted into a fifty thousand dollar stock company, has dealt a death blow to the smaller private industries. I cannot agree, however, that the whole cause lies here, or that a re-adjustment of our commercial legislation would remove the present tendency toward consolidation. A deeper reason, perhaps, will be found in the revolution which modern science has brought about in our industrial methods. Foremost among these may be mentioned the great and numerous inventions which, while cheapening, have also lengthened the course of production, and secondly, the great chemical applications by which the waste refuse of one industry becomes the raw product of another. It must be evident, however, that the more scientific our industrial life becomes, the more gigantic must be the scale upon which it proceeds. If these conclusions be true, we must ask ourselves whether we are willing to forego all this saving of physical labor and material for a return to primitive simplicity. Is the lightening of labor and the increase of social commodities to result only in social degradation? Shall we not rather say that every such advance must mark an onward step in physical and moral freedom?

Though the present outlook may at times seem dark, let us not be of those who would lose faith in the social future. Can we not rather draw comfort from the present tendencies of our industries? When we see these vast consolidations being successfully operated under a single head, does it not give promise that the advocate of socialized industries may yet hope to see his expectations to some degree realized?

In conclusion I would add a word on another issue, which is following in a far different field as a result of our scientific progress. I refer to the large share which matters scientific and industrial now occupy in our national systems of education. "Schools Scientific" and "Schools Technical," is the present burden of our educational song. That these should occupy a large space in our national system, no one can deny. If the purpose of the school be to prepare the child for filling his place in the social organism, then surely these great industries and processes which have so much to do with our social life should not be shut out from the school curriculum. Ought we not, however, to ask ourselves whether in our zeal we may not be overlooking other phases of this problem? Let us not forget that the world moves at least not less through moral than through physical forces. When we find that in our great schools and colleges our students of Greek language and literature, the great source and fountain head of moral truth and beauty, when I say we find that these students may be numbered upon our fingers, should we not ask ourselves whether we are not thinking more of meat than of life, more of the raiment than of the body.?

Let us not forget that above all things we are laboring for moral and spiritual freedom; that high ideals and lofty sentiments are the greatest inspiration of a nation; that only when the heart is filled with the music of humanity shall we find a soul that is truly noble, and an influence that shall never die.

BIRDS OF NEW ZEALAND.

A paper on some of the Birds of New Zealand, read before the Association December 5th, 1901.

BY DR. D. V. LUCAS, OF GRIMSBY.

Nature is laid before us as a great book with many pages. Some of us take very naturally to one page, some to another. The enthusiast always feels, whatever department he may have chosen, that he has had the rare good fortune to light upon the most interesting of all, whether it be a study of diatoms or of diamonds; of molecules or of mountains.

I will not say that the subject I place before you to-night is superior to all others on your annual list, though I hope you will find it at least worthy of your attention for an hour or so now, and afford you profitable and pleasant remembrances of it in the days to come.

In many senses New Zealand is a remarkable country, and in considering her birds we have before us one of her most interesting features, especially in her natural kingdom. She has not only a great variety of birds without wings, especially if we include the now extinct Moa, but there are also birds in that country which, though they have wings, seldom or never use them. There are ten different sorts of Parakeets and about fifteen different kinds of Parrots.

To me a talking bird is always a wonder. Why should a bird possess the power of imitating the educated human voice? There is something more than a mere pronouncing of words by some of these birds; there is apparently an appreciation of the relationship of one word or one thought to another. I stood by and heard one of these talking birds say to a dog, "Carlo, come here," and the dog came. The bird said, "Carlo, lie down," and the dog lay down. The bird said, "Carlo, roll over," and the dog rolled over. The memory of these birds is to me as great a matter of wonder as their power of speech. I have met with instances where the memory of the bird has been equal to carrying a thought through three, and in another instance, nine years. During the entire lapse of these years the bird never once was known to refer to some one thing he had been taught until something happened with which that thing was especially associated, and then there was the most satisfactory evidence that he remembered it as clearly as if the association of thought respecting it had been of daily occurrence.

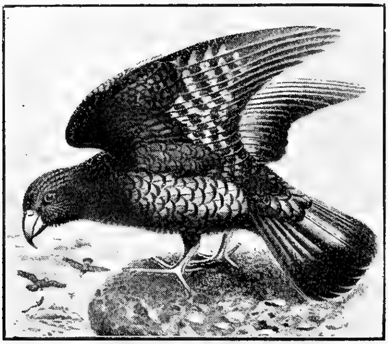
The power of classifying sounds and observing the difference in sounds is also a striking peculiarity of some talking birds. Let old "Major" be put in the other room and the door closed tight; now hit your side of the door with a stone or cane or key or your own knuckles, and he will say, "Come in." Take a small tin cup and hit the door with the corner of it and he will say, "Milk," and you cannot deceive him, so long as you strike loud enough for him to know that you have hit the door with something.

New Zealand's talking birds are not equal to those of Australia, though some birds, especially the Ka-Ka, are fair speakers.

The most interesting of them all is the owl parrott, or Ka-Ka-po. This bird, though possessed of strong, large wings, never uses them, except to steady itself in its descent from a higher to a lower limb. In ascending it always creeps up, never flies. Its nest and *rendezvous* are in the hollow, or under the roots of old, large trees. Its habits are almost entirely nocturnal. It is said, indeed, that the Ka-Ka-po is never seen during the day. Before the use of dogs to drive it from its burrow, natives were accustomed to hunt it at night, confusing and blinding it with lights. It feeds wholly on the ground, glutting itself with some kinds of mosses, ferns and grass. It offers a formidable resistance to a dog, by means of its strong claws and beak.

THE KEA.

The Kea, or hawk-parrot, is, if anything, a still greater curiosity. In former years this bird fed entirely on nuts and fruits. Discovering a sheep's pelt on the fence near the settler's residence it began to peck at it, more apparently from curiosity than anything else, and at length, from this beginning, became a carnivorous bird. It has learned the art of attacking the living sheep, and in the higher altitudes where sheep feed on the mountain slopes, as many as 15,000 a year have been destroyed by the Kea. The N. Z. government have found it necessary to offer 75 cents a head for their destruction. The bird lights on the back of the sheep, and having fixed its claws firmly in the wool, flaps its wings, causing the sheep to run until it is so completely exhausted it yields itself up to its fate, and then the bird picks through the small of the back, tearing out the kidneys and surrounding fat, leaving the poor sheep to die slowly from its wounds.



THE KEA.

THE SADDLE-BACK.

The Saddle-back gets its name from its very peculiar marking. It is a black bird, about the size of our American Robin, with a very broad band of reddish brown color running across the back and across the wings, giving him the appearance of being saddled. The most curious thing to be noted of the Saddle-back is his habit of accompanying a flock of Yellow-heads, a small wild Canary. Wherever you see a flock of these little birds, there you will see also a single male Saddle-back in the midst of them, an apparently self-appointed general, directing their movements and protecting their interests. Naturalists have never yet been able to discover the bird's motive for this queer habit. This bird is exceedingly restless and noisy. In the day time he cannot, apparently, remain more than a very few seconds in one place, making a harsh cry. In the breeding season, however, his notes are very soft and musical, and it is a matter of surprise to the naturalists, that a bird so restless and noisy should be able to conduct himself at any time with such modesty and delicacy.

THE CUCKOO.

There are two very different kinds of Cuckoo in New Zealand, both as regards color, size and general habits; the only common characteristic, making them both Cuckoos, being they are both robbers of the basest sort, stealing the home of smaller birds, the fruit of long and patient toil. The nest in which a single Cuckoo egg, by either the long tailed or the bronze Cuckoo, is deposited, is usually that of the "Gray Warbler," a bird not over one-third the size of the conscienceless invader. The larger bird of the Cuckoo breed soon ejects the smaller offspring of the rightful owners of the nest, and then receives their sole attention till he is fully matured and made ready by the innocent victims of his parent's knavery, to go forth himself to perpetuate the dishonesty and thieving propensity of his ancestors.

CROWS.

The Crow is a very different bird from the American species in appearance. His habits, however, much more than color or form, assign him a place in the Crow family. He is like all his cousins, inquisitive, shy and crafty. The notes of the male are loud and varied. The most noticeable one is a long drawn organ note of great depth and richness. Sometimes his notes resemble the soft tolling of a bell. Its wings are small and rounded, and its flight therefore feeble and limited to very short distances. They prefer passing over the ground on foot, hopping as they go, usually in single file, if there are several of them. They will follow their leader like a flock of sheep. If the first bird should have occasion to leap over a stone or fallen tree in the line of march, every bird in the procession does not fail to follow the example to the very letter, and do exactly what has been done by the one ahead of him.

THE TUI OR PARSON-BIRD.

This bird is about the size of our large Canadian Black-bird. The early colonists nick-named him Parson-bird, because of the tufts of white feathers which adorn his throat, with their fancied resemblance to clerical bands. It is said, however, that in more striking appearances he resembles the forcible preacher, for when indulging in his strain of wild notes it gesticulates in a manner suggestive of a declamatory style of preaching. He shakes his head, bending to one side, then to another, as if he remarked to this one and to that, and now and then with pent-up vehemence his voice waxes loud in a manner apparently intended to awaken some of his drowsy listeners.

Tennyson makes his northern farmer say of his Parson :

> I 'eärd 'um ah bummin' awaäy like a buzzard-clock ower my 'eäd,
>
> * * * * * * * * * * *
>
> An' I thowt a said whot a owt to 'a said an' I coom'd awaäy.

Evidently the farmer's preacher was not of the Tui style, or the farmer's ears would have been more attentive to what was said. He seems to be a thorough Mocking-bird, both in power of song and in power to imitate the human voice. I think it was Sir Geo. Grey who was addressing a Maori gathering on some political subject in a chief's tent. When he had finished, a Tui hanging in a cage above his head, said : "Tito" ("false")—which caused an immense roar of laughter among his hearers. The old chief said : "Friend, your arguments are very good, but my Tui is a very nice bird and he is not yet convinced." In a state of nature the Tui is much more lively than when in confinement. It is constantly on the move. The early morning is their time for music ; a matinee for sure. When engaged in song, the Tui puffs out his feathers, distends his throat, opens wide his beak, and gesticulates with his head as he pours forth the harmony of his soul.

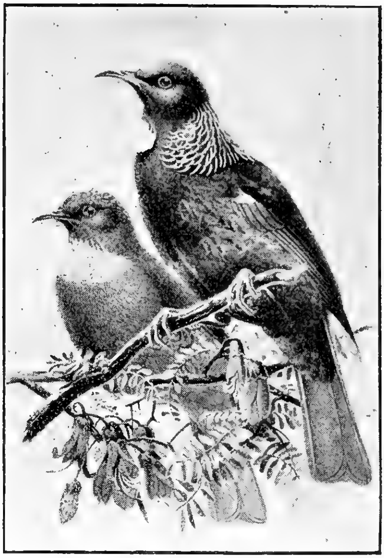
Sir George Grey, who thoroughly understood the Maori tongue, has given us in Maori, not only an illustration of the varied song of the Tui, but tells us what the native Maori thinks the bird says to him in his song. Any one who has listened to our Brown Thrush, or that more recent summer visitor from the South, the Cat-bird, which is, I think, a small species of the Southern Mocking-bird, will not fail to recognize the resemblance of the Tui's song to theirs, especially in the wonderfully varied notes.

The Tui's supposed song in Maori :

> "Ko tu Koe
> Ko rango Koe
> Ko te manuwhiri
> No runga te manuwhiri
> No raro te manuwhiri
> No to ti

No to ta
I Ki e roro
Te whare pa rua
E ronga
E ronga
E Kai
Ari nui
Ari roa."

Thus, on and on, apparently making it up as he goes along, poet and musician, all in one, seldom repeating. You have in the Tui a genuine songster, and he is as full of fun as he is of song. These birds will mount high in the air in parties of five or six in fine weather, indulging there in sportive flight, turning, twisting, throwing

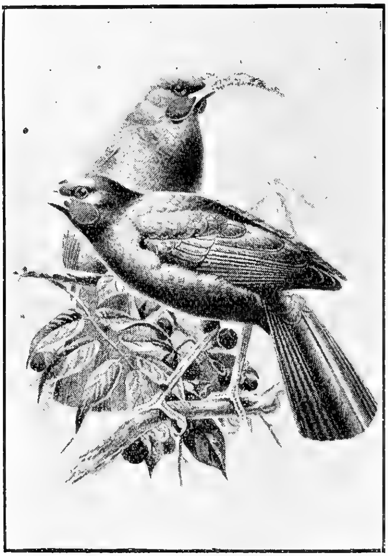


THE TUI.

somersaults, dropping from lofty heights with expanded wings and tail. High in the air he will sometimes close his wings and sustain himself for a few moments with a very rapid movement of his tail, allowing himself to drop slowly to a lower level, when, all at once, as if prearranged, the flock will dart downward in the thick forest and are seen no more for the day.

THE HUIA (HOO-YEH).

The Huia is the royal bird of the Maori as the Eagle is among our natives. Wherever you see a Maori in full dress, male or female, you will not fail to notice that the head is ornamented with one or more Huia feathers. The bird is about the size of our wild Pigeon. It is intensely black, with a bluish cast, with the exception of a broad, terminal band of purest white across the tail. The male and female are equal in size and the same in color and marking. That which makes the Huia most interesting is the marked difference in the beaks of the male and female. The reader will at once notice in



THE HUIA.

the picture before him this very great divergence. At first, Naturalists were greatly puzzled. The two birds with beaks so exceedingly unlike were marked down in the catalogues as belonging to different species. It was afterwards thought by some that the one with the long beak was the male, from the fact that it appeared at times to be feeding the other. At length the mystery was solved—the short beaked one is the male. Their principal food is the large white grub found inside the thick bark of dead trees. Without that form of beak he could not peck through the rough bark. The grub, disturbed by the continuous pecking, has moved away from it as far as possible, so that when the opening is made the bird could not get his prey if his partner were not at hand to insert her longer beak and bring him forth to be devoured. Instead, however, of selfishly appropriating it, they mutually declare a dividend, and share and share alike. We are sometimes a little amused at the ideas of some of our sceptical friends, who, in order if possible to get rid of a designing, intelligent Creator, would strive to make this very beak the mere product of the bird's necessities. What amuses us is the existence of the original birds depending upon this kind of food until a means to procure it was evolved or developed. Poor things, they must have had a sorry time of it waiting for this development to enable them to live at all.

THE KIWI (KEE-WEE).

We come now for a little time to consider those very queer birds of New Zealand, with a considerable number of species—birds without wings and without feathers.

The kind represented in the picture is the North Island Kiwi (Kee-wee)—the *Apteryx Bulleri.* I have a stuffed specimen in my collection of the South Island Kiwi, which differs a good deal from the Kiwi of the North Island in formation of the body, and color and form of coating, which is a continuous spreading of the hair instead of layers as in the picture. The Kiwi feeds in the low grounds or marshes on worms, snails and grubs, as its long, thin beak would naturally indicate to the reader. The head is small, but the neck is large and muscular. The thighs and feet are also very muscular and powerful, far beyond what might seem necessary for the general size of the bird. When at rest it tucks its head and beak so perfectly under its fluffy coat that all semblance to a bird is lost, and you see only what looks like a round ball of coarse wool. It is nocturnal in its habits and is quite unable to endure the light. The skin of the Kiwi is so thick and tough that shoes can easily be made from it. It resembles the skin of an animal rather than that of a bird.

One of the most striking peculiarities of the Kiwi is the enormous size of their eggs. Though the bird is not larger in size than the average domestic hen, the egg, in many instances, measures nearly five inches in length and over three inches wide.

The Kiwi is more interesting to us because of its resemblance to the gigantic Moa, of which so much has been written in New Zealand and in England.

THE KIWI.

THE MOA.

There were in earlier days no less than twenty different species of the Moa. How and when they became extinct cannot be satisfactorily settled. That they have been extinct at least 150 years is argued from the fact that no Maori, however aged, can be found who ever saw a Moa, nor can there be found a Maori who can tell us that he ever heard his father say that he had seen one.

The classification made by scientists has been entirely from bones discovered in different parts of New Zealand. Some of the scientific names applied to different species show the enormous size of at least a few of them.

Dinornis altus.
Dinornis elephantus.
Dinornis giganteus.
Dinornis ingens.
Dinornis maximus.

I have in my collection one bone (a *Tibia*), which is very nearly 2 feet in length, 17 inches around the upper joint, 14 inches around the lower joint, and 7 inches around the very smallest part of the bone. Even this bone dwindles into insignificance compared with a measurement given by Sir Walter Buller in his famous work on "The Birds of New Zealand"—*Femur*, 1 ft., 6 in.; *Tibia*, 3 ft., 3 in.; *Tarsus*, 1 ft., 8 in.; outer toe, 9¾ in. From the point of the toe to the very top of the leg a little over 7 ft., 2 in. And this bone had been lying in the earth for at least a century and a half.

I have also a handful of gizzard stones, found in considerable numbers among the remains of these birds, where from flood or fire, or foolish slaughter by the natives, large numbers of them have perished in a single day. In many instances the remains were so well preserved that it was not difficult to discover the very stones each had carried in the gizzard, many of them over 3 lbs each, and in a few the weight of the stones in a single bird was over 5½ lbs.

No one subject in the colony, of a scientific nature, has more fully and earnestly engaged the attention of literary men than the existence and so lately the extinction of this giant bird. Why has no other such bird been found elsewhere? By what means were they at length destroyed? And how many years is it since they ceased to exist? Prof. Owen says 400 years. Sir George Grey says not less than 150. No one knows; yet all regret that so noble a specimen of the bird world should have ceased to walk upon our earth.

[The Association acknowledges the kindness of the Toronto *Globe* for permission to use cuts which illustrate this paper.]

ANNUAL REPORT

OF THE

GEOLOGICAL SECTION

OF

THE HAMILTON SCIENTIFIC ASSOCIATION

For the term ending May, 1902.

To the President, Officers and Members of the Hamilton Scientific Association:

The Section has much pleasure in submitting this, its annual report, feeling assured that an advance has been made respecting the acquirement of a better knowledge of the rock system which is exposed in the neighborhood of Hamilton, and also of the fossil fauna peculiar to the different rock formations which go to make up that system.

That indefatigable member, Col. C. C. Grant, has devoted a good deal of his time searching for the eastern limit of the Guelph formation, with the object of discovering where it rests upon the beds known to him as the Barton beds, and whether the passage from the Upper Niagara to the Guelph formation shows any distinct deposit line, or a well marked gradation from one to the other. He has not yet discovered an outcrop which reveals the points which he is in search of.

The work of collecting fossil specimens has been carried on by several members of the Section with considerable success. Some new varieties have been found among the shingle from the Hudson River rocks (more recently named the Cambrio-Silurian), which lie strewn on the lake shore at Winona, the Beach and Burlington Heights, and in the quarries on the face of the escarpment. Col. C. C. Grant has sent quite a large number of fossils to different museums—the British Museum of Natural History, the museum at Ottawa and others. He also sent a number of specimens of the *Fenestellata* to Prof. W. A. Parks, of Toronto University, who is making a special study of that family. The fossil sponges obtained in the neighborhood of Hamilton always are in demand, and attract special attention among palæontologists. The flinty character of the sponges found here render the work of polishing sections very difficult. A local firm was induced to try some sections. The work proved to be very satisfactory indeed. The structural difference of the varieties was brought with clearness.

The Museum has been kept open on Saturday afternoons during the past year, to enable the visitors to derive some benefit from the visit. Messrs. Gaviller, Col. Grant and Schuler have collectively or separately been present to answer questions and explain the points of interest to the inquirer respecting the different specimens of natural history in the Museum.

During the autumn and winter months much time has been spent by Mr. Schuler and Col. Grant in re-arranging the specimens. Some of the cases are still overcrowded, and will have to be thinned out so as to get them properly labelled. We are using the cases which held the collection of shells lately moved from the Museum.

There is good reason for the Section to complain of the apparent lack of interest by the members of the Association in the work carried on under the Sections. Take all Associations of a similar character and you will find that the work done in the Sections is most important. The new discoveries are proved before being given out to the world and receiving the endorsation of the parent body.

The Section cannot close this report without expressing their deep regret at the loss by death of the Chairman of the Section, Mr. A. E. Walker, and desire that the following resolution be recorded in the Proceedings of the Association: "The Geological Section of the Hamilton Scientific Association desire to record the great loss the Section has sustained by the recent demise of our venerable and honored Chairman. Owing to his long and serious illness of late years, he was unable to take an active part in our meetings. Few of us can forget his addresses on corals, stromatopora and the Niagara fossil sponges. He possessed great skill in developing sections of the two latter, as may be seen in the valuable case of fossils he generously presented to the Association."

We were indebted to our late Chairman for drawing the attention of the famous spongologist, Prof. Rauff, to our chert sponges. He was among the first to recognize the true nature of the fossil anchoring spicules of our local Niagara chert beds.

The Section has held five meetings at which interesting papers were read. Following are the dates of the meetings and the title of the papers read, and the author :

Dec. 27th, 1901, Geological Notes.........C. C. Grant.
Jan. 31st, 1902, Coral Reefs, Ancient and Modern.......................... "
Feb. 28th, 1902, Geological Notes Continued. "
March 28th, 1902, Notes on Evolution versus the Fall of Man..................... "
April 25th, 1902, Notes on Evolution Continued .... "

All of which is respectfully submitted.

A. T. NEILL,
Secretary.

OPENING ADDRESS, GEOLOGICAL SECTION, FOR SESSION 1901-1902.

Read before the Geological Section of the Hamilton Scientific Association, Dec. 27th, 1901.

BY COL. C. C. GRANT.

As acting Chairman of the Section, in the absence of Mr. A. E. Walker through illness, I have the honor to submit for your inspection some of the specimens obtained during the past collecting season. A few doubtful, or little known ones, in addition, viz., Graptolites, Sponges, etc., were forwarded to Museums for the examination of palæontologists, who make the families a particular study. Perhaps it falls a little short of the previous year's collection, a very exceptional one, but I confess I am not quite satisfied even on that point. The accompanying correspondence submitted can prove that the Geological Section of the Hamilton Scientific Association is attracting a little attention beyond Ontario.

Thanks to the liberality of the President and Council, we were enabled to figure at least a few Silurian fossils, which may be new to science, in our late Proceedings. Let us hope the expense may not prevent us from seeing a few more of Mr. Scriven's admirable illustrations. I am in a position to state that we possess the necessary material, if required, in fine preservation.

The early part of the collecting season opened unfortunately at a time when the writer was unable to examine the fields along the corporation drain and elsewhere before they were ploughed up or planted. Later on, when he felt strong enough to have a look at what was planted (a very important matter here), he was much disappointed to find several familiar hunting grounds presenting aspects which led him to think the present year's collection, at least, of sponges, chert Bryozoons and fossils would be absolutely few and far between. Promising crops of clover and grass, as well as other things not conducive of success, were noticeable in every direction, but fortunately a few places near the city, and others beyond the reservoir on the escarpment, presented a more hopeful showing, and as they were well known to have yielded many specimens in previous years, it was expected a few, at least, this time might reward research. This proved to be the case, and several well preserved sponges and sections from the glaciated Niagara chert beds were forwarded to London, Dublin, etc.

Perhaps the restricted ground examined was more carefully searched than ever before, and to this we may partly attribute any success which may be claimed. There appeared to be very slight prospect of obtaining from these few curtailed points of observations many specimens unknown to scientific investigation, but we felt it incumbent on us to do what we could to furnish a few at least, and on the whole were tolerably successful. The field which presented so many complete sponges last year, some fourteen if I recollect aright, revealed only two on the present occasion. This was the more disappointing, for much was expected from a portion which had been under a pea-crop, and when this is harvested the ground is left quite bare and specimens can be easily detected on the surface. Indeed, in the case of the two obtained, their discovery was owing to turning over the lumps of chert in which they were embedded. It must not be forgotten that the early frost usually brings to the surface many sponges and sections, and if snow-falls do not interfere and cover up the ground several others may be added yet to our collections.

Among the more interesting sponges recently acquired is a fine specimen of *Aulocopina Granti* (Billings). Not complete by any means, but perhaps all the more interesting for all that, since nature has accomplished what the lapidary is sometimes directed to do, viz., to cut the sponge so as to display a vertical section. (The writer has often noticed while such sections are rare, transverse ones are of frequent occurrence).

One of the *Astylospongias* appears to be rather rare in the glaciated chert beds. The grooves are shallow and lobes very slightly raised. The existence of this sponge was first suspected from finding the transverse sections differ from ones better known, or commoner, in similar portions of the family groups here. It may occur at Tennessee, but I failed to recognize it in the collection I possess from that locality, and probably some may think the specimen merely a variety, and not a distinct species.

WINONA.

A very large amount of shingle was exposed along the lake shore, and A. Wilson, Esq., informed me they had a considerable amount of rough weather after his arrival at the park. The quality of material cast up, or laid bare, induced me to imagine that a larger amount of specimens than usual might be safely calculated upon, but in this I feel rather disappointed. Perhaps this was due in some measure to being unable to work as steadily as in former years, through an attack of grip or influenza, which weakened me previously, and the very hot weather, which rendered it difficult to handle the shingle. When it became somewhat cooler another visit was paid to the camp, and proved slightly more successful, yet hardly came up to the expectations entertained, although I was enabled to forward a few rare Cambro-Silurian fossils to the Dominion Geological-Survey Office, Ottawa, from the lake shore drift.

Among the specimens sent was a fair example of Dr. James Hall's *Orthodesma Curvata*, which was found in the Hudson River series in Ohio. Another and different species of the family was also sent there, but the latter was unfortunately poorly preserved. Several very fine slabs, containing numbers of the minute *Leperditia Canadensis* (T. R. Jones), were also obtained.

The Professor published a paper in the Annals and Magazine of Natural History, in May, 1898, on "The Fossil Cypridinidæ," a copy of which I received and to which I respectfully call the attention of our Geological Section. The figures displayed bear such a close resemblance to *Leperditia Canadensis*, that few of us could recognize the distinction. If the writer ever noticed this crustacean, possibly it may have been when collecting specimens from the Mountain Limestones of Tipperary, Ireland. Yet he believes that since then he has noticed it also at Burlington Heights (the ancient Lake Beach), and looked upon it erroneously as an enlarged form of *Leperditia*.

Although the writer made an extensive collection in Western

Canada, formerly in the Corniferous quarries and Devonian drift, he believes no specimen ever came under observation there. Slabs containing *Leperditia* require careful examination, as we may expect to find them there.

The oldest rock in which *Cypridina* first appears, remarks Professor T. R. Jones, in unmistakeable form, is probably of Lower Silurian *(Ordovician)* age as far as can be determined.

In Europe a member of the group occurs in the Upper Silurians. The peculiar beak, the notch and size, as figured by Professor T. R. Jones, are so characteristic that the family cannot well be mistaken for *Leperditia*. This minute Crustacean is represented by two or more distinct species in the Cambro-Silurian drift along the lake shore, between Winona and Grimsby, as well as at the Burlington Heights, near the railway bridge. The naked eye shows the distinction. In some instances you may remark when you split the slab the interior holds a number of specimens differing in size.

These may probably represent various stages of growth of the little Crustacean. In other cases the beach drift shingle presents others equally numerous, all alike in size and appearance. Single individuals are seldom discovered. Without a good magnifying glass and the originals, or correct figures, I fancy it would be rather difficult to name the numerous varieties of the Canadian examples of Professor T. R. Jones, F. C. S.

An old friend and correspondent of mine, Professor Chapman, of the Toronto University, calling the attention of the class he was instructing there formerly, pointed out the near resemblance the minute bivalve Crustacean bore to a grain of wheat. I have often noticed since then how appropriate was his illustration regarding both size and general appearance; some are as large as the ones we see produced under favorable conditions on rich virgin soil, while others hardly attain the dimensions of a grain of barley. The Section may think the writer has dwelt too long on this particular portion of palæontology. The fact is one remarks a general tendency to neglect minute fossils. How many of us, for instance, would have noticed the microscopic teeth discovered by Professor G. J. Hinde, of the Toronto University, in our own neighborhood. I am not aware whether the *Conodonts* found here were ever analyzed, but the only one I collected was glistening phosphatic, and the writer concluded it was the tooth of a very low class of fishes. If this view was correct it must carry back representatives of the class to a lower stage than Upper Silurians.

Pander published a description and figures of *Conodonts* he found in the Cambrians of Russia.

CITY QUARRIES.

During the past season a very large number of men were employed by the city in getting out road metal from the Webber Quarry. Many years ago, when the place in question was first opened, the face of the escarpment there presented an unusual number of graptolites, as was the case in the adjacent quarry which had previously been worked out. It was natural to think, under the circumstances, that one was likely to find colonies of graptolites and other fossils also. It was not so, however. Weeks and months passed and not a single colony was discovered, but at the base of the chert a few single graptolites put in an appearance—fine specimens, well preserved and likely to prove to be new species. We must not forget Barrande, the celebrated European palæontologist, declared that this class (graptolites), instead of disappearing as was stated, actually culminated as far as he saw in the Upper Silurians. Nothing foreshadows their decline, and this is the singular part of their history. They flourished in the muddy water when the Niagara shales were deposited. They survived when a different condition arose in this locality, when in clearer water. Our limestones were laid down without any change as far as can be noticed. The specimens exhibit more robust forms, a greater increase in size, as if under more congenial surrounding conditions. I call, gentlemen, particular attention to this, because not a few well-known palæontologists, erroneously, perhaps, imagine that Artic currents may have deposited the muddy shales where they are so frequently discovered. Doubtlessly this conclusion originated in certain local surroundings. One has rarely an opportunity of carefully examining the interior of limestone layers usually used for building purposes, or sandstones for the same reason. Yet both contain organic remains, whose existence could never be suspected from any external appearance. How often has an accidental shot of powder revealed here in Hamilton, by fracturing or splitting our local beds, limestone or chert, inside specimens, whose existence was looked upon as almost impossible? On this account, the writer hesitates to assert the Webber Quarry is less fossiliferous than the other which had previously been opened by the City Corporation. The few graptolites discovered there during the last two collecting seasons were generally in good preservation and differ from any found in the other quarries in several instances. Some were discovered at the base of the chert, and most probably may be new to science on this continent.

In the Webber quarry the men employed by the corporation have worked back the Macadamizing chert very nearly to the level, where rock material was removed formerly from the adjoining quarry, before it was worked out, and which I found contained large numbers of graptolites, differing from all found in well-known layers beneath. There was something in the glaciated bed—an irregular thickness in places—which reminded me of the abandoned quarry, and although many years have past I perfectly recollected everything relating to the point of the old beds where I had discovered so many specimens. The general appearance at present was such as led me to believe we were approaching the locality of a graptolite colony, and when some few specimens were recently obtained it tended to confirm the opinion. However, later research induces me to fear these may have been merely outliers from the older one. This is a matter which may soon be settled if quarrying is kept on a little longer. Indeed, there is every appearance of that, for the writer noticed men removing the overlying soil, and so far back that we may be afforded an opportunity of examining ten or twelve yards of rocks which had not been laid bare or examined in the other quarries. At the rock cutting on the Grand Trunk Railway I was only able to examine a few feet of the glaciated chert formerly, when I discovered the sponges and sponge sections *in situ*.

On returning to-day, October 28th, from an unsuccessful hunt for glaciated flint flake fossils, I paid a visit to the quarries, which I generally examine every day, wet or dry, when the Superintendent employed by the city, Mr. Nichol, informed me he had a little time before my arrival obtained a fine graptolite from a bed in the blue building Niagaras, lower down than he had ever seen one before. On pointing out the place and position it was clearly shown that the specimen in question, accidentally displayed by the charge of giant powder used in quarrying, was exactly similar to ones secured by the writer in the upper blue building bed there some few days previously. Had this been a solitary instance of a particular graptolite existing for perhaps centuries? (for remember Dana, the great United States Geologist, whose writings are sometimes alluded to by Dr. Talmage and other traditionalists, with approval, considers each foot of limestone may represent the deposit of 1000 years). A notice of such an assertion as this you will not find recorded by men who hold the view of the six days' creation recorded in the bible. They prefer to select isolated passages from the earlier immature publications of Agassiz and other geologists in order to discredit modern scientific research, carefully ignoring the conclusions arrived at by such writers when they gained more experience.

At a meeting of the American Association for the Advancement of Science, held at Denver on 30th August last, Professor W. J. McGee, Chesterfieldian ethnologist, read a paper on "Anthopology," in which he stated modern research had shattered the theory that mankind had sprung from a common parentage; it must be apparent that the Negro, Malay and Caucasian could not have descended from the same pair.

It may not be generally known that the celebrated palæontologist, Agassiz, arrived at the same conclusion as the great body known to us, "The American Association for the Advancement of Science." It is recorded that the entire assemblage, with two exceptions, adopted the views of the Smithsonian Professor regarding the ancient tradition of "Adam and Eve," dismissing it merely as an Eastern myth. Dr. Talmage's preaching appears to have little influence with the more intelligent of his own countrymen. He may, perhaps, be more highly appreciated by a few city aldermen, or emotional people of either sex.

An opinion was expressed that as the Lattice-Sponges *(Hexactinellids)*, *Euplectellæ* for example, are found living at a considerable depth in the modern seas, we may reasonably infer that the fossil representatives of this family existed here under similar conditions, and that our local chert indicated a deep sea bottom. The writer believes this conclusion to be quite erroneous, for the reasons submitted for consideration.

Particular attention for many years has been paid to this very point, and while only single valve impressions of bivalve shells are obtainable, such we know, from recent deep sea dredging, have been conveyed by currents, etc., from shallow to deeper water. Still the Corals, numerous Bracheopods, Bryozoons, Trilobites and Plants found associated are opposed to this conclusion.

The Fucoids are chiefly displayed as stained branches on the surface of a layer, in very poor preservation; sometimes, however, you find fragments of a plant colored green by iron salts.

One of the most difficult fossils for determination which our local chert beds ever presented was very recently obtained, unfortunately in a fragmentary condition—a wrinkled, flattened bituminous specimen. It may puzzle the most experienced palæontologist to classify even if more perfectly preserved. It may represent a crushed reed, and perhaps it may be obtainable in a better condition in Silurian rocks elsewhere. It would be desirable to secure a fairer representative than the one here submitted. The other impression, deeper and more marked, was forwarded about the middle of the month to Professor T. R. Jones, of London, but I doubt even if that admits of description. So many unexpected things have turned up of late that we need not altogether despair of securing another specimen which may enable our scientific friends to form a more reliable opinion than the writer entertains at present. The Niagara chert beds lately presented also the fragment of an *Orthoceras*, which does not correspond with any of the ones figured in the publications of Ohio Geological Survey or the later ones of the State of New York, which the late Dr. Jas. Hall, of Albany, kindly sent. The fragment reminds me of a cuttle fish to which Dr. Spencer, F. C. S., alluded to formerly in one of his papers on the "Palæontology of the Local Rocks." The *Orthoceras* in question must have been about 6 feet long, had exceedingly close septa, tapering slowly, apex sharply defined. The diameter of the chamber of habitation was exceedingly small, taking into consideration the length. Of course it would be impossible now to say more than the fragment produced reminds me of the very extraordinary cuttle displayed many years ago on the surface of the heavy limestones used for building in the city. It is greatly to be regretted that no drawing or photograph was taken at the time, for it was looked upon by all the writers consulted as new Niagara species from the description given.

It seems quite erroneous to suppose because the modern Lattice Sponges (*Euplectilla*), etc., are dredged from a considerable depth, that this is a certain indication of the existence of the Hamilton representatives under similar conditions. At first sight it seems quite natural to arrive at this conclusion, but we are compelled to suppose it to be erroneous when we recall the various organic remains which are found associated, not only with this particular class, but likewise with the graptolites, which also are supposed to indicate by some a deep sea habitation. Several years ago a geologist from the States, on examining a few Sponges and sections of the same, expressed this opinion, remarking these, unlike the colored Lingulæ of the Clinton series, indicate deep water in the Silurian Sea. The writer regrets he was unable to acquiesce in this opinion, and ventures to submit the reason for your consideration.

The Niagara Sponges and their sections so numerous in our local chert beds are chiefly confined to the upper portion, or in other words some 8 feet, which were ground down and disappeared in "The Great Ice Age," when land ice pushed down with irresistible force from the north, pressed on in invading this locality. That it did not possess a universal equal crushing power is certainly shown, since we find undisturbed chert beds. East and west of the Niagara escarpment layers of rock material in precisely the original position they occupied before the invasion of this northern avalanche of snow and ice, shod with the material incorporated in its progress, and bearing on its surface where disappearing the combed-out fragments of our Canadian Highlands, scattered far and wide. As objects, even intelligent farmers may perceive are absolutely unknown to them as quite foreign to the locality. With these rounded weather-worn or water-worn boulders, as palæontologists we have little to explain. They hold no fossils, and undoubtedly if such ever existed in the far-off time when deposited their disappearance may easily be accounted for. It is from the part of the chert beds (8 feet) removed from the escarpment near the city, but occupying their original position still, at the rock cutting beyond the reservoir, that the sponges are obtainable. Very rarely you find any underneath. Associated with them you will find impressions of shells (single valves generally), numerous Bryozoons, corals. The latter alone is sufficient to show the sponges must have flourished in comparatively shallow water, since leading naturalists such as Milne, Edwards, Sars and E. Forbes concluded that the coralline zone was from 5 to 50 fathoms, and the deep sea coral from 50 to 100, or a little more. We may be reminded of the extraordinary depth reached in recent scientific borings in reefs off the coast of Australia, but that merely indicates slow submergence.

The reef-building Polypes, Porites, Meandrina, Madripora and Astræa are confined to limited depths, according to Quoy and Gannard. We may conclude, remarks Darwin, that in ordinary cases reef-building Polypifers do not flourish at greater depths than 20 or 30 fathoms.

The plants of the chert beds are poorly preserved and few in number, but they indicate a litoral (perhaps a laminarian zone), viz., from low water to 15 fathoms. Yet here their representatives can hardly admit of denial, since their production is easily accessible to any one who doubts their occurrence. The writer must admit that he has merely obtained impressions of single (scattered) valves of the *Lamellibranchiates*, save in one or two very rare instances, which scarcely admits of positive assertion at the present time.

NOTES.

Mr. Schuler had on exhibition one very fine specimen of *Graptolite Dictyonema*, showing the stem and root; also *Canthograptus* (new variety), and a new variety of sponge.

Col. Grant showed several new varieties of *Inocaulis* from the Niagara formation; *Rhinopora Tuberculosa*, Fucoid from the blue building bed, Niagara formation; a number of specimens of Sponges, *Astylospongia*, variety; a large collection of fossils from the Hudson river formation, and three *Orthoceras* of different varieties.

A letter was received from Mr. Ray Lankester, Director of the British Museum of Natural History, acknowledging the receipt of Silurian fossils from Niagara formation of Hamilton; from John M. Clarke, State Palæontologist, New York State Museum, acknowledging the receipt of information about the rock system near Hamilton; from W. A. Parkes, acknowledging the receipt of several specimens received by him on his visit to Hamilton; from J. F. Whiteaves, acknowledging package of fossils from the Niagara chert and drift shingle of Winona.

CORAL REEFS—MODERN AND ANCIENT.

Read before the Geological Section of the Hamilton Scientific Association, Jan. 31st, 1902.

BY COL. C. C. GRANT.

Despite all that has been written by Darwin, Dana and others, including many officers in the Royal Navy, etc., we know little which can be regarded as absolutely reliable respecting the rate of growth of the modern coral reefs. But far more difficult must it be to form anything approaching a correct view as to the time taken to deposit a foot of limestone, shale or sandstone on the sea bottom. One of the best marked Palæozoic coral reefs ever noticed by the writer was close to the southwest point light-house, Island of Anticosti, Niagara series. The rocks named by the Director-General of the Canadian Geological Survey, Sir W. Logan, and E. Billings as the Anticosti group, are usually thin limestones and shales, but at the point stated the upper beds are of considerable thickness, very brittle, containing many embedded corals, together with immense quantities of crinoid stems, which impart to it a peculiar glistening appearance, which you may notice in the mineral Orthoclase. It is often seen in stems or broken plates of crinoids at Grimsby. It is quite a mistake to suppose a modern reef (coral) is solely built up by coral animalculæ. During its formation various other things are included in it, and this brings to my recollection a lecture on Bermuda by a well-known naturalist. He gravely commenced by informing his audience that the Island was chiefly formed from the remains of sea plants. The statement was received with ill-suppressed laughter. It is not the less true for all that. The Nulliporæ plants, of wide distribution and great abundance there, possess the property of encrusting the thalli with carbonate of lime, extracted from the sea. In Darwin's Coral Reefs, in section first, Keeling Atoll, it is stated on the margin of the reef, close within the line where the upper surface of the Porites and of the

Millepora is dead, three species of Nullipora flourish. One grows like lichen, on old trees, in thin sheets; the second in strong knobs, as thick as a man's finger, radiating from a common centre; the third moss-like, thin, perfectly rigid branches. The latter is a beautiful bright peach color.

We shall hereafter see that these coral reefs are protected by a similar thick growth of Nullipora on the outer margin. When these plants die, remarks Sir A. Geckie, their remains are cast ashore and pounded up by the waves. Being singularly durable, they form a white calcareous sand by the action of the wind. This sand is blown inland, rain water percolating solidifies and cements the particles. Changes of this kind have taken place on a great scale at Bermuda, where all the dry land consists of limestone formed of compacted calcareous sand, mainly the detritus of sea weeds.

Our local limestones of the Silurian age, in the immediate vicinity of the City of Hamilton, present little for comparison. Corals are few and their absence may be owing to the infilteration of mineral salts, antagonistic subsequently to their preservation. It seems to the writer to be a matter for a closer chemical investigation. Occasionally one may notice, even in what the United States Geologist, Dr. Jas. Hall, calls "The old Clinton Limestones," hollow receptacles, which once held corals, which disappeared.

Independent of what the Nullipora contribute to the building of these reefs, other things take part in their formation—sea weeds, star fishes, shells, etc. These are cemented by dissolved carbonate of lime, and furnish a platform for a fresh growth of coral. When crinoids were numerous in portions of the Silurian Sea bottom, we may not be surprised at finding their remains numerous in the Anticosti reef. One layer of limestone in the blue building series here reminds me strongly of an ancient coral reef.

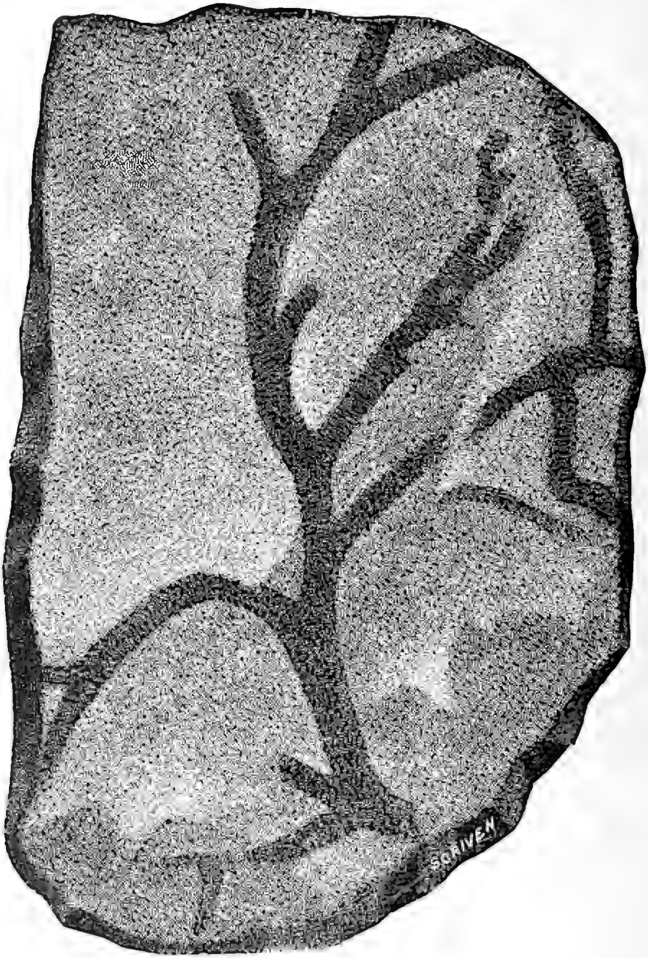
The writer obtained from the fishermen at Anticosti some years ago, about 8 or 10 beautiful branching Nulliporæ, colored ones, which got entangled in the hand lines used in Cod fishing, in what is known to naturalists as the Nullipora Zone.

In calling your attention to modern coral reefs, it may be necessary to explain that such things existed from early Silurian days to modern times. Perhaps no country can show such an extraordinary number of these fossils as the succeding formation, the Devonian rocks of Canada. The writer may not be quite astray when he asserted, instead of fishes, it actually represented the culminating age of corals.

Professor Schuchert, of the Smithsonian Institute, expressed astonishment at the vast piles of corals collected by the farmers from the surface of their fields in Ontario, rather in the part he visited (Thedford).

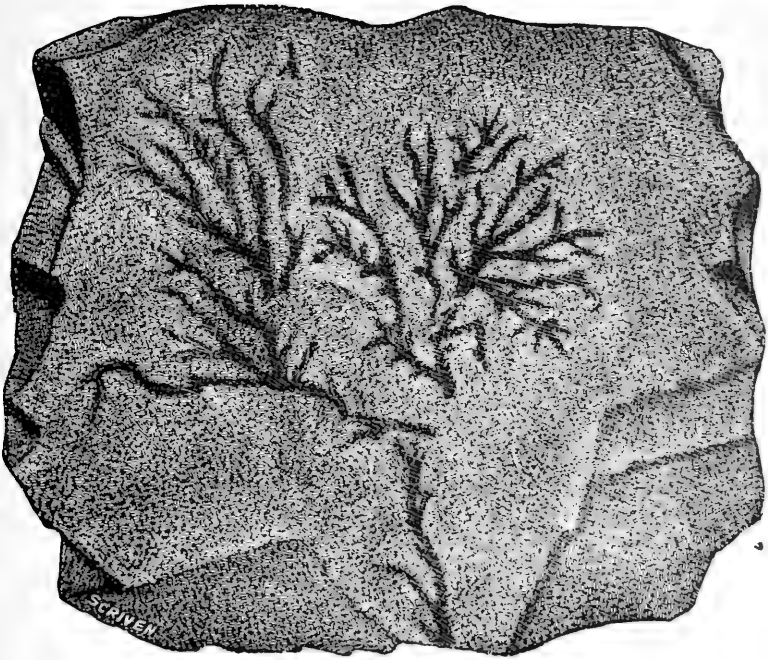
I have already called the attention of the Section to the upper glaciated bed at Limeridge. What is known to us as the Stromatopora band there, contains numbers of corals of the honey-comb species chiefly, what perhaps may be looked upon as a reef, the joint production of Protozoæ and Zoophytes.

The layer itself is very massive, of considerable hardness, and you may find much difficulty in extracting even a tolerably preserved specimen from it. A few shells in very poor preservation, so imperfect, in fact, that they could not be recognized, were noticed in this layer some few years ago.



No. 1.

No. 1 Graptolite was found at or about the same horizon as other members of the same family group. It differs from any noticed hitherto and probably may be a new species of *Inocaulis.*



No. 2.

No. 2 represents a fine specimen of Dr. Spencer's *Acanthograptus* proceeding from a single stalk.

GEOLOGICAL NOTES—(Continued).

Read before the Geological Section of the Hamilton Scientific Association, Feb. 28th, 1902.

BY COL. C. C. GRANT.

The writer has already brought to the notice of the Section a communication from the chief Palæontologist of the New York Geological State Survey. In reply to Dr. Clarke he stated we had not as yet, unfortunately, discovered in this locality the actual point of contact between the Niagaras and the Guelph formation of Sir W. Logan, and with regard to the organic remains in the respective series, no greater difference existed than one may find between the Clinton and Niagara rocks. The mineral composition of the beds may differ ; even that may admit of explanation. Ossilation of the sea-bed itself is certainly more pronounced in Silurian times, not only in Ontario, but in the Island of Anticosti, whose geology and palæontology afforded the writer such an intense satisfaction that he would willingly incur again the accidental starvation there experienced once for another chance of clearing up one or two undetermined conclusions.

Dr. Clarke failed to see, apparently, in the specimens of the Barton beds forwarded to the late Dr. Jas. Hall, satisfactory palæontological evidence as regards the connection or separation of the Guelph and the underlying series, viz., the Niagaras. In reply, I mentioned so many of our Barton beds seemed common to both, that I believe Sir W. Logan's formation can hardly be recognized as such, and that it merely represented the capping of the Niagaras, a conclusion which has already been expressed by some field geologists in the States.

The actual point of contact has not as yet been discovered, perhaps it may not be far from where Sir W. Logan supposed it may be found, but my impression is that the change from the one to the other was gradual, in much the same manner as the Barton succeeded the chert in the vicinity of Hamilton. Slow subsidence of the sea-bed may have taken place. The difference in the chemical composition of the respective rocks may admit of a more satisfactory explanation than the writer cares to offer.

On looking over the organic remains, you may observe that although the Guelph fossils in the Museum belong to several families, as a general rule they are poorly preserved and frequently present moulds merely of the shells, etc., which disappeared. *Stromatopora* and *Murchisonia* are common fossils in both series. Some are identical in the Barton beds also, as in specimens of the yellow *Crystalline dolomites* of the Guelph formation, you notice similar hollows once occupied by dead representatives. The *Pleurotomaria*, which the writer submitted for the inspection of the Geological Section at our last meeting, viz., *Pleurotomaria Solaroides*, *Hall*, was obtained from a quarry in the Barton Niagaras, abandoned several years ago. The fossil is not uncommon, remarks the late Professor Nicholson, in the Guelph formation of Hespeler, Guelph and Elora.

The late palæontologist of the Dominion Survey, E. Billings, named a coral he found in the Guelph formation *Amplexus laxatus.* Nicholson states these limestones at Hespeler and Elora contain an abundance of a species of coral. Some specimens have the form of detached cylindrical tubes, irregular in thickness, varying in diameter. The marginal Septa in the form of strong longitudinal ridges and hollow tubes, as described, are also found in the Bartons, that I recognized as representing a species of *Amplexus.* On reference to a work I received from the Survey Office, Ottawa, I found the so-named coral figured so accurately by Professor Whiteaves' assistant (Foorde), that little difficulty was experienced in recognizing it as the one he claimed as coming under the head *Monticuliporidæ.*

Having already, in a former paper, said that among palæontologists there is much difference of opinion regarding the true classification of many organic remains, let me remind you of a remark of one of the greatest palæontologists the United States gave to this Dominion, and whose scientific investigations attracted world-wide attention to Canada. "Many Palæozoic fossils appear to unite in themselves two distinct families seemingly." He here, perhaps, anticipated the evolution of the Brachiopods, etc., now universally accepted by all the leading scientists on this continent.

The organic remains of the Barton Niagaras are very poorly represented in the Museum cases here. When the beds at Russeux Creek were first noticed, the banks and bed of the brook afforded me some exceedingly fine limestone slabs, thin (like the Anticosti ones) and very fossiliferous. They were found *in situ* in the soft, muddy shale, a little above the surface of the stream, in the same field as the Waterlime Quarry, but beyond it. Some were forwarded to the Redpath Museum and to Europe. The few contained in our cases are much inferior to the specimens formerly discovered there. Great things were expected when the Waterlime Quarry was first opened, and when the "concealed measures" of Dr. Spencer, F. G. S., were laid bare, but the result has been very disappointing.

Mr. Bartlett informed me he got a specimen of the honey-comb coral (*Favosites*) in one of his visits to the creek last summer. The blue shale in which it was found corresponds from the description to a very large one obtained by the writer some years ago from the same horizon, and that one particularly you may permit me to describe, although others subsequently discovered did not precisely correspond with the outward form of a still larger one, whose internal structure you may notice, which I secured for one of the side cases of the Museum. I am under the impression I called the attention of the Geological Section in a former paper to finding *Palæozoic* corals of considerable size so frequently in muddy sediment.

The first specimen the writer obtained at the Waterlime Quarry presented the appearance of an irregular round mass, with hardened shale adhering to it. As it possessed no outward indication of its nature, I concluded it was merely concretionary. I only learned what it proved to be on breaking it up. Wishing to obtain for Dr. Clarke some few Barton fossils, I proceeded to the waterlime beds in October last. Although somewhat disappointed at not finding an *Avicula* or specimens of *fucoids* I particularly wanted, I succeeded in getting several of the Waldron Indiana shells.

One of the best marked Favosites of the Barton waterlime beds is *Favosites Forbesi.* The peculiar shape and the irregular distribution of the large, angular cells corresponded with the one figured in the 28th Report of the New York State Survey received from the late

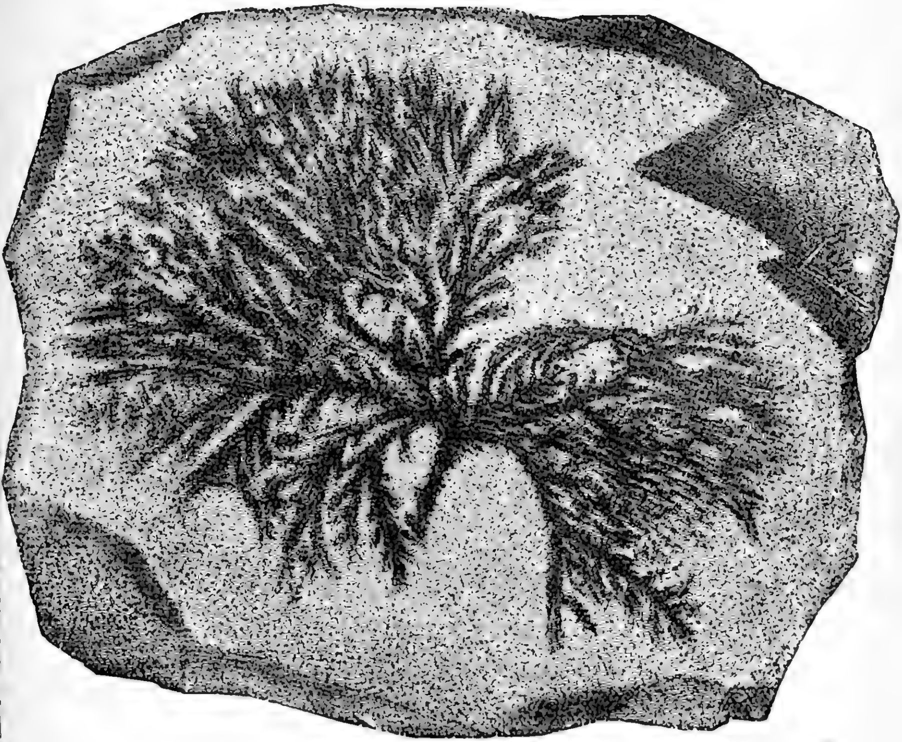
Dr. Jas. Hall. The epitheca at the base was absent. The form, however, was there, and the long experience I had in collecting Devonian Corals in Western Canada led me to think that that was a matter of little significance or importance, knowing that in many cases this characteristic feature had disappeared through some unaccountable process of fossilization. The late Dr. H. Nicholson states in "The Palæontology of Ontario" that he recognized it also in the Guelph formation at Hespeler.

The smaller corals of the Barton waterlime beds are very numerous *(Streptelasma, Zaphrentis)*, etc. The upper part is usually filled with hardened shale (this is the cup of the coral), which renders it difficult to classify. *Streptelasma Conulus* of Rominger is comparatively rare. Before the quarry was opened, and the bed of the brook disturbed, or its banks interfered with, I had traced to their original positions nearly all the characteristic fossils to be found in or near the portion excavated already. Now I find much difficulty in securing a single specimen where formerly a dozen were obtainable.

At the head of the quarry filled, where the stone road is crossed by a wooden bridge, is a low bank, a portion of which has been worn away annually by river floods; there you may find a few inches above the bed of the stream itself a shale flag containing in the interior quite a colony of the singular graptolite figured and described by Dr. Spencer, F. G. S., *Phillographus dubius*. On one slab alone, close to the bridge at the other side of the road, I counted 14 distinct individuals. After quitting the mineral quarry, Mr. Carpenter opened another for road metal. It held very few fossils in poor preservation. That was abandoned, probably, because the lower portion was found becoming soft and thin. I had reason to regret this; the last charge of powder fired there disturbed a layer lower than anyone previously, revealing not only the large *Plurotomaria Solaroides* recently submitted for your inspection, but a fine well preserved *Trochoceras* as well. The latter was found to be one similar to a specimen described and figured in a Report of the New York Geological Survey, as occurring in Waldron Indiana beds (Niagara Series). It is now in the Redpath Museum at Montreal. As well as I can remember, Sir W. Dawson acknowledged the arrival of the parcel containing a large collection of the Barton organic remains.

On pointing out this abandoned Barton quarry to C. D. Walcott, now the Director-General of the United States Geological Survey, and showing him the place where I found the *Pleurotomaria*, etc., in the absence of pick and bar he set to work with the sharp end of his hammer and managed to turn up a *Trochoceras ;* the annulations were indistinct as far as I remember, and it was rather poorly preserved. It may be necessary to remark the term "Concealed Measures," so often met in the sub-division of the field geologist, is merely applicable to such layers as are hidden from view in quarry or river-bed. We need not be surprised at the term being often misunderstood by fossil collectors, occasionally when one points out to him that in certain indicated layers he will probably discover the shell he requires, and the result is different from expectation. It must not be forgotten that organic remains are not found in every portion of a bed.

On one occasion a visitor expressed admiration for some Niagara Graptolites in one of the Museum cases, and the writer gave her information regarding the locality and places in the chert where such things may be found. I never suspected she had any intention at the time of entering on a fossil-hunt at the Corporation or other quarries, or of course I would have volunteered to accompany her. Investing in a hammer and a hand-basket, which she expected to fill with specimens (a quarryman said the latter was big enough to hold all the dinner pails over there), with a facetious remark from a countryman of mine of "More power to yer elbow, Miss," he placed and fixed for her rather a tough layer from the base of the chert which she had selected for operations. If one may judge from the heap of broken chert and limestone, she must have displayed considerable muscular prowess, and the result of her exertion in scientific research proved rather unsatisfactory. The writer was informed as she retired from the quarry with the empty basket she expressed her conviction that Annanias ought to be the patron saint of the men who compose a certain Section of the Hamilton Scientific Association.



No. 3.

ACANTHOGRAPTUS.

No. 3 has the same peculiarity as No. 2 (page 47). Spencer's *Genera* was founded on two species from the glaciated upper part of the Niagara chert beds. The two latter are from the base where such things have not been discovered before.

NOTES ON EVOLUTION VS. THE FALL OF MAN.

Read before the Geological Section of the Hamilton Scientific Association, March 28th, 1902.

AN ESSAY BY RONALD D. GRANT, A. M, D. D, IN REPLY BY COL. C. C. GRANT.

The Doctor at the beginning of the essay remarks that the subject, some people tell us, ought not to be spoken in the pulpit—it belongs to the platform. He adds (regretfully, perhaps from personal experience) that there are some exquisitely holy souls who will accept nothing but pious platitudes, while press and platform, by the enunciation of false principles, are apparently undermining the whole structure of Christian truth. Now, no apology was offered and none was required at all in this matter. The subject concerns the churches solely. Geologists, who seek but truth, are ever ready to welcome investigation, and the silence of the pulpit in a benighted Province of the Dominion you so deeply deplore may have had its counterpart in Ontario, also, but for one High Church dignitary who was never known to miss an opportunity of denouncing our Godless university and its scientific teaching. Truly, "a brave soul has arisen amid the confusion of tongues."

The Christian church (meaning, of course, that particular denomination to which the writer belongs) is not on the offensive. Indeed, that may be true of some sect or branch unknown, or it may be confined to an out of the way locality, such as British Columbia; but how is it with regard to the pulpit generally? I could furnish my learned kinsman of the McAlpine line with a few out of many selections from the low, vulgar abuse of a Talmage, to the more polished, but not less offensive, vocabulary of other preachers.

I find even the secular press of Ontario has not been slow to perceive and condemn the denunciations of your orthodox champions. Witness the following extract, one of several which may be furnished :

"Nor have our great explorers in the realm of geologic and other natural science reclined upon a bed of roses. Huxley, Tyndale, Herbert Spencer, Darwin and other great geologists, archæologists and originators, had to contend against charges of atheism and blasphemy, against the denunciations of the clergy, and the frowns of the good, but short-sighted class, who could not appreciate the fact that science and true religion always walk hand in hand."

The writer hopes no layman of our immediate district is alluded to in the concluding paragraph, otherwise an expressed opinion may require modification.

The Doctor asserts he has been a student of geology for a lifetime, and having some convictions of his own, they may be as foolish as those of others. Let us suppose he has not expressed misgiving on this point. Much depends on the field of observation, that may be very restricted; much time may also be wasted in poring over the crude speculations of the early writers on the subject, and little real knowledge acquired. A quarter of a century ago it was merely in its infancy, and as a critic recently remarked, "more has been learned since then of the earth we inhabit, and its past life, than in all the centuries preceding"

Modern research has shattered theories unquestioned until now. "We deny," says the Doctor, "the evolution of one species from another, and our second point for consideration is that species that have lived have been *individually perfect.* When it appears it is immediately seen that it is not capable of *any* improvement."

Deny evolution, and there remains but one thing to fall back upon—countless creations at vast intervals. The deposits in Devonian and carboniferous seas alone reach a thickness of six miles; Cambrian and lower Silurian, about 48,000 feet; middle and upper Silurians, about 8,000 feet. Since Bigsby's compilation (Schuchert remarks in his work on "Fossil Brachiopoda, America") the total number of the Brachiopods has probably been increased to 6,000, one-third of which occur in this continent. These Palæozoic rocks, divided for convenience into distinct formations, hold organic remains peculiar to themselves, but in some cases you will find shells, etc., unchanged, going up from a lower to a higher series.

It is claimed, remarks Dr. Grant, that lower types are found in the older strata, with higher types of life succeeding them. Then, by way of illustration, he draws six layers of rock, sub-divided into thinner beds, numbered from the bottom upward, 2 to 6. "We stumble now," he remarks, "upon the forms of life manifest by their stony shapes. Our first find is a *Trilobite.* The specimen found in the lowest and oldest belt is perfect, while 2, 3 to 6 reveal a degradation of a startling character." This statement alone is sufficient to prove that despite the life-long study of Geology, he has acquired very little knowledge of Palæontology. The most charitable construction we can put on the matter is that the learned gentlemen has never seen a Cambrian Trilobite. Take the earliest known to science, the Crustaceans of the lower and middle Cambrians. The writer is in possession of the second contribution to the studies of the Cambrian Faunas of North America by the Director-General of the United States Geological Survey, the Hon. Chas. D. Walcott, a man whose knowledge of the class is superior to that of any living man. I also have figures of the extensive collection of the New York Survey, not to call your attention to the few in our own museum cases. I ask the section what conclusion can you arrive at regarding them when you compare them with others of a later date. Unless I am greatly mistaken you will agree with Professor Miller, the author of "American Palæozoic Fossils." The Articulates are represented by the lowest form of Trilobites, which, in their perfect state (note this) represented the embryonic condition of the existing *Limulus.* This is the opinion, likewise, of other palæontologists, who notice their inferiority, loose-jointed, crustaceous—some unfurnished even with eyes. Yet the Dr. informs us we are quite mistaken—that when it appears it is immediately seen that it is not capable of any improvement. Being perfect, he adds, it could not be made more so, and thereby evolve into something more perfect, being already complete and faultless.

One may feel inclined to pity the Reverend Doctor's congregation if his theological views have not a surer foundation than "his life-long study of geological matters." Modern research has completely demolished many of the views once entertained, and with a movement of this sort a portion of "the unco good" cannot have much sympathy. Our free libraries are doing much in dispelling superstitious belief in ancient traditions. Short though the time since the one in Hamilton was opened, we can perceive already that

Chaldean myths, viz., "The Creation," "The Deluge" and its "Ark" (which was of smaller dimensions than a modern steamer), have lost their hold on many of the faithful followers of Orthodoxy. They no longer *believe to be true what they know to be false.* This was a definition of "Faith" recently by a boy at a public examination of his class in England. "It is seen" the Doctor states, "that the most perfect of every species are the first ones." The writer may allude later on to earlier forms of life, but his present intention is to prove how completely mistaken he has been in such an opinion. Compare, for instance, the earliest known Cambrian and Silurian *Hexactinelid* sponge with the Venus Flower-basket *(Euplectella)* of the present day. I need not put the question to any member of this Section. Again, take the Star-fishes. The writer obtained twelve from the lower Silurian of Anticosti and the May Hill (Clintons) of Ontario. Some were in good preservation. All were stunted in growth, the largest of the lot merely a few lines across. In one of the family *(Palæasteria Jamesi)*, figured by Dana from the Cincinnati group, you may notice a marked improvement, but the Star-fishes only reached (like several other organisms) their culmination in modern days. There was, as every palæontologist knows, elevation as well as degradation of species. In a lecture on "Persistent Types of Life," the late Professor Huxley pointed out, while some forms attained their climatic tens of thousands of years ago and perished, others persevered and without advancing in any material respect are alive to this day. The mystery remains unsolved.

It has been remarked that text-books on Geology, which were issued a little more than ten years ago, require revision; it is a progressive science, and more knowledge of it has been acquired during the past quarter of a century than for more than double the time. Old publications on the subject are obsolete and misleading. If Dr. Grant could procure a work by Prof. Schuchert on "The Evolution of the Brachiopods" (issued by the United States Geological Survey), he may see how much he is mistaken regarding a class once more numerous than at present. A short time since the writer called the attention of the Geological Section of the Hamilton Scientific Association to a communication from E. Billings, palæontologist of the Canadian Survey, in which he stated that many of the early forms of life appeared to him to partake of a double or two-fold nature. I arrived at the same conclusion, also. You may recollect on several occasions I called your attention to the difference of opinion which existed among the most experienced regarding what were looked upon as widely separated families, apparently.

The famous palæontologist sent me a copy of the work he was employed on, entitled "Canadian Organic Remains" (Decade). It contains description and figures of the lower silurian *Cystideæ* and Star-fishes. One Trenton specimen from the City of Ottawa, you may see, bears such a close resemblance to a *Cystid* that he finds it necessary to state: "I have placed *Edrioaster Bigsbyi* in the order *Asteriadæ*, because its structure appears to me to be more like that of the Star-fishes than that of the *Cystidieæ*." He had previously named a different member of the group *Aglacrinites*, clearly mistaking it, as he well may, for a *Crinoid*. Owing to this two-fold nature in some of the lower forms of life, the most experienced have much difficulty in assigning them to their true natural position. The earliest forms are the most perfect. One may well infer from such a statement, that the learned gentleman had never seen one of the early Reptile-fishes of Agassiz figured or described. Compare *Cephalaspis Dawsoni* or *Pterichthys Cornutus*, at page 122-123 in Sir W. Dawson's "Chain of Life," with one of the fishes of modern times, or of the chalk formation. I ask to which would you assign inferiority. Again, take the birds furnished with teeth, and frequently described as flying reptiles. Unceasing change and development are noticeable in all classes; the very term varieties prove that.

From this time forward, the corniferous, remarks the Author of "American Palæozoic Fossils," Professor S. A. Miller, the five sub-kingdoms in animal life are represented in every group of rock capable of their preservation, viz.: *Protista*, *Radiates*, *Malluscs*, *Articulates*, *Vertebrates*. They all continue to change and develop, but the great field of evolution is well nigh surrendered to the *Vertebrates*. Each of these sub-kingdoms is now in the highest state of its development, though many families and some orders in each have had their days and become extinct, or have been on the decline for ages.

In the introduction to the now famous Lowell Lectures on "The Ascent of Man," by Dr. H. Drummond (the work has already reached a fourth edition), you will find the following statement, viz.:

"Evolution is seen to be neither more nor less than the story of creation as told by those who know it best." Science is likely to fare ill at the hands of the church if it ever controls the Dominion Public Schools and Universities. The organs of its many denominations are already endeavoring to get in the thin edge of the wedge. Few, if any, are free from the contemptible practice emphatically denounced by the press as "Heresy-hunting," and while science proceeds on its way, brushing aside from its path ancient superstition and modern theological error, need we feel surprised that the clergy should endeavor to arrest its progress. Can they see without disfavor congregations falling away, and, what that means, diminished incomes?

The following extract is taken from "The Cambrian Fauna of America" by the Director-General of the United States Geological Survey: "The resemblance between the whole structure (of the "sponges) and that of the Palæozoic Corals seems also to show that "in the lower Silurian seas organic forms existed combining the "characters of the *Protozoa* and *Cœlenterata.*" This confirms Billings' view.

TRILOBITES.

Extract from "Cambrian Faunas of North America," page 166: "Although *Mesonacis* is found at the same horizon as *Olenellus*, I "regard it as showing the transition of *Paradoxides* to *Olenellus.* "Mr. Ford considers the relationship between *Olenellus* and *Para-* "*doxides* one of genetic character, and that *Olenellus* is a *later* and "*higher* form than *Paradoxides.* We assent to this statement."—C. D. WALCOTT.

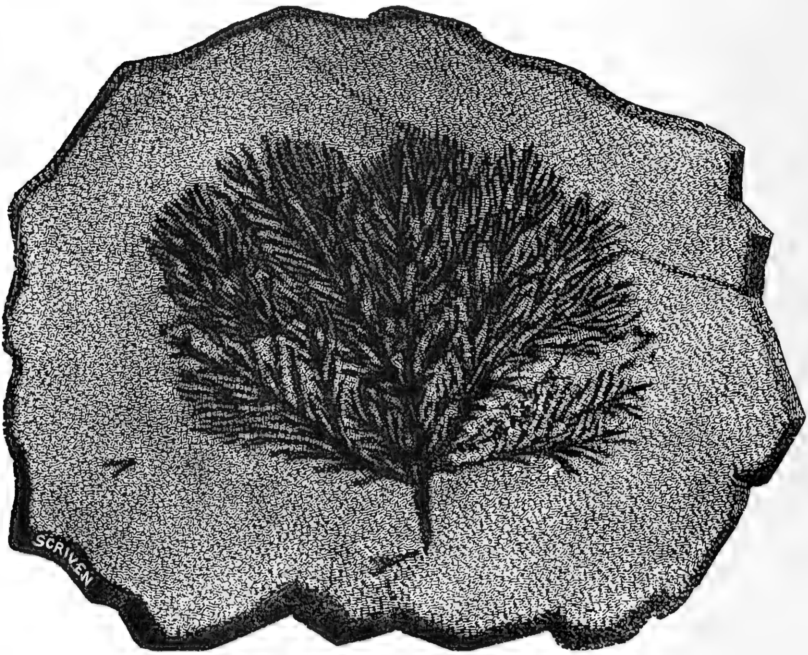
Microdiscus punctatus (Salter) (eyes and facial suture entirely absent) Professor Whiteaves states was first detected by the late E. Billings in the primordial slates of St. Johns, N. B.

SPONGIA.

"The genus *Etmophyllan* (Cambrian sponge) is a very interest-"ing form, for in it we observe the septa, vesicular structure and "poriferous system that later, in Palæozoic time, appear in the va-"rious divisions of the *Zoantheria* branch of the *Actinozoa*, "*Zaphrentis*, *Cystephyllum*, *Favosites*, etc."—C. D. WALCOTT.

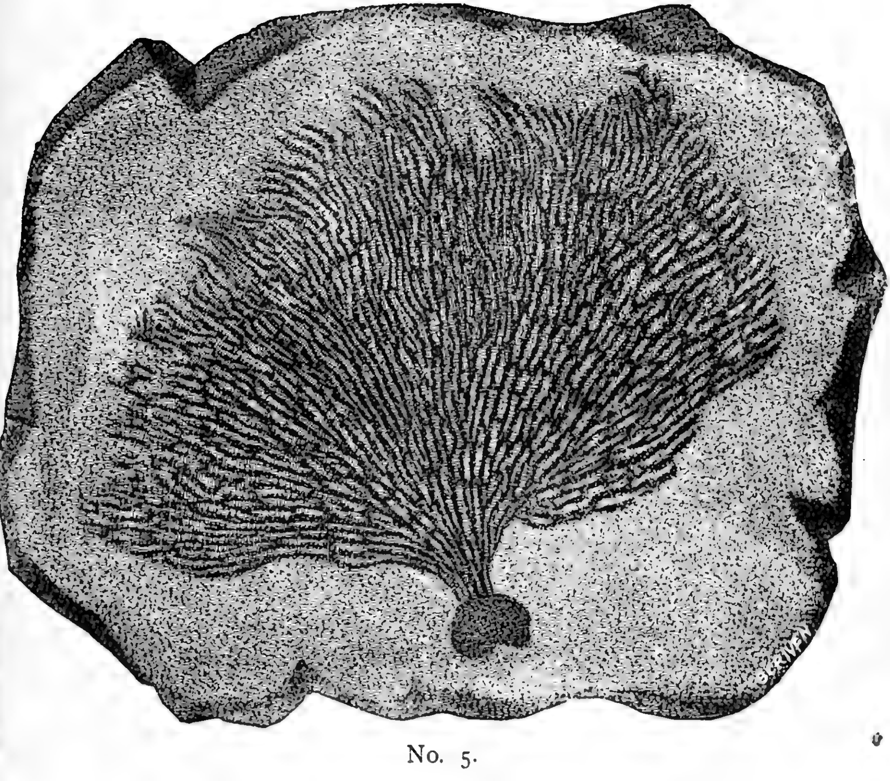
CRINOIDS.

"It must be remarked that the *Eucrinites* (chambered shells) "of this early period are not so numerous or perfect in form as in "secondary strata. In mountain limestone Crinoides attain their "meridian."—ELEMENTS OF GEOLOGY BY D. PAGE.



No. 4.

Since No. 2 (page 47), was collected, Mr. Schuler, one of the members of the Geological Section, obtained No. 4, another single stalked *Acanthograptus* from the same horizon as No. 2. They are identical species probably, but the thorn-like process seems more marked.



No. 5.

No. 5, obtained also by Mr. Schuler, differs slightly from the bulbous *Dictyonema* figured in last year's Proceedings. The branches are farther apart. The general shape corresponds however, but it occurs higher up in the Niagara chert beds.

EVOLUTION vs. THE FALL OF MAN.

Read before the Geological Section of the Hamilton Scientific Association, April 25th, 1902.

AN ESSAY BY ROLAND D. GRANT, A. M, D. D. REPLY IN CONTINUATION BY C. C. GRANT.

The writer during the past session called your attention to a meeting of the "American Society for the Advancement of Science," and to an address by Professor McGee of the Smithsonian Institute, in which he mentioned that he considered it absurd to believe that the Negro, Australian, Caucasian, etc., were all descended from the same parents. The entire assemblage, with two exceptions, concurred in this view, and decided that there never was an Adam or Eve. Dr. Grant will probably attribute this decision to the dislike of the Negro in the States, and he expresses his belief under the head "Hybrids." This sterility of mongrels is the hand-writing of God on the law of species. It certainly is a singular fact that the offspring of white man and negro, however numerous, die out in the second, and seldom reach a third generation. Does it confirm Dr. Grant's view respecting composite relations? The evolutionists, he remarks, admit that no case has ever been found of the development of one species into another. On this point I most respectfully submit an extract of an address to "The Anthropological Society of Great Britain" from a leading member, the Rev. F. W. Farrar, M. A. "It is erroneous to assume that the fertility of hybrids furnishes a "decisive proof of the unity of species, and it is premature to assert "that the union of all varieties of the human race produces an "offspring continuously fertile. Fruitful hybrids have been produced "between animals whose common origin cannot for a moment be "assumed. The repulsion between different races occasionally is "overcome. Experiment has proved that wolf and hound, dog "and fox, goat and sheep, horse and ass, are severally capable of "producing fertile offsprings. Does anyone seriously assert that "their several classes must severally originate in a single pair?"

Mr. Broca (specialist), as well as Dr. Knox, expressly denies human hybrids are fertile.

Dr. North stated half-casts are short lived, and if they intermarry are unprolific.

Another paper by the Rev. F. Farrar, entitled "Climate and Color," did something to dispel popular errors in England. In the extract before me, he states that so far from being an important agent, climate has on color little influence. Eastern Asia, from 70 degrees to the Equator, with every variety of temperature, has one type, the Mongolian, whose hue grows darker to the north. By fair Circassians we find brown Calmucks, short, dark Lapps, tall, fair Finns. The Nepaulese, inhabiting a temperate mountainous region, are far darker than Bengalese. The descendants of the Dutch at the Cape are as fair as the fairest European, remaining so, though 300 years there. We find Negroes, not only in Africa, but in Assam, Formosa, the Andamans, Phillipines, etc. The real African is copper colored. Dr. Hunt expressed the opinion the Negro was a distinct species; Pusey and Dr. Salmon coinciding in this. So you may perceive "The American Association for the Advancement of Science" have many influential supporters of its views in the old country. "Heresy-hunting" there has been nearly abandoned. The "Blasphemy Act" passed in the time of William III. has never been repealed, but no government would dare enforce it.

In all our theological seminaries where we make ministers there ought to be professors to give lesssons in Natural History, remarks a well-known preacher in a sermon, a copy of which the writer received. We may cordially agree with him in that. We may, however, feel inclined to imagine the teacher of science would not long hold his position if he expressed disbelief in the soldiers *arresting the sun in its course.* Did not some foolish astronomer assert 'twas the earth that moved, and not the sun? How long would he occupy the chair if he ventured to remark that he agreed with a certain branch of the church at Chicago which taught in its Sunday-schools that the Genesis account of the creation is not historical or scientific; that men never lived to so great an age as is asserted, and that the marginal chronology has been proved to be absolutely worthless.

Dr. Grant, the writer believes, may be in possession of the works or of early publications on geological matters, for example: Dr. Ure's "New System," David Page's "Elements of Geology," and perhaps he may be unacquainted with what has been more recently learned regarding the ancient Fauna, etc., of the earth. I recollected I had copies of both authors stowed away on the mineral shelf, and on taking down the latter work, an American edition, published in 1864, and on referring to the chapter on "The Organic Remains of the Old Red Sandstone System," at page 134, I find as follows: "The fossil fishes, or *Ichthyolites*, of the old red sandstone present the first distinct trace of the existence of the highest division of the animal kingdom, namely, *Vertebrata*. It must be remarked, however, that the earliest genera are not of the most perfect structure, but form, as it were, a link between the humbler crustacea and fully developed fishes. The *Cephalaspis* in general figure resembles the *Asaphus* of the Silurian rocks." (It was not known, when Page's work was published, that fishes existed also when the upper Silurians were deposited, characterized by similar inferiority as their successor). The unequally bilobate tail, Page states, is produced by a remarkable prolongation of the vertebræ, which bears a striking analogy to the prolongation of the same part in reptiles, thus connecting the cartilaginous fishes with the reptilia, not only by internal structure, but also by the evidences of external form. The Conodonts found by Pander in Cambrian and Lower Silurians, and by Hinde in Canada, may indicate a still lower class of fishes at an earlier time. Yet the Doctor would have us believe that the *first* that appeared were *perfect of their kind*—that there was no room for improvement.

THE MAMMALS.

Since the Doctor has referred to Dawson, Dana and Hitchcock as authorities, thereby leading his readers to infer that the distinguished scientists' views were similar to his own. Let us see if such is the case or not. The earliest known examples, *Marsupial*, as regards type were discovered in Triassic and Jurassic rocks of Europe and America. Now, if we turn to Sir W. Dawson's "Chain of Life," what do we find in Chapter IX regarding *Marsupials?* "They are for the most part confined to Australia, though a few occur in America, and are decidedly *inferior in rank to the ordinary Mammals.*

They antedated the others by a vast lapse of time. The *Placentals* are not found until we reach the beginning of the Tertiary. In Dana's "Manual of Geology," revised edition, in the chapter Progress of Life, page 592, it is stated the *Amphibians* show their inferiority to the reptiles in the young having gills like fishes; the early *Thecodont* reptiles' inferiority to the later in having biconcave vertebræ like fishes; the *Marsupials* and *Edentates* inferiority to other *Mammals*, etc." In the previous page—Length of Geological Time—occurs this passage: "From calculations elsewhere stated by the author, it appears that the increase of a coral reef probably is not over a sixteenth of an inch a year. Now some reefs are at least 2,000 feet thick, which at one-sixteenth of an inch a year, corresponds to 384,000 years." Now, for all we know, the Rev. Dr. Grant may firmly believe in the six days' creation recorded in Genesis, and if such is the case he may find some little difficulty in accepting such a statement. He may reserve the right of rejecting all that may be opposed to his personal idea. The approval may be exceedingly limited. May not a like objection be urged in the case of the great Canadian palæontologist, Sir W. Dawson?

HYBRIDS.

Under this head the Doctor states "any animal that has been born of composite relations will become sterile, and produce no more or else return to the normal stock. The evolutionists admit that no case has ever been found of their development from one species to another."

Agassiz declared the Negro and Whites never descended from the same pair. This was the opinion also of Professor W. J. McGee at the meeting of "The American Society for the Advancement of Science" at Denver, recently, when the entire assembly, we are told, acquiesced in the view (with only two exceptions).

"Each scientist has a creed of his own, all as much at variance with each other as any theological variance," remarks Dr. Grant. Is such the case? I think you will find a noticeable unanimity on all the main points of Darwin's great work as far as leading scientific men are concerned (incomplete as it was). Any deficiency has, since its publication, been made good by others, more especially by the Lowell lectures on "The Ascent of Man," by Henry Drummond.

Was there any want of unanimity at the meeting of the Royal College of Surgeons, etc., in England, recently, presided over by the late Sir W. McCormack, who gave up his great practice in London to attend our sick and wounded soldiers in South Africa? Among all the Fellows of the Royal College on that occasion there was not found any to dispute the facts of Evolution brought forward by Dr. McNamara in his address. The study of Evolution is evidently not confined to the Fellows or higher members of the medical profession. Lectures on the subject are frequently given in the old country by M. D.'s also, which meet with approval. Wherever Darwin's theory is advocated, even in Ottawa (Ont.), etc., it advances with giant strides. Dr. Daly, at the Y. M. C. Association of that city (Ottawa), lately read a paper on "The Relation of Geology to Geography," of which the following is an extract: "Living organic species have no "more surely been evolved from earlier types than the present form "of the land has been developed from pre-existing forms."

Undoubtedly the most valuable testimony we can get on Evolution is that of medical experts. The Doctor claims that the finest scientific minds are not agreed as to Evolution; the best do not accept it—some who did now give it up. The statement is quite inaccurate. It has been accepted by the leading scientists in England, Germany, France, Italy and the United States in overwhelming numbers. Only recently I called the attention of the Geological Section of this Association to the honors conferred on Heckel and others by the great English university; to the meeting of the Fellows of the Royal College of Surgeons, presided over by Sir W. McCormick, as I mentioned. The writer has obtained, through the kindness of an old friend and brother officer, copies of two papers published by "The Cheltenham Natural Science Society." One was the president's address on "The Evolution of the Hand and Wrist in Vertebrate Animals." The writer states that our information concerning the evolution of limbs comes from several sources, which are largely supplementary to each other. The first is *Comparative Anatomy*, or an examination of the parts themselves; the second is *Embryology*, by which we are enabled to observe in the individual growth an epitome of those evolutionary changes through which the adult creature has come to be what it now is; the third is *Palæontology*, or the record of the rocks—admittedly imperfect, but of inestimable value. The conclusion, he adds, seems irresistible that all own a common source and blood-relationship.

In an earlier lecture by a medical man to the same society (which unfortunately has been mislaid) he points out that while man and the ape may be descended from a common ancestor, it was a popular error (not shared, however, by evolutionists) to imagine the former descended from any of the latter now known to us. Long before modern research established the fact that life originates in a single cell, whether in man, animal or plant, scientific men like an important section of the Church of England rejected as mythical the early chapters of Genesis, as the writer showed in a former paper.

No doubt Darwin may not have sufficiently admitted his indebtedness to the author of "The Vestiges of Creation," as was remarked by a great American palæontologist; that he profited by the suggestions appears certain.

It is equally certain, asserts Dr. H. Drummond, that the materials for his (man's) body have been brought together from an unknown multitude of *the lower forms of life.* At the bottom of the scale is the Amæba, a speck of protoplasmic jelly—headless, footless, armless. When it moves towards the microscopic particle it feeds upon, a portion of its body lengthens out, flows over and engulfs it. The blood of every man, woman, child and animal contains even yet this very lowest form of life we can conceive. How did it come there is the mystery.

NOTE.

The Amœba in the Pond.—Now see at the bottom slow-gliding lumps of jelly that thrust shapeless arms out where they will, and, grasping their prey with these chance limbs, wrap themselves round their food to get a meal; for they creep without feet, seize without hands, eat without mouths, and digest without stomachs.—HUDSON & GOSSE ON "ROTIFERA."

ASTRONOMICAL SECTION OF THE HAMILTON SCIENTIFIC ASSOCIATION.

Secretary's Report for Season Ending May, 1902.

This society was formed at a meeting held at the residence of D. B. Marsh, Sc. D., on December 20th, 1901. It was considered that there would be sufficient interest in the science of astronomy to form a society for the study of the same, and the idea has been justified, the society having had a most successful winter session; ten meetings have been held and the following valuable papers have been read :

"Astronomy," by D. B. Marsh, Sc. D.; read Jan. 13th, 1902. This inaugural address was an introductory to the study of the science, and Dr. Marsh laid in plain and intelligible form the general aspects and data from which a student would proceed to view the field of astronomy.

"The Sun," by President D. B. Marsh, Sc. D.; read Jan. 21st, 1902. This paper covered the general facts known up to the present, and was made of great interest by the explanation of the instruments and procedures used in the observations of the sun, and the excellent views with which the lecturer illustrated his paper added to the interest.

"Chemistry of Creation," by J. M. Williams; read Feb. 4th, 1902. This paper dealt with the Nebular Theory from the standpoint of the chemical action of matter on matter in the evolution of solids from the gaseous. The assumption that the earth is solid was deduced from the process outlined in the forming of our globe from a nebulous condition. This paper was received with much interest. The explanations and definitions made clear the theory of nebular origin, while some of the remarks trended to originality.

"A Trip to Venus," read by Wm. Bruce, March 4th, 1902. A charming composition of fact and fancy, blended with poetic imagery, making a collection of astronomical facts, figures and calculations. An interesting and delightful lecture.

"The Atmosphere." by Rev. R. E. M. Brady; read March 18th, 1902. A well-delivered technical paper, covering the historical facts relating to the discoverers of the principles involved in the instruments used to indicate the states of the atmosphere—the barometer, thermometer, etc. The lecture was made clear and instructive by the use of apparatus and blackboard illustrations.

"The Planet Neptune," by D. B. Marsh, Sc. D.; read April 1st, 1902. This interesting and instructive paper will be found in the pages of the Proceedings.

"The Weather and Earthquake Phenomena," by R. F. Stupart, Esq., Toronto, Director Meteorological Bureau. Mr. Stupart, in response to an invitation from the society, kindly favored us with the above paper. The lecture, with the excellent slides, made the audience familiar with the old, old question of the weather in a way they had never met it before. Mr. Stupart went over the ground of storms and stormpaths very carefully, and made plain the various phenomena observed and reckoned on in chart-making and weather-predicting. Earthquakes proved in the lecturer's hands an exceedingly interesting subject. So many strange facts, new to many, made the technical and scientific of such interest, and simplified by the full descriptive wording of the speaker, that everyone went away interested and pleased.

"The Moon," by H. B. Witton; read April 29th, 1902. This delightful paper will be found with the printed papers. Its charm as heard from the lecturer himself, interspersed with quotations and references in great number, will be lacking, yet even in print Mr. Witton's writings are always good.

The society records with pleasure the visit in February to the Meteorological office at Toronto of some of the members by the kind invitation of Mr. Stupart. Those who went wish to record their appreciation of the courtesies of Mr. Stupart and Mr. Blake. The afternoon in the company of these gentlemen will ever be remembered as one of the pleasant places in a lifetime. The sacred temple of the weather prophets was opened to the pilgrims, and we were shown and had explained all the mysterious and fascinating instruments of magic which linked together, by the master power of electricity, the story of a day and a year and a century.

The membership, which includes ladies and gentlemen, is forty members. The officers are:

Hon.-President,	Adam Brown.
President,	D. B. Marsh, Sc. D.
1st Vice-President,	Rev. F. E. Howitt.
2nd "	Stuart Strathy.
Treasurer,	Jos. J. Greene.
Librarian,	E. Howard Darling.
Secretary,	J. M. Williams.

Council—J. A. Culham, Rev. R. E. M. Brady, Wm. Bruce.

D. B. MARSH, Sc. D.,
Chairman.

J. M. WILLIAMS,
Secretary.

ASTRONOMY TO BEGINNERS.

Read before the Astronomical Section of the Hamilton Scientific Association, January 13th, 1902.

BY REV. D. B. MARSH, SC. D.

Astronomy is the science which treats of the heavenly bodies and the laws which govern them. It may be included in the study of Physics as the laws of motion, equilibrium, gravity, etc., have all much to do with the arrangements and positions of the stars. The term "Astronomy" is derived from two Greek words, "astron" a star, "nomos," the law of the stars, hence Astronomy no more than any other of the physical sciences can stand by itself. As light, heat, electricity, etc., are inter-dependent, so Astronomy is dependent upon mathematics, particularly Geometry and Trigonometry for the problems to be solved.

In other branches of science numerous instruments are necessary before we can take even the first steps. In Astronomy, however, a small telescope, such as may be possessed by any household (even a good field glass) will reveal interesting things, or even with the naked eye, with good star maps in our hands, upon fine, clear nights, easily find out the position of the constellations and trace their forms in the mighty expanse. But with telescopes of very convenient size, and moderate price, a student may enjoy delightful observation of the sun, moon, planets and stars; even with a 3-inch telescope, at a cost of about $130 to $150, with a proper assortment of eye pieces, sun-shades, etc., sun spots can be delightfully studied, the moon's surface thoroughly mapped, following the mountain ranges distinctly, locating with ease almost numberless craters and isolated individual lunar mountains; the phases of Mercury and Venus can be traced; the snowcaps of Mars, when the planet is favorable for observations, and other markings can be seen. Jupiter, with his belts and moons; Saturn, with her rings, showing belts and some of her sattelites; even those far-away planets of Uranus and Neptune can be seen with a disc. In addition to all this a good knowledge of the constellations can be obtained. Many double, binary, quadruple and multiple stars can be seen, and many other interesting objects of study.

It is not my intention in this paper to plunge the Hamilton Astronomical Society into the slough of calculations, nor to detail the laborious calculations by which astronomers have arrived at the many great discoveries that have been made. What I wish to do is to make plain a few principles necessary, and indicate the road by which the student may arrive to those fields of scientific knowledge and pursuits. Before doing this, however, let me say a word regarding the history of Astronomy, but my time will permit of only a few remarks. The history is nearly as old as the human race. From the earliest ages men have gazed upon the starry expanse. To the early traveller of the East the planetary system served as compass, clock, calendar and barometer.

Our knowledge of Astronomy is due primarily to the Chaldeans, Chinese, Indians and Egyptians. They named the planets, grouped the stars and marked the sun's track in the sky. Astrology was cultivated in very remote ages. The Jews practised it, and Astrologers of subsequent periods played very important parts in devining the future of individuals. Many of the predictions came true, as was remarked by Pascal, "as misfortunes are common the Astrologers are often right." The destines of individuals and nations were, at a very early date, attributed to the influences of the stars. We read that the stars in their courses fought against Sisera; then we have the phrases "unlucky star," "born under unlucky star," "mark my stars," "moon struck;" also "contemplate" is a term simular for Templum (a Temple); was formerly a space marked upon the sky in imaginary lines and traced on the ground in accordance with the supposed diagram. This Temple became a place for heavenly contemplation.

In our old poets we have allusions to the influences of the stars:

"Now glowed the firmament
With living sapphires; Hesperus, that led
The starry host, rode brightest, till the moon,
Riding in clouded majesty, at length
Apparent queen, unveiled her peerless light,
And o'er the dark her silver mantle threw."—*Milton.*

Whilst the Chaldeans were doubtless the first to place on record the rising and setting of the celestial bodies, and dividing the ecliptic into 12 equal parts, and the day and night into 12 hours each, yet the Chinese have recorded astronomical phenomena as far back as 2857, B. C. And the Egyptians, although well versed in science, yet we have no important records from them more than the signs of the Zodiac, which were of their invention. Yet it is to Thales, who lived about 610, we must credit the beginning of the history of Astronomy. He predicted the eclipse of the sun, which came to pass, and made observations of startling nature to our knowledge of the science of Astronomy. Some years after this Aristarchus and Eratosthenes made some important observations which were left on record. But Hepparchus (169-125) B. C., discovered the procession of the equinoxes, calculated eclipses and determined the length of the year.

But coming down to A. D. 130 to 150, Ptolemy, of Alexandria, founded the theory which bears the name, which recognized the earth as the centre of all—the sun, moon, stars and planets and stars all coursing around it. Whilst this theory has long since been proven incorrect and abandoned, yet he paved the way for his successors and left many valuable records. Although the study of Astronomy was not altogether neglected, yet there is but little of value till A. D. 1543, the year in which the great philosopher died. Capernicus promulgated the true theory of the solar system. He placed the sun in the centre and all the planets revolving about him. His great work, *De Revolutionibus Orbium Celestium*, in which he explained his theory, was not finished till within a few days of his death.

The next of note after Capernicus I wish to notice is Tycho Brahe, a Danish scientist, who lived during the latter part of the 16th century. He adopted the theory that the sun and moon revolved around the sun. Whilst this theory was incorrect, yet it is not without interest, and many valuable observations are left on record. I may remark here, that to perpetuate his memory, the great lunar crater which forms so conspicuous an object on the lunar surface at the time of full moon is called Tycho.

After Tycho came Kepler, whose observations were many and valuable. His observations on the planet Mars has cleared away many difficulties, and in addition he laid down three great laws, stated in brief as follows:

1. Every planet describes an elliptic orbit about the sun, which occupies one focus of each such ellipse.

2. If a line be drawn from the sun continually to any planet, this line will sweep over equal areas in equal times.

3. The squares of the periodic times of the planets are proportional to the cubes of their mean distance from the sun.

About this time, the 17th century, was the invention of the telescopes, and who was the actual discoverer is not known, but whoever invented it, it did not penetrate into Southern Europe till about 1608. Galeleo in 1610 had made observations with the telescope and had discovered the moons of jupiter. This discovery of course went far to confirm the Copernican theory, and with Newton's immortal theory of gravitation, and Picard's researches, the relation of the sun and planets became more evident and the Copernican theory firmly established.

Did time permit I would like to speak of the work done by Laplace, Adams, Leverrier and others, but suffice to say that these, with Sir J. Herschel, brought Astronomy into prominence perhaps more than ever before, and with the introduction of better telescopes many new and important discoveries were made.

The Spectroscope, an instrument of great value in the hands of able astronomers, reveals to us elements existing in the vapors and composition of the sun, etc., and stars are now known to be seen, some of which are much like our own sun, others differing much from it. Even the Nebulae have been analyzed and found to be stars or gas burning in space, hydrogen and nitrogen being the chief constituents.

Of late years astronomical instruments have not only multiplied, but have been brought to a wonderful degree of perfection.

So much for the history of Astronomy. Now let me give some astronomical terms frequently met with, and their explanation.

1. *Axis.*—The Axis of the earth is an imaginary line passing through the centre, north and south; the poles are the extremities of this line.

2. *Equator.*—The Equator is an imaginary circle passing round the earth, dividing it into northern and southern hemispheres.

3. This Equinoctial circle extended to the heavens is called the Celestial Equator or "Equinoctial;" when the sun appears on this line, as it does in March and December, the days and nights are of equal length.

4. *Ecliptic.*—The Ecliptic is the sun's apparent path through the heavens. The Ecliptic cuts the Equinoctial at an angle of 23 degrees.

5. *Zodiac.*—The Zodiac is a girdle extending 8 degrees on each side of the Ecliptic. In this space of 16 degrees all the planets move. This Zodiac is divided into 12 parts of thirty degrees each, called the Signs.

NORTHERN SIGNS.

Spring.	*Summer.*
Aries (the Ram) March.	Cancer (the Crab) June.
Taurus (the Bull) April.	Leo (the Lion) July.
Gemini (the Twins) May.	Virgo (the Virgin) August.

SOUTHERN SIGNS.

Autumn.	*Winter.*
Libra (the Balance) September.	Capricornus (the Goat) Decem'r.
Scorpio (Scorpion) October.	Aquarius (Water-bearer) January
Sagittarius, November.	Pisces (the Fishes) February.

6. *Colures* is the dividing line of the Ecliptic into four equal parts, thus making the seasons.

7. *Horizon.*—There is the sensible horizon, which is the boundary line to our vision, and there is the true horizon, which is the circle as on a globe, dividing the globe into two hemispheres.

8. *Nadir* and *Zenith* are the poles of the horizon; the Zenith is exactly overhead, the Nadir is exactly underfoot.

9. *Azimouth Circles* are lines or circles drawn at right angles to the horizon, to the Zenith or Nadir points.

10. *Meridians* are lines passing through the poles at right angles to the equator. Whilst every place has a meridian, there are but twelve meridians upon the globe, the 1st passing through Greenwich, Eng., from which all the British calculations are made. The Canadian tabulations are made from the 75th meridian, a few miles east of Ottawa. Many think there should be a change and the Tor-

onto meridian adopted as the basis of tabulation, as it is in Toronto our observatory is located.

11. *Declination* is the distance of the heavenly bodies from the equator north or south, viz., north of the equator or south of the equator.

12. *Orbit* is the planet's path in the sky in its revolution round the sun.

13. *Apogee* is the point of a planet's orbit farthest from the sun.

14. *Perigee* is the nearest point of a planet's orbit to the sun.

15. *Nodes* are the opposite points of a planet where its orbit cuts the ecliptic or the earth's orbit.

16. *Radius Victor* is a line drawn from a planet to the sun, wherever the planet may be.

Having made a few statements *re* the science of Astronomy itself, and given a few words of a historic character and some of the more important definitions, I would like to say a few words to beginners regarding what books to read, how to proceed in the study of Astronomy and a few hints on observation.

As to books, they are numerous. But I would advise the use of very elementary works to begin with, such as "The Story of the Solar System," by Geo. F. Chambers, a book I think which sells for 35 cents; "Solar System," by Thos. Dick, L.L. D., an old book of course, but delightful for beginners; "The Story of the Stars," by Geo. F. Chambers; "Popular Astronomy," by Flammarion & Gore; "Half Hours in Air and Sky, or Marvels of the Universe," published by James Nisbet & Co., of London, and "Star Maps," by Proctor. I mention these simply for beginners, for those more advanced there are many valuable works, such as Newcomb & Holden, Chambers, Airy, Lockyer, Lardner, Peck Herschet, etc., etc.

As to the manner of procedure first of all master the Copernican System, get a good knowledge of the definitions and terms used, and the orbits of the planets, in fact I would say confine yourselves almost to the Solar System till you know the planets, their motions, orbits and attendants. After this, then take the study of say the sun, then the moon, or the moon first if you choose, then the individual planets and stars.

Now a few hints on observation:

First of all a telescope. A telescope of even 2½ or 3-inch diameter with a couple of celestial eye pieces, a low power and one stronger, with sun shades, you can begin observation.

To-day, Jan. 13th, 1902, there is a family of beautiful sunspots on the north-west portion of the sun's disc, and with a 3-inch scope and an 80 eye power, I had a delightful observation, and the sun continuously affords delightful observation. The moon is a good object to the amateur observer. Don't wait for observing till the moon is full. When it is in the first quarter to half full it is perhaps most interesting, although continuous observation should be made during the phases. Venus is more favorable for observation in the day time, but without equatorial mountings it is almost impossible to find it. Jupiter and Saturn will be favorable for observation during the coming season, and should be studied by every member of the Association.

As I close my paper, let me ask each member of the Society to set himself for such elementary reading as has been intimated and to get telescopes as soon as possible.

THE PLANET NEPTUNE.

Read before the Astronomical Section of the Hamilton Scientific Association, April 1st, 1902.

BY REV. D. B. MARSH, SC. D.

No unaided human eye has ever seen Neptune; he pursues his lonely way far beyond the vision of mortal man. Only with the telescope can the veil of the distance be lifted, and even then only very imperfectly.

With a telescope of moderate power Neptune is seen as a star of the 8th magnitude. With an eye-piece of about 300 magnifying power a disc is perceptible, yet even this reveals glorious mystery. A view of Neptune by the telescope creates a thrill of wonder and awakens transports of solemn joy within the soul which no words can describe.

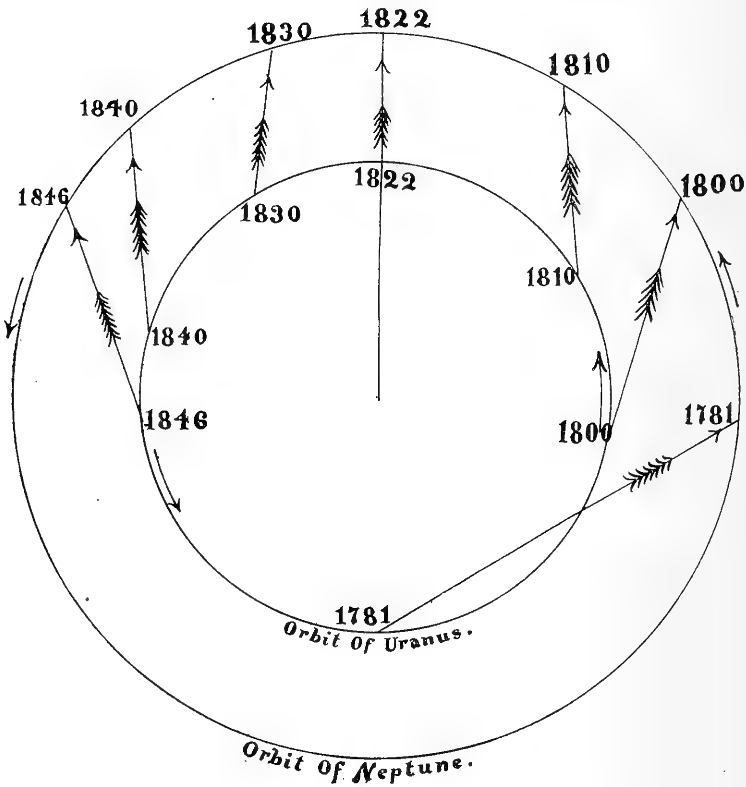
That we may know the place of Neptune among the planets, and that we may have some conception of its vast distance from us, it will be necessary for me to take you nearly all the way there. I trust that you will enjoy the journey and the study of the planet when we get near enough for favorable observation, which will be only a few hundred miles from the planet.

Before starting the journey I would like to say a few words regarding the discovery of the planet, and while I am doing this those of you who intend accompanying me can get your wraps about you and be ready for the tremendous journey through space.

In the discovery of Neptune we have the triumph of calculation; the discovery is due to the sole power of numbers. The existence of this planet in the sky was revealed by mathematics. The disturbance of Uranus in his orbit permitted the mathematician to say that the cause of these perturbations was an unknown planet beyond the orbit of Uranus. A telescope was directed towards the sky, as directed by the mathematician, and in less than an hour the planet was found. If the planets only obeyed the traction of the sun, they would describe around him simple elliptical orbits; but they act on each other as well as on the central star, hence from these various attractions perturbations result.

For many centuries past astronomers have computed in advance tables of the positions of the stars in the sky, in order to know exactly where they could be found and to observe them according to the interest presented by their position in their orbits, and also for the benefit of navigators. Bouvard, a Paris astronomer, calculated in 1820 the tables of Jupiter, Saturn and Uranus, and ascertained that his computations agreed exactly with his observation with Jupiter and Saturn, but not so with Uranus, and for twenty years these discrepancies puzzled all astronomers. Bouvard, Madler, Bassel, Valz, Arago, etc., expressed the opinion that these discrepancies were due to attraction from some planet not yet discovered. However, mathematical calculation went on, and observations of Uranus carefully taken. In 1830 the difference of calculation and observation increased to 20 seconds, in 1840 to 90 seconds, in 1844 to 120 seconds, in 1846 to 128 seconds. To men of the world this would have been nothing, as two stars thus separated would require keen eyesight to distinguish them as two. But to a man of the skies nothing is too small to escape notice, hence such a difference was a veritable cause of insomnia. The problem was the topic of the day, and Arago, always in the vanguard of progress, advised a young man skilful in mathematics—Le Verrier, of France—to undertake the problem. After a careful review of the tables of Bouvard, and making several corrections, boldly announced the hypothesis of a planet beyond Uranus, acting in a continuous manner upon it and changing his motion, and on 31st of August, 1846, he announced to the Academy of Sciences that a new planet should be found at latitude 326. On September 18th he wrote to Dr. Gale, of the Berlin observatory, telling him that a planet should be observed there, and requesting him to look for the planet. Dr. Gale got the letter on the 23rd, and it being a clear night he pointed the telescope to the position in the sky, and lo! an unknown star appeared, and which with increased eye power showed a perceptible disc; and thus far, far away, Neptune was discovered. I should not omit the fact that a Mr. Adams in England was at the same time making calculations, and leaped to the same conclusion. He wrote the result of his calculations to Prof. Airy; the planet was seen but not reported on.

The accompanying diagram will illustrate the disturbing action of Neptune upon Uranus. This shows the positions of the two planets from the discovery of Uranus to that of Neptune. We see that from 1781 to 1822 the influence of Neptune tends to draw



Uranus in advance, while from 1822 to 1846 to retard it. Here we have the discovery of Neptune. In its simple grandeur it is splendid, and of the highest order from a philosophical point of view, for it proves the security and precision of the data of modern astronomy.

Now we have found Neptune, and find him to be the most remote planet known of our solar system; and I presume you are all anxious to go and see him and learn his mysteries. How shall we go? The distance is great, and the time is short and precious, hence the most rapid vehicle for the journey must be chosen. We cannot go by train, for a train running a mile a minute would require 5310 years to take us within good seeing distance. Some one suggests that we embark in a great cannon ball, and be fired from one of the fort guns, but I fear this would not be satisfactory, as it would take us 255 years to get there. Suppose we make arrangements with a telegraph company, and be flashed through space as our messages are from continent to continent; this I fear would also be too slow, as it would require over six hours to make the journey. Can we not then board the car of light, and sweep through space at the awful rate of 186,000 miles per second? Would we not then arrive at our journey's end in a moment? Oh! no. It would take us over four hours to get there. How, then, shall we go? Must we abandon our prospect? No; let us try once more. Wrap your garments closely around you. *A moment in thought*—we are there. Now that we are close to Neptune, what do we see? We see a globe 35,000 miles in diameter, greenish or greenish yellow in color; no markings are seen on it, probably because of the envelope of atmosphere much like our own terrestrial atmosphere.

Notwithstanding the weakness of Neptune's light, spectrum analysis has succeeded in ascertaining the existence of certain gases which do not exist on our earth. The real diameter of Neptune is nearly four times greater than our earth, and its volume fifty-five times greater than ours. Its density, however, is hardly a third, but its gravity is almost identical with terrestrial gravity. As yet astronomers cannot determine the rotation of this distant planet on its axis, as no markings are visible on its disc. It may be very rapid, like Jupiter, Saturn and Uranus, and most likely it is, but great improvements in optics will be necessary before we can see markings on this pale disc. At about 260,000 miles from Neptune we see a star of about the 14th magnitude, which we recognize as its moon. This little satellite completes its orbit around the planet in a little less than six days, whilst the planet itself requires over 164 of our years to complete its orbit of over 2,791,600,000 miles from the central star—the sun. Neptune in one circuit of the skies travels 17,000,000,000 of miles, which gives a velocity of 299,000 miles a day, or 12,460 an hour, 200 miles a minute, and 3.33 miles per second. A child of Neptune at 10 years has lived 1,648 years of ours. A young girl of 18 years marries at the age af 2,950 terrestrial years, whilst the young man of her dreams is more than 3,000. The child of Earth, whose sweet face to-night looks up to the spangled vault to where Neptune hides himself, will have grown up, will have fought life's battle, will have grown old, died, and have lain in the grave 100 years by the time the Wanderer of the Skies returns to the same place.

Is this planet inhabited? Is it the abode of intelligent and moral beings like ourselves? To this question some say no; they see, or think they see, many difficulties in the way. They say it is too far from the sun—too little light, too little heat; that certain gases exist there which would prevent life, etc. Friends! has not God adopted the plan of adaptation and variety? Where can we turn our eyes and not behold this? Has He not fashioned the beetle, the mole, and the worm for the mouldering soil? Has He not fashioned the whale and the walrus for the frozen north, the camel and dromedary for the arid sands of the desert, the serpent and monkey for the tropical forests? The air we breathe is full of life; even corrosive poisons and strong acids teem with life. We are, therefore, not only warranted, but directed, to look for life and adaptation of life to its circumstances, in every part and province of God's creation. Can not God as easily create and adapt a population to a planet as to create a planet and adapt it for its lonely way so remote from the central star? It is as easy for God to populate Neptune as to supply oceans, lakes, rivers and brooks with fishes.

Is it not consistent with reason—is it not in harmony with analogy and all we know about the wisdom and goodness of God to believe that not only is Neptune, but all these planets, these stately mansions, have their sentient and intelligent inhabitants to travel and contemplate their transcendent scenes of grandeur; that their plains and valleys and mountain sides teem with millions of happy beings that offer up their daily prayers and adorations to the same Father and God whom we worship and serve?

> "Each of these stars is a religious house:
> I saw their altars smoke, their incense rise,
> And I heard hosannas ring through every sphere."

CHEMISTRY OF CREATION.

Read before the Astronomical Section of the Hamilton Scientific Association, Feb. 4th, 1902.

BY J. M. WILLIAMS.

It will be thought a somewhat presumptuous title that has been taken for this paper. Will one assume that he can take the universe into the laboratory; will one say that he shall separate in the workshop matter from matter so that the tremendous works of nature shall lie piecemeal on the study table? Scarcely. It may be that its alliterative form may have written it. Still, while one may not say that he will melt a planet or diffuse a star, yet he may, with the faculty of imaginative reason, sort and separate each from each, atom from atom, until there lies before us the analysis of a world. If then a world, then a universe. Creation to us is a subject which takes its rise with a basis of belief in the importance of our earth as the principal factor, with the stars and the solar system as mere adjuncts for our benefit. When the light of knowledge opens the field of vision, how faith shrinks and hope almost dies. Shall man stop here amid the wreckage of his early lessons? No; but with the greatness of the human mind to grasp and grapple with the unthought and unknown, given to use, designed to learn, he shall, on the very ground built of the ashes of error, unravel, unravel, unravel. That which we call the solid earth, in figures of poetic speech we say "firm as the everlasting hills," "firm as the earth on which we stand;" this, in the hands of chemistry, disperses back to the evanescent air, and that which is solid proves but a vapor. Ere time was counted by the course of suns, ere space knew the system of our orbit's course, our sun, whirling on its track alone, ringed with a coronet of glory, stirred by the finger of God, to revolve, until, cooling to a nucleus, there gathered stratum upon stratum, till earths were builded and planets grew.

In this constructive stage operated the action of heat becoming magnetism; and dimagnetic, or, as it is generally expressed, rarified vapor, or, as it may be described, highly heated matter in the form of vapor, on cooling became magnetic, and thus would be formed the nucleus referred to. This nucleus would then be said to possess an attraction of gravitation—hence *gravity is magnetism.* The nucleus, having a rotary motion initiated by the rotation of the parent sun, would, as the planets now are, be an armature revolving in the field of a great magnet in which the magnetism was, possibly, in turn derived from its rotating in the field of a greater magnetic centre, and in its envelope its corona, or chromosphere, existed in the form of light emitting heat.

This heat and light form of force became the magnetic form of force (or gravity), and the gradual decrease of temperature of the parent mass, "the sun," would allow of the nucleus exerting its magnetic attraction on its surrounding atmosphere, or, as it would be then, its chromosphere, for at this stage the vast amphitheatre of our solar area would be a great nebula of wonderful luminosity; and viewed by the inhabitants of other worlds would in all probability be an object of the greatest admiration, especially as its various members separated themselves into the various colored stars which they now are—that is, those which have not passed the complete change from a dimagnetic luminous body to a strongly magnetic and non-luminous, as our earth is. This magnetic nucleus would increase in size as its surrounding vapor became condensed, its heat and light in turn being absorbed in the construction of a solid from the gaseous, the magnetism possessed by solid matter, the power or force by which its atoms are held together being the same force in another form which held them asunder, and the force which now makes a steel bridge strong once held, dispersed through the regions of the solar area, the carbon and iron which it now holds so securely on our earth. We here meet with the theory or hypothesis or question of the solidity of our earth. We can deduce from the starting point of the nucleus formation that it is solid, and, moreover, that it is metallic—in a sentence, *our earth is a metallic ball* with a crust of oxides a few miles thick, and the huge deposits of metals, which we boast of as being rich or common, are but the scraps left in the oxides or slag surrounding the solidified metal. The smouldering remains of volcanoes, which we have now but a few, are the last remnants of the constructive age in which as the metallic center attracted its envelope with greater rapidity as it grew in size, and as it in consequence of its greater size swung by centrifugal action further away from the sun and its heat, it would create a temperature that would retain the oxides on its surface in a fluid form; these would receive a shell of cooled oxides, the silicious matters floating to form in future ages the soil of earth, and as the oxygen and hydrogen came in from outer regions to take the place of the heavier vapors which had now become solids and fluxes, water would be formed by the electrical discharge, inflaming great masses of hydrogen and oxygen which had become, as we might say, sufficiently cooled to unite, or really sufficiently magnetic to unite, for we must keep in mind that it was dimagnetism which held them apart. To digress a moment: it seems that it is but a question of polarity of atoms. Atoms of a certain polarity will unite; produce an opposite polarity they fly apart. To go back to our subject: as the hydrogen and oxygen atoms, by their changing polarity following the heavier, that is, the elements possessing greater capacity of polarity, what we call the highest fusing metals, would solidify first and in turn each, until we arrive at the crust or shell, literally the slag. The illustration which seems here to be suitable is that of a smelter—the metal at the bottom, the slag above, and above that again the composite cold mass of coke, limestone and ore. The polarity of the atoms of the ore has been, by the violence of the action set up by forcing heated oxygen into a mass of heated carbon, so altered that the iron has been separated from its oxygen, and obeying the magnetic attraction of the earth, sinks to the bottom of the cupola, and the fused oxides float on the mass of metal as the fused oxides floated in the chemical work of creation.

We go back to where we find water to be formed. The immense mass of metal revolving in the magnetic field of the sun carries around it a magnetic field of its own, and as the first mists formed by the union of the hydrogen and oxygen of the earth's envelope became charged with electricity, they would in turn react to produce more water, and thus the shell over the slag crust of earth would be cooled and the alternate advent of water and its repulsion by the hot slag would have its share in the chemistry of creation, and the oceans were made. We have observed the fact of a magnetic field around this metallic globe (insulated with a few miles of sand and water). This field will carry in the twentieth century messages round the world.

The progressive stages which we have been here considering have, in the case of our moon, which, by a separate nucleus, was formed in a like manner as our earth, and by its rapid rotation around its magnetic center, our earth, coupled with its revolution with us round the sun, has passed sooner than us through the complete course of formation from highly rarified dimagnetic gas (we have no language for another state, for we do not know another state—we have only the manifestations which constitute the sum of our present knowledge) to a cold solid, for the moon has passed through the stage of the formation of water from her atmosphere, and her atmosphere has lost all its dimagnetism, and has, as one might say, been absorbed, and so have her oceans. Her surface is oxidized metals, and the deathlike stillness of those majestic wastes which so charm the astronomer are deathlike indeed, for dust and ashes is the surface of that obsolete world. And we too will probably follow our moon ; we will absorb our atmosphere and our oceans, and then it will swing as one of the moons of the sun until ———.

We have considered the chemical, as we call it, separation of the elements of the parent nebula ; we have only considered the part of the nebula which became our earth. The other planets, while they followed the same process will not have had the same composition, the various elements which constitute the chromosphere and corona, and as a sequence the body of the sun, are not all known to us, and even if they were it would still leave us able to apportion them among the planets. The outer peripheries of the nebular area surrounding the sun would be of the most dimagnetic, or to use the language most familiar, the most rarified elements, that is, the ones capable of being dispersed to the greatest extent. These rings of matter as they whirled in the vortex of the solar area gathered in centres of a polarization of the degree consequent on their composition, and what we called the lighter planets would be on the outer circles of revolution, because the sun would be exerting a dimagnetic influence at that period, and the light elements would be able to go into a globular mass around a magnetic nucleus, then, whereas, later, when the sun became as we say cooler, they could not ; hence we find on the outskirts of our solar system huge planets of a lighter composition than ourselves and they swing round their orbits by the centrifugal force obtained in their vast revolution at a period when the sun's dimagnetic state allowed their masses to revolve further and further away, as they (we have to use the word), cooled, and because of sufficient density to swing far away into space. They thus assembled themselves the lightest (to put it into simple language), on the outside circle, the heavier next, and by a natural selection until we reach our earth. We may here observe that the number of moons are an indication of the composition of the planets, the lighter the more nuclei could form, and in the case of Saturn there is likely to be present a proportion of some element (possibly some familiar to us but under our conditions part of our earth), whose magnetic properties are such that in the proportion it is in the belts of Saturn, it has not yet had time to condense (as we would say).

To repeat, the lighter the planet the further away from the sun (the reason we have observed), and the more moons.

If it is required or that we wish to observe the absorption of our atmosphere, we have but to look at a chalk cliff hundreds of feet high, or the deposit of coral, in which lie countless tons of oxygen and carbon locked, by the magnetic force with which every atom of our planet is imbued, with the calcium which once, together with the other elements, floated as our chromosphere, locked forever or until ———, on the ocean floor. Or again, the rusting of the rocks, bethink you of the limestone, the ore mountains, the whole earth, indeed, slowly but surely drinking, atom by atom, the ocean of air in which we live. But we may leave the question here, and in a crucible in our laboratory we may, in the littleness of our scope, repeat the great, great work of the Chemistry of Creation.

SELENOGRAPHY.

Read before the Astronomical Section of the Hamilton Scientific Association, April 29th, 1902.

BY H. B. WITTON.

Except the sun itself, none of the heavenly bodies has attracted so much attention as the moon. Her apparent size and nearness to the earth, the subdued splendor of her light, her erratic course in the heavens, the rapid change and frequent recurrence of her phases, and the weird effect of her eclipses, have made the moon, from time immemorial, an object of intense interest. Literature, ancient and modern, bears witness to the truth of this. The Vaidie hymns shew that in the early dawn of Indogermanic civilization the phases of the moon were personified, and her influence was invoked with solemn rites. In many languages her name is given to one of the days of the week; this indicates how long she has been held in veneration, as Laplace has shewn names of the week-days are among the most ancient monuments of astronomical knowledge. Poetry, too, has thrown over the earth's satellite graceful veils of myth and fancy; while the most prosaic utilitarianism, in the interests of commerce, has been fain to do her honor. Pythagorus, in his system of cosmic harmony, credits the moon with contributing the highest note to the music of the spheres; and our own less imaginative forefathers, by such names as lunar caustic, selenite—thought to be moon-froth—and lunatic, have left a legacy to our vocabulary shewing their faith in the potency of the moon's influence.

In these latter days, that peculiar veneration the moon formerly commanded no longer obtains. The age of faith in her occult powers expired with the astrologer and alchymist, to be succeeded by an age of inquiry and knowledge which, rejecting the superstition of the old learning, still cherishes some measure of its devotion. Though we no longer plant and sow, herd our cattle, prune our vines, and gather in our harvests in awe of her sovereignty, yet our lunar tables, nautical almanacs and observatories shew that the moon's influence is not yet ignored. In the sharp conflicts which have overthrown numberless ancient conceits, veneration for the moon did not utterly perish by the hand of the iconoclast, but in spirit still lives, transformed into the attention paid to her by positive science and investigation of her physical influence upon the world we live in.

Much that is noteworthy concerning the moon is inscribed so boldly on the firmament above us that the most listless observer cannot choose but read and be instructed. From the earth's axial rotation, both sun and moon have an apparent motion from east to west none can fail to notice. In addition to this apparent motion toward the west, common to all the heavenly bodies, observation of the star-sphere will shew that sun and moon proceed on a course among the stars toward the east. But that motion, though similar in direction, is otherwise different. One day with another the moon moves eastward about 13 degrees daily, making the circuit of the heavens in a month, while the sun goes towards the east but 1 degree each day, requiring a year to complete his circuit. Moreover, the eastward motion of the sun is apparent only, being caused by the earth's translation in her orbit, while the moon's eastward course is her proper orbital motion round the earth.

In her monthly course the moon, whose light is received from the sun, assumes various familiar phases. When in conjunction, nearest the sun, she is for a day or two lost in the sun's brightness. After such temporary concealment each month, she comes again to view—a radiant sickle in the western sky. The limb, or convex outline of the waxing crescent, is toward the sun. The horns of the crescent, and terminator, or dividing line between the bright and dark parts of the disk, are to the left hand of the beholder. Immediately before concealment the waning moon shews a reversed crescent having its limb toward the east, and its horn and terminator to the beholder's right hand. When half her monthly course is run, the moon in opposition becomes full moon. From new to full moon the dark part of the disk generally becomes illuminated, and from full moon till the waning crescent is lost in the blaze of the sunlight, the illuminated part of the disk by almost imperceptible degrees becomes obscured.

In going through these phases the moon more than completes the circuit of her orbit around the earth, for the earth during a lunation is carried forward in its movement around the sun about 30 degrees, and the moon must pass over that distance before sun, moon and earth take the relative positions requisite to make new moon. Such a lunation, or course of the moon once round the earth, and far enough on a second course to come again in conjunction with the sun, is called the moon's synodical revolution. The mean time for making it is 29 days, 12 hours, 44 minutes and 3 seconds. The mean time it takes for the circuit of her own orbit only is but 27 days, 7 hours, 43 minutes and 11 seconds. Thus in each lunation the moon, from the earth's motion of translation round the sun, proceeds 2 days, 5 hours and 52 seconds on a second course before coming into the necessary alignment with sun and earth essential to present the phenomenon of new moon. These figures furnish the mean time in which the moon is carried through her orbit, but disturbing forces so considerably affect her velocity and direction, that astronomers, only by long profound research, have succeeded in foretelling what will be the moon's place in the heavens at any given future time.

Astronomical science regards the heavenly bodies in two aspects: in their relations to time and space, and as masses of matter moving in obedience to cosmical forces. Ages of observation prepared the way for the latter conception, and ancient astronomy chiefly kept watch over the times and seasons. Still, in the early stages of astronomical research, the moon was accorded attention, as many ancient nations used the moon's phases as a measure of time. The word moon, it is thought by some philologists, can be traced to the root *ma*, meaning to measure.

Although a lunation is, in many respects, a desirable standard for measuring time, it has been found extremely difficult to make it a sub-division of the tropical year, or the time taken by the earth to complete her course from, and return to, the vernal equinox. Whereever the lunisolar year has been adopted intercalations have been necessary to bring the lunar months and solar years out even. The Greeks used simultaneously the two standards, and had no end of difficulty to keep them from overlapping. Their Olympiads supply a record for a thousand years, and are perhaps the best scale of past events on record. They originated from holding, every four years, games at Olympia, at the time of first full moon after the summer solstice. For a long time Greecian months alternately comprised 29 and 30 days, but as a lunation is not the exact mean of these numbers, occasional corrections had to be made. The best known of such correctional devices, the cycle of Meton, covered a period of 19 years, 7 of which had 13 and the rest 12 months to the year, a total of 235 months for the cycle. One hundred and ten of these months had 29 days each, and the remaining 125 months of the cycle had 30 days to each month, making altogether 6940 days, 9 hours in excess of 19 tropical years, and 7 hours more than 235 lunations, leaving but a trifling discrepancy for future correction at the end of the cycle, between the three modes of reckoning time, by tropical years, calendar months and lunations. This cycle, called the golden number, because, it is said, the Athenians proclaimed it in figures of gold, is still used to determine the time of Easter, as ecclesiastical authority has decreed the Sunday following the first full moon after the Vernal equinox shall be observed as Easter Sunday. Thus modern Christendom and ancient Heathendom both accepted the moon as an indicator of the precise time for holding their great festivals.

Long years were given to the task of explaining the moon's motion. But modern astronomers have succeeded in shewing that motion accords with, and lucidly illustrates the principles of their science. The reasoning on which astronomical science depends is confessedly intricate, and its thorough mastery may well challenge the devotion of a lifetime. Nevertheless, it requires no special gifts or training to comprehend that the main links in that chain are: the conception of Copernicus that the earth has a daily axial rotation and an annual translation around the sun; and Kepler's laws—that a planet's orbit is an ellipse about its primary as a focus, that the areas swept by the radius vector of a planet are proportionate to the time of its motion, and that the squares of periodic times of planets are proportionate to the cubes of their distance from the sun. Add to these the discovery of Newton, which confirms them, that all bodies attract each other directly as their mass and inversely as the squares of their distance from each other, and we have the axioms on which the whole structure of modern astronomy is built. Kepler's generalizations were epoch-making. They compel all the more admiration that they were conceived in astrological times, and were mixed up with astrological fancies. But Kepler, even in error, erred like a man of genius. When his feet took the wrong path, his face often turned toward the right. He believed the sun to have a soul, which was constantly rotating. He also thought that between sun and planets there is a friendly side, and a side that is hostile; and that when the friendly side was turned the planets moved toward the sun, and when the hostile side was turned they moved from him.

All this was fanciful enough, but here error pointed in the direction of truth, for twenty years later Galileo saw through his telescope that the sun's rotation was a reality. Newton's theory has withstood more than two centuries of criticism, and is confirmed by the most careful observations. Eight thousand telescopic observations taken of the moon during a period of eighty years were compared, under direction of Prof. Airy, with the place at which, by Newton's theory, the moon should be at the time of each observation. Each theoretical place was computed separately and independently. The work took a body of calculators eight years, at a cost of £4,300, and by it the truth of Newton's theory was fully sustained.

If the moon revolved around the earth, controlled solely by force of their mutual attraction, the calculation of her orbital motion would present no special difficulty to the expert astronomer. What would be the moon's position in the heavens at a given future time could be predicted with like exactness to that of Jupiter, which has been given ten years in advance, to within half a second of actual observation. But in addition to attraction of the earth, the moon is influenced by that of the sun, and to a less extent by that of the nearest planets. Moreover, from the moon's elliptic orbit and inclination of the plane of that orbit to the plane of the ecliptic, the sun's attraction is a force constantly varying, both in degree and direction. Hence calculation of the lunar motion is one of the most difficult tasks accomplished in the field of physical astronomy. In a letter to Flamsteed, Newton himself lets fall words bordering on doubt as to whether he should finish the task. These lunar inequalities, as they are called, Prof. Airy explained in his work on "Gravitation." His book was written for general readers; and Lord Brougham, who tried his hand at similar work, deemed it the best account of the Newtonian philosophy ever written, or likely to be written.

Besides theoretical interest of being able to predict exactly the moon's place in the heavens at any future time, toward the latter part of the 17th century, the more advanced governments of Europe recognized the great value such predictions would be to navigation. Increasing commerce with India in the east, and America in the west, made some exact method of determining longitude highly desirable, especially if it could be made simple enough for general use at sea. What was needed, and sought after, was to find the exact difference in time between two meridians, as the distance could then be readily enough known. The seaman could know from the sun's altitude the time at his meridian of observation, but it was at that day impossible for him to know at the moment of such observation the exact local time at his first meridian. To meet that difficulty two plans were suggested. One was to make accurate timekeepers not affected by ordinary changes of temperature, the other was to make the moon serve as a chronometer. To accomplish the latter task it was necessary to work out in advance at some first meridian the exact angular distance, at every hour, between the moon and some of the principal stars. By this means, when the seaman had taken the exact distance between the moon and a given star, simple inspection of his tables would shew him the exact time at his first meridian, when moon and star were the same angular distance apart as at his observation.

Charles II. was told in 1674, that such tables of lunar distances, worked out in advance, would be of great service to English seamen. The result was Greenwich Observatory was founded in 1675, and Flamsteed, who furnished his own instruments, was appointed "Astronomical Observator," at the salary of £100 a year. He determined with great accuracy the positions of about 3000 stars, and made a large number of lunar observations.

In 1714 the English parliament offered a reward to any discoverer of a method of finding the longitude at sea, the reward to be proportionate to the accuracy of the method found out. £10,000 was to be given if in a long voyage the method discovered approached absolute accuracy within sixty miles, £15,000 if within forty miles, and £20,000 if within thirty miles. Many methods were suggested. Some of these, as described in a letter by Flamsteed to his assistant, Sharp, were most absurd. The problem was at length solved by John Harrison, whose improved chronometers brought him, in instalments, the maximum reward of £20,000. Harrison was a Yorkshire carpenter, who would have had little chance of success in a modern competitive examination; but his ingenious application of the different expansion by heat of two different metals to the construction of chronometers, was an inestimable service to his country and to the world. He made four or five chronometers. Of these, it is said, one was of such exactness that it did not vary a whole minute in ten years. Two of the Harrison chronometers are preserved at Greenwich Observatory. Sharp's biographer says: "A part of the escapement was, a few years since, removed from one of these, when the train of wheels ran down with velocity, though they had not turned for more than a hundred years."

In 1724, five years after Flamsteed's death, an Act of Parliament offered £5,000 reward for a set of tables giving lunar distances correctly to fifteen seconds of arc. Mayer, of Gottingen, worked out such a set, and sent them in 1757 to be tested, as, by terms of the Act, they had to be compared with actual observations for eighteen years and a-half. These tables were used in the Nautical Almanac first issued in 1767. Mayer died in 1762. His wife received the sum of £3,000, and Euler, a Swiss mathematician, was awarded a like sum. Euler's service was an approximate solution of the famous problem known as that of "the three bodies," namely: given their distances, velocities, masses and direction, what will be the path of one of three bodies around another, when all move in accordance with the law of gravitation? Hansen's lunar tables have since superseded those of Mayer. The British nautical almanac devotes six of its pages each month to lunar distances. They are now given to one second of arc, and are published three years in advance.

With what accuracy the position of a ship at sea can now be determined was exemplified a few years since by picking up the broken Atlantic cable from the bottom of mid-ocean. The cable was no larger in section than a ten cent piece; the buoys left to indicate place of the break were washed away, and nothing but his nautical skill was left to guide the navigator in what looked to be so hopeless a search. Yet with such extreme precision was the place of breakage recorded, and the searching vessel guided in her forlorn quest, that in a few hours the lost cable was successfully grappled.

Simultaneously with advancement of lunar investigation in the direction referred to, other observers were scrutinizing and mapping out the moon's surface. Without instrumental aid only a faint indication of the more prominent objects on the moon's disk can be seen, and it is not surprising these were long thought to be reflected images of the seas and continents of the earth. Galileo's "perspective glass," made by him about 1609, was the first known instrument by which the moon was seen more distinctly than by unaided vision. A year after Galileo made his glass he published an account of what he had seen through it. The quaint title of his book tells its own story. It reads in full: "The Sidereal Messenger, announcing "great and wonderful spectacles, and offering them to the consider- "ation of everyone, but especially of Philosophers and Astronomers, "which have been observed by Galileo Galilei, etc., etc., by the aid "of a perspective glass lately invented by him: namely, in the face "of the moon, in innumerable fixed stars, but especially in four "planets which revolve around Jupiter at different intervals and "periods with a wonderful celerity, which hitherto not known to "anyone, the author has recently been the first to detect, and has "decreed to call the Medicean stars." Galileo said that his first telescope made objects look three times nearer and nine times larger, and that he made a second, having a magnifying power of sixteen times. He probably never used an instrument which magnified more than thirty diameters. But by their use he constructed the first map of the moon ever made, and measured some of the lunar mountains. It is needless to add that Galileo immortalized his name by extending the boundaries of human knowledge, and by preparing the way for a more adequate conception of the infinite grandeur of the great Cosmos, the glorious universe of God.

A younger contemporary of Galileo, John Hovel (or Hevelius, as he was called in Latin, who was born at Dantzig) carried the work of lunar observation further than any of his predecessors. In his youth Hovel (whose father was a rich brewer) studied law, though mathematics and astronomy were his favorite pursuits. He travelled in Europe four years, attended in London the lectures of Wallis, one of the founders of the Royal Society, and would have visited Galileo in Italy, but was summoned home by his aged father to take charge of their brewery. But to astronomy he bent the best energies of his life. He fitted up three contiguous houses owned by him, making them his observatory, workshop, engraving and printing office, and library. Hovel was an extraordinary man. He made his own instruments, engraved his own maps, and printed his observations with his own hands. On the 26th of September, 1679, a vicious servant wickedly sat Hovel's observatory on fire. Although most of his important works had been already printed and distributed, the loss of his instruments and many papers caused him much grief, and hastened his death. His "Selenography" appeared in 1647. The telescope he used magnified from thirty to forty diameters, and from his observations he engraved a map shewing two hundred and fifty lunar formations. The chief lunar formations he named after the earthly formations he fancied they most resembled. The lunar Alps and Apennines, and four of the lunar promontories, retain the names he gave them; and the term *Mare* used by him to designate the dark lunar plains has since remained in common use. He called these plains seas, he says ("*weil er sie mit nichts anderm besser zu vergleichen wisse*"), because he knew nothing better to liken them to. For more than a century Hovel's map was the best map of the moon.

The first telescopic observers soon found: the lunar hemisphere turned earthward is always the same, or nearly the same. The difference there is, is due to libration, and its maximum amount is not a forty-ninth of the moon's circumference, or more exactly is 7 degrees, 53 minutes of lunar measurement. To that extent only the moon changes the face turned earthward. The rest of her sphere is hidden forever from mortal sight. Hovel was first to explain that libration in longitude is due to the fact, the moon rotates on her axis at a uniform rate, while her movement of translation varies in velocity with her varying distance from the earth. Galileo had already found out that there is a similar libration in latitude, due to the moon's axis of rotation not being exactly perpendicular to the plane of her orbit.

In 1651, J. B. Riccioli, a member of the Society of Jesus, compiled a lunar map noteworthy chiefly from its nomenclature. In lieu of Hovel's names, he designated the craters and places marked on his map after names of eminent mathematicians and astronomers. A French astronomer archly says: "Riccioli shrewdly avoided the jealously of his contemporaries, by taking for his map only names of philosophers who were dead." His successors have marked his selections with approval, as more than two hundred of the names he chose are retained on lunar maps. For the great plains called by Hovel seas, Riccioli retained Hovel's names, but added others to them, intending thereby to indicate their supposed influence over the earth. This faint vestige of astrological conceits, if such it be, has not been obliterated from our maps. We still speak of the lake of death, sea of serenity, and the rest of Riccioli's fanciful names. But they have become meaningless. The belief which called them into being, namely: that the heavenly bodies influence human destiny, and that such influence in individual cases might be ascertained by protracted study, was once dominant in the world, but has faded away never to return.

Thirty years later Cassini published a lunar chart. He was a learned astronomer and a most indefatigable worker, and made important contributions to lunar knowledge. Lalande re-published Cassini's map in 1787.

About the middle of the eighteenth century, Mayer, whose lunar tables have been mentioned, proposed the publication of a more complete lunar map than had then been issued. He, unfortunately, died before his plans were carried out, though a map eight inches in diameter was published with his posthumous works in 1775. Although small, it was the most accurate map of the moon printed till 1824.

During the last quarter of the eighteenth century the elder Herschel, in England, and Schrœter, in Hanover, directed their attention to lunar investigations. They worked with better instruments than had been used by their predecessors, using magnifying powers from 150 to 300 diameters. Herschel, whose mechanical genius improved every astronomical instrument he touched, used micrometer measurements for his lunar drawings, instead of trusting entirely to skill of eye and hand. Schrœter's *Selenotopographische Fragmente* gave views of parts of the lunar surface with more details than any earlier map had given. He named many formations in the south-west part of the moon's disk, and sixty of his names are still retained. He first adopted the practice, still in vogue, of designating small spots near craters already named, by letters of the Greek and Roman alphabets.

In 1824, Lohrman, of Dresden, proposed to issue in twenty-five sections a lunar map 36½ inches to the moon's diameter; but, his sight failing, only four sections were printed. As Lohrman was a professional surveyor, and was assisted by the astronomer Encke, and used one of the celebrated telescopes made by Frauenhofer, of Munich, his work had rare merit, and is still referred to.

In 1834-6 appeared the map of the moon, by Beer and Mædler. It was on a scale of 3 ft. 2 in. to the moon's diameter, and was followed the next year by their great explanatory work—*Der Mond; oder allgemeine vergleichende Selenography.* Their labors carried lunar investigation far beyond the most advanced stages reached by their predecessors. Their book of more than 400 closely-printed pages, for exhaustive descriptions, and their map for minute details, won them unstinted praise, and still command the highest esteem. Later workers in their field of labor have employed more powerful instruments and made out details they failed to record, but their drawings and descriptions are still standards of authority, and are likely to remain such. Their mode of working shows the value of their work. To fix ninety-two chief points on the moon's disk, as bases for further measurements, they made nearly a thousand micrometric measurements from the limb of the moon. They also measured one hundred and forty-eight lunar formations with the micrometer. They made one thousand and ninety-five measurements of the shadows thrown by eight hundred and thirty different lunar mountains, minutely noting particulars of illumination at each measurement. From the length of these shadows the height of each mountain was carefully computed, and the resultant heights served as standards for determining the elevation of minor peaks whose shadows were projected under like conditions of illumination. They named one hundred and fifty lunar formations not named before, but made no innovations on the accepted nomenclature except that in carrying out Schrœter's plan of designating un-named craters by Greek and Roman letters they used Greek letters only for elevations, lower-case Roman letters for depressions, and Roman capitals for measured points. Their telescope was a Frauenhofer refractor of 8¾ in. aperture, having a magnifying power ranging from one hundred and forty to three hundred diameters. They worked chiefly with an aperture of 4½ in., and did not often use so high a power as 300. As Lohrman had done before them, they followed Schrœter's system of describing by numbers the relative brightness of objects they observed. Their scale, since in common use, runs from zero for shadows to 10 degrees for the brightest lights.

Beer and Mædler's great work enjoys the reputation of being a model scientific monograph. Without trace of vanity or egotism, the workman in it is lost in his work. One of them, not content with his protracted labor on a difficult portion of the moon's disk, adds: *Quæ potui feci, faciant meliora potentes.* Involuntary one bows in respect to these plodding, sincere workers, as they say in conclusion: "The time and strength our labors have taken, make us aware this "is the chief work of our lives, but our toil will be rewarded if it "meet the expectations of the scientific world." Beer was a German banker, brother of Meyerbeer, the musical composer.

Schmidt, of Athens, for many years held a chief place of honor among observers of lunar phenomena. He made more than a thousand original drawings for a lunar map 75 in. in diameter. His map was completed more than thirty years ago, though publication was delayed from the question of cost.

In 1864, the British Association appointed a "Moon Committee," of which Mr. Birt was secretary. They decided to map the lunar surface on a scale of 100 in. to the moon's disk, and to use for that purpose a telescope magnifying 1000 times. It was decided to use preliminary sketch maps double the size of the map to be finally engraved. Some of the sketch maps were issued, but I am not aware that the finished map has ever been published.

Among English writers on lunar subjects, Nasmyth, the celebrated engineer who invented the steam hammer, is entitled to a high place. His book, "The Moon considered as a planet, a world, and a satellite," was issued in conjunction with Mr. Carpenter, and has run through several editions. It is much prized for its chapters concerning the physical condition of the moon, and for its exquisite drawings of lunar craters, mountains and plains. Nasmyth's exceptional skill in drawing never shone to more advantage than in his illustrations of lunar scenery. In his most interesting biography, Nasmyth describes his method of obtaining these illustrations. He first made, directly at the telescope, careful drawings of the part of the moon's disk selected for description. Full notes were taken with the sketch as to illumination and other particulars to be kept in mind. The drawing, with its craters, mountains, rills, with all details of the part of the lunar surface adjacent, were next modelled in clay, and from the clay models, after they were dried and corrected by further telescopic observation, plaster casts were taken. These casts were then carefully illuminated to throw shadows similar to those projected by the objects when the drawing was made, and finally they were photographed. By such an unexampled expenditure of time and skill, were obtained those contrasts of light and shade, and delicate half tints, which make the Nasmyth lunar drawings so exquisitely beautiful.

To the instructive writings on lunar subjects by Webb, Elger and other popular writers, it is needless to refer. Nor need mention be made of the writings and eloquent addresses on these subjects by the late Prof. Proctor. His works speaks best for themselves to all who care for astronomical instruction.

The most complete treatise accessible to English readers concerning the moon is that published a few years since for Mr. E. Neison, F. R. A. S. Professedly based on the great work of Beer and Mædler, it has original merit, and not only includes his own observations for eight years, but those of Mr. Webb and other observers who aided him in his work, and also contains much interesting matter from the works of Schrœter and of Lohrman. His instruments were of the best class, and included a fine 6 in. refractor, and a 9½ in. With-Browning silvered glass reflector. The lunar map accompanying his book is in twenty-two sections, and is on a scale of two feet to the moon's diameter. Though his chart is more than a third smaller than that of Beer and Mædler, it is finely engraved, shewing more formations than are given in their map, and more rills than are shewn by Schmidt in his "*rillen an dem Mond.*"

Neison groups the lunar surface under the names of plains, craters and mountains. His plains include all the large, dark, comparatively smooth tracts, called by the early selenographers *Maria*; the smaller tracts they named *Palus*, *Lacus*, *or Sinus*, and the brighter, smooth tracks which previously had received no name. For easy reference he divided the lunar craters into walled-plains, mountain-rings, ring-plains, crater-plains, craters, craterlets, crater-pits, crater-cones and depressions. His special names for the lunar mountains are great ranges, highlands, mountain-peaks, peaks, hill-lands, plateaus, hills, mountain-ridges and land swells. These are arbitrary divisions, intended solely to shorten the printed descriptions and make them definite. To these groups are added the rills, or peculiar markings first noticed by Schrœter, that have somewhat the appearance of river-beds, but which some take to be fissures in the moon's crust. Several years since, Schmidt had a list of five hundred of these peculiar lines, and to present date that number is more than doubled.

Neison retains the names Beer and Mædler gave the four hundred and twenty-seven formations shewn on their map. To these he adds eighty-six others, making his map contain in all five hundred and thirteen formations. Each of these is described in the order of its place, and for easy reference an alphabetical list is also given. For every formation he cites the authority for its name and degree of brightness, and for craters and plains he gives their dimensions, and for mountains their height. The position in lunar latitude and longitude is given for each formation, in most cases to minutes, in some to seconds. Minute particulars are also furnished respecting parts of special interest, with name of observer and date of observation. Tables and formulæ to aid in computation are given, that the book may be of service to students desirous of engaging in original work. In proof of the merit of this book it was translated into German so soon as published.

Photography has been pressed into service for taking views of the moon. Dr. Henry Draper, of the University of New York, many years ago took excellent lunar pictures, using a silvered glass speculum he himself made, and mounted especially for taking lunar photographs. Prof. Rutherford, of New York, afterwards carried the art to still greater degrees of excellence ; and although he had competitors in all parts of the world, a most competent judge, writing in the latest edition of the Encyclopædia Britannica, pays Mr. Rutherford the compliment of calling his the best photographs of the moon that had then been taken. During the decade just past, excellent lunar pictures have been taken at many of the great astronomical observatories in various parts of the world; those from Paris and from the Lick and Yerkes observatories being widely known and highly esteemed.

The field of lunar investigation is large, its laborers many, and the task of lengthening the bead roll of discoverers already given would be easy and pleasant. But to add to this lengthy list were needless, if not wearisome. Moreover the names referred to fairly indicate the chief sources of positive knowledge concerning the moon, and the progressive efforts by which that knowledge has been obtained. There is a wide difference between the "perspective glass" of Galileo, which made the moon look nine times larger, and modern telescopes with magnifying powers of six thousand diameters. The optical part alone of a great modern instrument costs a handsome fortune, and its mounting and outfit of accessory instruments are costly, taxing as they do the resources of mechanical engineering and scientific skill. With such well equipped observatories, and the accumulated records of a century at command, one might suppose that knowledge concerning the moon would be nearly perfect. But science moves at a slow pace, and is more bent on gathering facts for inductions than in forming crude inductions from imperfectly ascertained facts. The man of science has to curb imagination tighter than in other days, and has learned to speak on many subjects with more diffidence than did his predecessors. A hundred years ago the elder Herschel believed the moon to be inhabited, and after his time a learned man with an excellent telescope and keen vision—Gruithuisen, of Munich—wrote a scientific paper, entitled, *Entdeckung deutlicher spuren der Mondbewohner*—discovery of clear traces of the moon's inhabitants. It is not conceivable that such a paper could now be written in earnest. Since that paper was written such visionary notions have found little credence. The work of Beer and Mædler defined the legitimate boundary of lunar investigation.

An object 300 feet high and about a mile long is said to be approximately the minimum visible with a modern large refracting telescope, with usual low power ocular. With highest oculars, and best conditions of observation, a detached object, 40 feet high, projecting its shadow on a level surface might be perceptible. Beer and Mædler take 3⅓ English miles to be the extreme distance at which a person of keen, unassisted vision can distinguish an object 6 feet high, and estimate that it would require a telescope to magnify 51,000 diameters to shew such an object on the moon. Not much more than a tenth part of such magnifying power is at present available. The moon's disk subtends an angle of about half a degree, and mapping the lunar surface into 360 degrees of latitude and longitude, a lunar degree at the centre of the disk measures nearly 19 miles. Little that man has wrought on earth, could his most gigantic work be transferred to the moon, would attract much if any notice at the earth's distance, though if man's handiwork would pass unnoticed, no important lunar formation could now disappear or be materially changed, and elude detection. At the centre of the moon's disk, one second of arc equals 1.1585, more than one and a tenth English miles. What portion of the star-sphere a second of arc covers may be realized by calling to mind, a linear foot subtends a second of arc at 39 miles distance, and that the pole-star and its companion are 18 seconds of arc apart.

In the present stage of research there is divergence of opinion on many questions of lunar physics, though not more than might be expected from independent investigation. Bessel estimated the moon's atmosphere to be a thousandth the density of that of the earth, while Neison considers it to be greater than Bessel's estimate. Nasmyth, on the other hand, concludes that the moon is devoid of water, atmosphere and soil, and excepting contraction and expansion of the lunar crust from change of temperature, he thinks the moon now undergoes but little change. That there is great variation of temperature on the moon's surface from exposure for half a lunation to the sun, and from radiation of lunar heat into space for a like period admits of no doubt. The six foot speculum of Earl Ross' great telescope was, some years since, used for investigating the probable temperature of the moon. Earl Ross considered his researches tentative, and results approximate only. From his experiments and observations it was concluded that the difference between maximum and minimum temperature at the moon's surface is 200 degrees Centigrade. This difference in temperature between lunar mid-day and midnight was computed from measurement of the moon's radiant heat. This agrees in part with Sir John Herschel's estimate of the moon's climate. He writes: "The lunar "day is one of unmitigated burning sunshine, fiercer than an "equatorial noon, continued for a time equal to our fortnight, and "the lunar night is a period of the keenest severity of frost, exceed-"ing that of our polar winter, and of the same length as the "lunar day."

Neison's theory of the moon, in the main, is similar to that made popular by Mr. Proctor. They contend : the primary substance of both earth and moon was the same, and the forces by which both were fashioned to what they now are must be analogous in nature if not in intensity. And further, as the earth has thirteen and a-half times more surface than the moon, and eighty-one times greater mass, the moon will run through a series of physical changes common to both, proportionately sooner than the earth, or in about one-sixth of the time.

There are few sights more impressive than a telescopic view of the moon. The deep stillness reigning alike over crater, plain and mountain is almost appalling, till one considers that this busy earth, at the same distance, would seem to be as still. Opportunity to behold the glory of the heavens, revealed by a great telescope, is given to but a few. Still, who that has once watched, through but ever so small a glass, the peaks of some crater or mountain of the moon slowly emerge from the gloom of lunar night till they stand revealed in sparkling sunlight, intensified and made more glorious by the cool, dark grey lunar shadows, can ever forget the sight?

But lunar studies have higher aims than to measure and name every grey spot on the moon's face, or to watch the flight of lunar gloom before the radiance of the advancing sun. To the best student of lunar phenomenæ, maps and measurements are but scaffolding to the building, means to higher ends. Such an enquirer is not stung by the satire of gruff old Butler, who lashed the dilletanti philosophers of his day for longing to know :

"Whether the moon be sea or land
"Or charcoal, or a quenched firebrand,
"Or if the dark holes that appear
"Be only pores, not cities there."

How successfully these and kindred studies have already compassed such higher ends by aiding the progress of civilization, and by furnishing a clue to a higher conception of the universe; and how the humblest sincere student may always find in their pursuit unsullied intellectual gratification, may the latest section of our Association, the Hamilton Astronomical Society, abundantly succeed in making known.

REPORT OF THE CAMERA SECTION

of the Hamilton Scientific Association for the term ending May, 1902.

During the year there have been added to the membership 18 new names, among them a considerable number of ladies. These contain the names of some who are well known in photographic circles as leaders in the art, and the section will be much benefitted by their presence.

At the beginning of the season it was decided not to join the American Lantern Slide Interchange, although the reason does not reflect great credit upon the members of the section. It was found that a sufficient number of good slides could not be got ready in time, and so the matter dropped for the year. As stated in the report last year, the making of interchange slides has always been left too late, and with the Exhibition almost at the same time of the year, it is a mistake to leave the interchange set to the last minute. Although it should not be necessary yet to stimulate the members to work to this end, your President early in the season offered a gold medal for the set of six slides that should be considered the best, handed in before the 1st May, 1902. It is to be hoped that there will be a hearty response to the generosity of the section's head officer.

There has been a considerable number of very useful demonstrations during the year. Mr. J. S. Gordon gave a fine lecture on "Composition;" the Demonstrator of the Canadian Kodak Co. showed the virtues of Dekko paper; Mr. J. R. Heddle gave several demonstrations of Reducing and Enlarging; Cloud Printing by Mr. Harry Tansley; and Flower Photography is at present booming, owing to the recent exposition on its merits by Mr. J. Gadsby.

Our President, in the interest of his health, visited the scenes of his childhood days in the old country, and brought back with him several films. These pictures were made the basis of one of the most interesting illustrated lectures of the year. Another member on business bent visited the old land, accompanied by a 4 x 5 Poco. Your Secretary is to-night on the high seas on his return from a trip to the Holy Land, having visited Egypt, etc. Rumor has it that when he started out he was threatened with extra charges for excess baggage, consisting of cameras, films, plates, etc., but of course no credence can be placed on such reports. Messrs. J. H. Land and W. A. Lees gave us an illustrated talk on our "Western Provinces and Territories."

Through the generosity of the *Spectator* Printing Company, who gave us $50 for prize money, the section's annual exhibition of photographs was perhaps the best in the history of the Club. Early in the year circulars were printed and distributed to Camera Clubs in Canada, United States and Great Britain, announcing three open classes in the competition to be held in November. The response to this was very gratifying, bringing pictures from United States and Canada. There were also closed classes for members only, and the prizes included cash as well as two medals which accompany the two trophies for annual competition. In the open classes the pictures sent by members of the Toronto Camera Club claimed a large share of the money, Mr. J. Gadsby of the section holding first place in Class C. In the members' classes the awards were as follows: Figure Study, W. Mulvaney; Landscape, Harry Tansley; Marine, A. H. Baker; Enlargements, G. F. Hunt; Beginners, H. A. Whitney and G. B. Kemp. The 1st trophy and gold medal for general excellence was won by A. H. Baker, and the 2nd trophy and silver medal by W. Mulvaney.

Considerable improvement has been made in the Dark Rooms. A set of twelve large lockers has been added, and probably more might be made use of. The enlarging apparatus is still the point around which a good deal of discussion revolves, and it remains for the officers of the ensuing year to remedy the same.

The prospects for the coming year are very bright and encouraging. Everything points to greater activity among the members. Several new cameras have appeared on the scene and more has been promised—the latest, the newest that's out—and all of us have had experiences of the man with a new box. Our exhibitions are beginning to show that our members are not of the press-the-button style, but have learned that picture-making means careful selection of subject and study to bring the best out of the materials at hand.

Respectfully submitted,

D. A. SOUTER,
Secretary pro tem.

NATURAL HISTORY NOTES.

Read before the Biological Section of the Hamilton Scientific Association.

BY WM. YATES.

Quite a big snow fall came upon us on Monday night, Dec. 9th, and brought with it to our fields a vast assemblage of snow buntings. My grandchildren admired the birds' evolutions much, as anon the white feathered chirrupers wheeled and careered from side to side of the oat stubble and cornfield. The snow also brought to our vicinity what the gunner boys who gave chase called a white eagle. After several futile gun discharges the quarry was discovered to be a large snowy owl. The bird soon distanced its sanguinary pursuers and found safe refuge, for a time at least, in a neighboring cedar swamp. The white owls are rare vistors to this district (very).

During the summer (last July), I think some boys near here noticed several small cub racoons making calls of distress high up amid the branches of an elm tree in the swamp. The tree was forthwith cut down and three of the young procyons captured, not much the worse for the fall to terra firma. The cubs were half starved and somewhat emaciate; the supposition is that the parent coons had been trapped or killed some days previously. The racoons are now owned not far from here, and fed and petted in kennels. A young man who has one of the procyons has also a large, captive, horned owl (*Strix Virginiana*). The man tells one that the owl is confined in a big cage in the poultry house, and the captor gives forth its strange, ghostly hootings in the dread hours of midnight and at occasional other trysting hours (indicating, perhaps, weather changes), occasioning evident consternation to the tame poultry roosting in the same fowl house.

My son, since the beginning of this week, accompanied a youth out on a hunt. They, by the help of our terrier, captured two fine minks and several gray rabbits. Red squirrels they report of as being numerous, also ruffed grouse. Our chicadee friend, too, have put in their usual appearance at the tree where they are accustomed to find a beef bone suspended, and the tree creepers are never-failing denizens of the sugar bushes.

The last snowfall (on Sunday last), after the flooding rain of the 13th and 14th of December, caused the snow bunting flock to be again much in evidence; a reliable observer estimated the group as numbering at least 1,500. On enquiry, when on our recent visit to Georgian Bay region and to vicinity of Barrie, Ontario, we were told that flocks of snow buntings were believed to be very rare, indeed, visitants to that section of country.

MISDIRECTED ABILITIES.

After having an hour or two of reading in the pages of Prof. Wesley Mill's "Nature and Development of Animal Intelligence," we put pen to paper to memorandize a few thoughts about some useful animals whose idiosyncracies chanced to come under our observation. Animal intelligence seems to be an inert, dormant or latent quality, quite undemonstrative until "drawn out" or developed by environment, or the circumstances that induce what is termed experience.

We once owned a puppy of the Collie breed, but had no leisure to devote effort to his training; the beastie grew to be affectionate and to have many traits of intelligence, susceptibility and much gentleness towards children, also evident love of being noticed and caressed, and was of some service in helping to herd cattle and to keep various farm animals (when the dog was bidden), "in the ways that they should go." "Bruin" was the name bestowed on the puppy, and he grew to be a very rough-haired specimen of the reputable Collie breed, and soon evidenced a hankering or desire to prefer the society of sheep to that of other farm animals. "Bruin's" instincts in this direction were not utilized by his owners, and the propensity to follow sheep and to bark at and control their movements and wanderings soon became spontaneous, and therefore dangerous to the well-being of the ovine denizens of the neighboring pastures. In such undirected wanderings "Bruin" soon fell into the company of tatterdemallion canines that kept bad hours, and his owners soon began to have apprehensions that Bruin would attain to the unenviable notoriety of being a "sheep-killer," so he was for a time carefully kept chained to his kennel, yet otherwise kindly treated and well fed, on account of his general amiability and faithfulness, except in the one dangerous direction. In an unlucky day, or night, seduced, as was believed, by evil counsels of canine associates, Bruin wandered towards neighboring sheep-folds and met his death by the rifle bullet of an irate stockman of the vicinity. So the moral of it all seems to be that qualities and biases if not wisely modified and judiciously directed, become evils and scourges in exact proportion to their aboriginal energy and vigor.

The oft alluded to anecdote of the discouraged school-master, who, on being railed at by one of the parents of a non-progressive pupil, gave as a reason for said pupils being always at the bottom of his class: "My dear friends, I fear that the boy's unsatisfactory status is attributable to his having no capacity." "Oh," replied the guardian, "he need no longer be kept back on that account, for we will buy him a 'capacity.'"

It may be oftened noticed by farmers what a vast difference there is in the temperment and quickness of apprehension of farm animals, some being stolid and imperturbable, while others are habitually suspicious, irritable, or what is called in a perpetual state of aggressiveness and irascibility, individuality being as well marked a trait perhaps in all the inferior forms of animal life as it is seen to be in the genus "Flomo."

A volume might be written truly describing the peculiarities of constitutional temper, disposition and mental traits, and leanings and investigating powers of the various creatures that are to be met with on every farm. The farmers' tact seems often to consist in the exercise of prudent, selective work, and to repress the perhaps "too wide-awake" and self-resourceful peculiarities of some tribes of stock, such as are to be kept and pampered in monotonous quietude on the most nourishing food rations in rapid route to the abbattoir, while others may be better utilized by deliberate training, mental and sinewy qualities, as in the cases of "breaking in the horse, ox or dog." The semi-wild cattle of the ranch, in their struggles with their compeers and with numberless dangers of circumstantial surroundings, soon evince acuteness to "size up" a sudden danger or a suspicious ambuscade, in short a higher phase of intelligence and craftiness than those well-groomed congeners (rarely out of the range of the cattle byre, or the smell of the hay manger) ever give evidence of.

Those farm animals most servicable in harness, as in plow or other team work, are often characterized by sound digestion, vigor of constitution, and are in fact sometimes too enterprising, and when liberated in the pastures outwit their owner by disregard of fence boundaries and unlimited self-help in indulgence of luxurious tastes, amid oatfield preserves or the stores of blossoming clover.

Farmers have frequently been heard to remark: "My Nimrod's super-excellent qualities, I regret to have to tell, are nearly counter-balanced by his incurable breachiness;" or, "he is an invaluable treasure on farm or road, but a piratical brute when out of harness, and I believe that if he wished to sample a bit of choice pasture he would jump a stake and ridered barn."

Probably one might sum up that the mystic superstructure (a sort of metaphysical germ, capable of almost illimitable development), exists at the fount of life, and is shown in the life doings and possibilities in beast, bird and insect. The horse tamer, Rarey, had among men one of the clearest conceptions of that truth. But we assert that all the domestic animals are easily seen to exemplify the assumption of truism: when the spirit is evoked in farm animals one has heard the trait alluded to as Satanic, demoniac, and is often at its climax in the fox or the crow among birds, or the jay genus, but it has been known to arrive at considerable maturity in the sheep, as well as very frequently in porcines, and perhaps being more under the notice of the average man in equines.

A pair of blue-jays were once made pets of here, and their behaviour was a surprise to numberless beholders, so much so that a spectator bought a pair of just fledged jays, but after some months of their cage-life, turned the birds out in disappointment and vexation as nasty, squalling, gormandizing brutes. Said a critic to the jay cage owner, "Oh, what could you expect, when you know that you never took any trouble to draw them out."

CURATOR'S REPORT.

All the glass cases loaned on May 9th, 1901, to the museum at Dundurn, which had contained Mrs. Carry's collection of shells, have been returned, thereby enabling the collections in this museum to be rearranged to much greater advantage. There have not been very many additions to the collections during the year. The museum has been open to the public every Saturday, when many visitors have expressed themselves as having been much interested.

The Geological Section still has the able attention of Col. Grant, who has added largely to the museum.

I have lately received from a nephew in England a collection of fossils from the chalk formation of that country; also some Roman coins, which will be placed in the museum at some future day, when a proper receptacle is provided for them.

ALEX. GAVILLER,
Curator.

TREASURER'S STATEMENT TO 8th MAY, 1902.

RECEIPTS.

Balance from 1901	$187 75
Government Grant	400 00
Members' Fees	88 00
Horticultural Society, Rent	13 50
Refund	50
	$689 75

DISBURSEMENTS.

Rent of Museum	$138 00
Rent of Dark Room, Photographic Section	18 00
Caretaker, $42.00 ; extra work, $17.50	59 50
Gas Account	7 80
Printing and Engraving	41 75
Printing Annual Journal	135 00
Postage and Stationery	20 50
Lectures and Expenses	40 05
Grant to Photographic Section	30 00
Insurance	10 00
Sundry Accounts	21 09
Balance on hand	168 06
	$689 75

P. L. SCRIVEN,
Treasurer.

REPORT OF THE CORRESPONDING SECRETARY FOR THE SESSION OF 1901-1902.

To the Officers and Members of the Hamilton Scientific Association :

Your Corresponding Secretary for the year 1901-1902 begs leave to report that :

1. He has carried on the ordinary correspondence of the Association.

2. He has received and acknowledged the exchanges in accordance with the subjoined list of institutions and societies, and these various bodies have also been furnished with copies of our last annual "Journal and Proceedings."

F. F. MACPHERSON.

LIST OF EXCHANGES.

I—AMERICA.

(1) CANADA.

Astronomical and Physical Society............Toronto.
Canadian Institute..........................Toronto.
Natural History Society of Toronto...........Toronto.
Department of Agriculture ....Toronto.
Library of the University....................Toronto.
Public Library ....Toronto.
Geological Survey of Canada ....Ottawa.
Ottawa Field Naturalists' Club...............Ottawa.
Ottawa Literary and Scientific Society.........Ottawa.
Royal Society of Canada....................Ottawa.
Department of Agriculture ....Ottawa.
Entomological Society.......................London.
Kentville Naturalists' Club..................Kentville, N. S.
Murchison Scientific Society.................Belleville.
Natural History Society.....................Montreal.
Library of McGill University ....Montreal.
Nova Scotia Institute of Natural Science.......Halifax.
Literary and Historical Society of Quebec.....Quebec.
L'Institut Canadien de Quebec ....Quebec.
Natural History Society of New Brunswick.....St. John.
Manitoba Historical and Scientific Society .....Winnipeg.
Guelph Scientific Association................Guelph.
Queen's University ....Kingston.
Niagara Historical Society..................Niagara.

(2) UNITED STATES.

Kansas Academy of Science..................Topeka, Kan.
Kansas University Quarterly.................Lawrence, Kan.
American Academy of Arts and Sciences......Boston, Mass.
Psyche.....................................Cambridge, Mass.

Library of Oberlin College	Oberlin, Ohio.
American Association for Advancement of Science	Salem, Mass.
Museum of Comparative Zoology	Cambridge, Mass.
American Dialect Society	Cambridge, Mass.
United States Department of Agriculture	Washington, D. C.
Biological Society of Washington	Washington, D. C.
Philosophical Society of Washington	Washington, D. C.
Smithsonian Institution	Washington, D. C.
United States Geological Survey	Washington, D. C.
American Society of Microscopists	Buffalo, N. Y.
Buffalo Society of Natural Sciences	Buffalo, N. Y.
California Academy of Sciences	San Francisco, Cal.
California State Geological Society	San Francisco, Cal.
Santa Barbara Society of Natural History	San Francisco, Cal.
University of California	Berkley, Cal.
Minnesota Academy of Natural Sciences	Minneapolis, Minn.
Academy Natural Sciences	Philadelphia, Pa.
Academy of Sciences	St. Louis, Mo.
Missouri Botanical Gardens	St. Louis, Mo.
American Chemical Society	New York City.
New York Microscopical Society	New York City.
The Linnean Society	New York City.
American Astronomical Society	New York City.
American Geographical Society	New York City.
New York Academy of Science	New York City.
Terry Botanical Club	New York City.
Central Park Menagerie	New York City.
American Museum of Natural History	New York City.
Scientific Alliance	New York City.
Cornell Natural History Society	Ithaca, N. Y.
Johns Hopkins University	Baltimore, Md.
Kansas City Scientist	Kansas City, Mo.
Wisconsin Academy of Science, Arts and Letters	Madison, Wis.
Society of Alaskan Natural History and Ethnology	Sitka, Alaska.
University of Penn	Philadelphia, Pa.
Franklin Institute	Philadelphia, Pa.

Brooklyn Institute of Arts and Science .... Brooklyn, N. Y.
War Department .... Washington, D. C.
Field Columbian Museum.................. Chicago, Ill.
Academy of Sciences...................... Chicago, Ill.
Agricultural College...................... Lansing, Mich.
Colorado Scientific Society .... Denver, Col.
Museum of Natural History .... Albany, N. Y.
State Geologist........................... Albany, N. Y.
Rochester Academy of Sciences............. Indianapolis, Ind.
Indiana Academy of Sciences............... Indianapolis, Ind.
Davenport Academy of Natural Sciences....... Davenport, Iowa.
Pasadena Academy of Sciences .... Pasadena, Cal.
U. S. Board of Geographic Names............ Washington, D. C.
Lloyd Library............................ Cincinnati, O.
Colorado College......................... Colorado Springs.
University of Montana .... Missonla, Mont.

(3) WEST INDIES.

Institute of Jamacia....................... Kingston, Jamacia.

(4) SOUTH AMERICA.

The Royal Agricultural and Commercial Society
of British Guiana...................... Georgetown.

(5) MEXICO.

Instituto Geologico de Mexico............. . Mexico, D. F.

II—EUROPE.

(1) GREAT BRITAIN AND IRELAND.

ENGLAND.

British Naturalists' Club .... Bristol.
Literary and Philosophic Society of Leeds ..... Leeds.
Conchological Society .... Leeds.
Royal Society............................ London.
Royal Colonial Institute .... London.
Society of Science, Literature and Art......... London.
Geological Society .... London.
Manchester Geological Society.............. Manchester.

Mining Association and Institute of Cornwall...Camborne.
Cardiff Photographic Society ....Cardiff.
Owens College Conchological Society ....Manchester.

SCOTLAND.

Glasgow Geographical Society...............Glasgow.
Philosophical Society.........................Glasgow.

IRELAND.

Royal Irish Academy.......................Dublin.
Royal Geological Society of Ireland...........Dublin.
Naturalists' Field Club.....................Belfast.

(2) AUSTRIA-HUNGARY.

Anthropologische Gesellschaft.................Vienna.
K. K. Geologische Reichsanstalt ....Vienna.
Trentschin Scientific Society..................Trentschin.

(3) BELGIUM.

Societe Geologique de Belgique..............Liege.

(4) DENMARK)

Societe Royal des Antiquaires du Nord........Copenhagen.

(5) FRANCE.

Academie Nationale des Sciences, Belles Lettres et Arts...............................Bordeaux.
Academie Nationale des Sciences, Arts et Belles Lettres...............................Caen.
Academie Nationale des Science, Art et Belles Lettres...............................Dijon.
Societe Geologique du Nord..................Lille.
Societe Geologique du France...............Paris.

(6) GERMANY.

Naturwissenschaftlicher Verein...............Bremen.
Naturwissenschaftlicher Verein...............Carlsruhe.

(7) RUSSIA.

Comite Geologique...........................St. Petersburg.
Russich-Kaiserliche Mineralogische Gesellschaft.St. Petersburg.

III.—ASIA.

(1) INDIA.

Asiatic Societies of Bombay and Ceylon.
Asiatic Society of Bengal .... Calcutta.
Geological Survey of India .... Calcutta.

(2) STRAITS SETTLEMENTS.

The Straits Branch of the Royal Asiatic Society .. Singapore.

(3) JAPAN.

Asiatic Society of Japan .... Tokyo.

IV.—AFRICA.

(1) CAPE COLONY.

South African Philosophical Society .... Capetown.

V.—AUSTRALIA.

(1) AUSTRALIA.

The Australian Museum .... Sydney.
Royal Society of New South Wales .... Sydney.
Linnean Society of New South Wales .... Sydney.
Royal Anthropological Society of New South Wales .... Sydney.
Australian Natural History Museum .... Melbourne.
Public Library of Victoria .... Melbourne.
Royal Society of Queensland .... Brisbane.
Queensland Museum .... Brisbane.

(2) NEW ZEALAND.

New Zealand Institute .... Wellington.

(3) TASMANIA.

Royal Society of Tasmania .... Hobartown.

OBITUARY.

MR. A. E. WALKER.

In his eighty-second year, Mr. Alfred E. Walker passed away April 17th, 1902, respected and beloved by all who knew him. Although a gentleman of retiring disposition, and of by no means robust health, he nevertheless took a keen interest in affairs of the Hamilton Scientific Association, and did much work to promote its welfare.

Mr. Walker repeatedly occupied the office of Vice-President of the Association, and was also President of its Geological Section. Blessed, as he was, with a sympathetic disposition and versatile talents, the specific work of no Section of the Society was altogether foreign to him, or devoid of interest. He was not unmindful of the grain of wise counsel in the adage which enjoins us "to know something of everything," and took still greater heed of the complement to that adage which bids us "know everything of something." Geology, and the fossil life of the strata exposed in the Hamilton escarpment, were his favorite study. Col. Grant, his collaborator for more than a third of a century, pays touching tribute to the memory of his friend, and gives unequivocal testimony to the thoroughness and value of his study of the rocks and fossils of this district.

Mr. Walker, Col. Grant writes, "possessed a thorough knowledge of the Palæontology of several Geological formations. An outline of two of his addresses on *Coral and Stromatoporoids* was published, though their most interesting portions were verbal and not reported. He skilfully prepared sections of the recently discovered Niagara Chert Sponges, and was the first to point out internal differences among the genera *Aulocopina*, a family of fossil sponges named by Billings, and found as yet only in this vicinity. Dr. Head, of Chicago, lately named a newly discovered fossil sponge *Aucolopina Walkeri*, in honor of our friend."

Like all generous men, Mr. Walker took delight in sharing with others the results of his own investigation, and his enthusiasm for the study of nature influenced for good all his friends.

THE LATE A. E. WALKER.

THE LATE DR. REYNOLDS.

DR. REYNOLDS.

Dr. Reynolds was born at Brockville, Ontario, June 6th, 1858, and died at Baltimore, Maryland, June 9th, 1902. He was the son of the late Thomas Reynolds, M. D., one of the old practitioners at Brockville. He was educated at the Public Schools of Brockville, and McGill University, Montreal, where he took his medical degree in 1881. For a time he practised his profession in Hamilton, and in 1885 was appointed to the Medical Staff of the Hamilton Asylum as Junior Physician. With the exception of a short interval of a few months at the Mimico Asylum, his whole official career was spent at the Hamilton Asylum, where he had risen by promotion to the position of Assistant Medical Superintendent.

In 1890 he married Miss Mary L. Logie, daughter of the late Judge Logie, of Hamilton, who with one daughter survives him. A sister, now deceased, was the wife of Dr. Malloch, of Hamilton, and a brother, E. J. Reynolds, K. C., was recently appointed a deputy Judge at Brockville.

About the beginning of the present year his health began to fail and he went to Southern Pines, North Carolina, to recuperate, accompanied by his wife and daughter. They were on their way home and had stopped off at Baltimore to consult Dr. Osler, when he suddenly became worse and was taken to Johns Hopkins Hospital, where he received every attention which medical skill could suggest, but he gradually sank and died the following day from lung disease.

From 1881 to the time of his death, Dr. Reynolds was an active member of this Association. His services in connection with the Biological Section, in which he was for a number of years a faithful office-bearer, were especially valuable. In 1893 he became a Vice-President of the Association, succeeding in 1898 to the Presidential chair. The two years of Dr. Reynolds' occupancy of that office will rank among the most successful in the history of the Association.

Dr. Reynolds belonged to the Anglican Church, being a very active member of St. Thomas' Church, Hamilton. He was a prominent Mason and a Past Master of Barton Lodge. He was also a member of the Independent Order of Oddfellows, of which Order his father was the first Grand Master in Ontario. He was a member of the American Medico-Psychological Association, and was present at the meeting held in Milwaukee in 1901.

He was a most lovable man, kind, gentle and charitable in disposition, and ever ready to lend a helping hand to his fellows. He had a wide field of operation for his generous nature in the great Institution with which he was for 17 years connected. His early death, in the midst of his usefulness, was greatly lamented by those with whom he was associated officially, and also by a large circle of relatives and friends who had learned to love and appreciate his noble, manly, Christian character.

THE LATE A. W. STRATTON,
Principal Oriental College, Lahore, British India.

A. W. STRATTON, Ph. D.

Intelligence comes from India that Dr. Stratton passed away at Gulmarg, Kashmir, whither he had gone for his summer vacation. From 1899 to the time of his death, Mr. Stratton was Principal of the Oriental College in Lahore, and Registrar of the Punjab University, a position of marked responsibility and honor, in which he was immediately preceded by Dr. Stein, an Indianist of high reputation. By the death of Dr. Stratton, at the early age of thirty-eight years, Oriental scholarship loses from its ranks an earnest worker of great promise, and the native born alumni of government colleges in the Northwest Provinces of British India mourn the loss of an able, sympathetic and conscientious educationalist.

Dr. Stratton graduated at the Toronto University in 1887, was appointed to a fellowship at Johns Hopkins University in 1893, and was docent in sanskrit to the University of Chicago from 1896 to 1898, when he received his Indian appointment to Lahore.

For some years Mr. Stratton was on the teaching staff of the Collegiate Institute of this city, and was Secretary of the Hamilton Association for the promotion of science. In both these positions, his kindly disposition and love of learning won him the esteem and affection of those who knew him. The dirge of Matthew Arnold over the beloved brother, who also died at his post as instructor of his Indian fellow subjects, now alas, supplies a too fitting epitaph for Dr. Stratton.

> "Pondering God's mysteries untold
>   And tranquil as the glacier-snows,
> He by those Indian mountains old
>   Might well repose."

LIST OF MEMBERS

OF THE HAMILTON ASSOCIATION.

HONORARY.

1881 Grant, Lt.-Col. C. C., Hamilton.
1882 Macoun, John, M. A., Ottawa.
1885 Fleming, Sanford, C. E., C. M. G., Ottawa.
1885 Farmer, William, C. E., New York.
1885 Small, H. B., Ottawa.
1887 Charlton, Mrs. B. E., Hamilton.
1887 Dee, Robert, M. D., New York.
1887 Keefer, Thomas C., C. E., Ottawa.
1890 Burgess, T. J. W., M. D., F. R. S. C., Montreal.
1891 Moffat, J. Alston, London.
1898 Carry, Mrs. S. E., Hamilton.
1899 Stratton, A. W., Ph. D., Lahoore, India.

CORRESPONDING.

1871 Seath, John, M. A., Toronto.
1881 Clark, Chas. K., M. D., Kingston.
1881 Spencer, J. W., B. Sc., Ph. D., F. G. S., Savannah, Ga.
1882 Lawson, A. C., M. A., California.
1884 Bull, Rev. Geo. A., M. A., Niagara Falls South.
1885 Frood, T., Sudbury.
1889 Yates, Wm. Hatchley.
1889 Kennedy, Wm., Austin, Texas.
1891 Hanham, A. W., Quebec.
1891 Woolverton, L., M. A., Grimsby.
1901 Herriman, W. C., M. D.
1902 Ami, Dr. H. M., Ottawa.

LIFE.

1885 Proudfoot, Hon. Wm., Q. C., Toronto.

ORDINARY.

Adam, Jno.
Alexander, A., F. S. Sc.
Alexander, A. G.
Appleton, L. G.
Asman, H. O., B. A.
Aylett, Fred.
Ballard, John F.
Baker, A. H.
Bale, F. J.
Baldwin, T. O.
Barton, Geo.
Beasley, Thos.
Beasley, Mrs. Thos.
Beavis, Rev. H. S.
Bertram, Jas. B.
Berry, H. G.
Bicknell, H. H.
Black, Geo.
Blatz, Adam
Brown, Adam
Brown, Hillhouse
Broughton, Benj.
Brady, Rev. R. E. M.
Briggs, Samuel
Brunke, Amande
Burkholder, J. G. Y.
Burns, J. M.
Burnside, J. W.
Campbell, Mrs. C. C.
Campbell, D. J.
Campbell, Robt.
Campbell, Mrs. Robt.
Campbell, C. C.
Campbell, Mrs. C. C.
Campbell, R. W.
Caswell, Rev. W. B.
Castell, Alex.
Carrol, Robt.
Childs, W. A., M. A.
Clark, D., D. D. S.
Cloke, J. G.
Clappison, Fred P.
Cockburn, Dr.
Connor, A. W.
Coburn, H. P.
Cochran, C. S.
Connors, Mr.
Crawford, A.
Cunningham, A. M.
Culham, J. A.
Cummer, Albert
Cummings, S., M. D.
Darling, E. H.
Dickson, J. M.
Eastwood, John M.
Easter, S.
Fearman, F. W.
Fearman, R. C.
Findlay, W. F.
French, Thos.
Gadsby, J.
Gaviller, Alex.
Gaviller, E. A., M. D.
Gill, Jas., B. A.,
Gordon, John
Graham, C. O.
Grant, W. J.
Grant, A. R.
Greene, Joseph J.
Grossman, Julius
Hansel, Franklin, D. D. S.
Haldane, J. G.

Hardy, Capt.
Heddle, J. R.
Hedley, R. W.,
Holcroft, C. J.
Hore, J. G.,
Hoyle, Chas.
Hobart, Geo.
Hooper, Wm.
Hoyle, R.
Howitt, Rev. F.
Hunt, Fred.
James, W. A.
Jones, C. J.
Jones, Herbert
Johnston, Geo. L., B. A.,
Kemp, Geo. B.
Land, J. H.
Lee, Lyman, B. A.
Lees, Geo.
Lees, W. A.
Leaney, C. A.
Leggat, Matthew
Lister, Miss E.
Logan, W. F.
Luxon, James
Lucas, E. H.
Magee, Frank
Marsden, Miss
Marsh, Rev. D. B., Sc. D.
Marsh, Mrs. D. B.
Millard, J. W.
Mitchell, W. M.
Milne, Chas. A., B. A.
Morrow, J. A. C.
Moodie, J. R.
Moodie, Jas.
Moodie, C. W.
Moore, H. S.
Morris, Thos. S.
Mulvaney, W.
McIlwraith, Thos.
McLaren, Col. Hy.
McKenzie, A. M.
Macpherson, F. F., B. A.
McPherson, A.
McPherson, Rev. N., B. D.
McMillan, Miss M. G.
Neill, A. T.
Nichol, C. O.
O'Dell, Alexander
Orr, Thomas
Overholt, A. M , M. A.
Patterson, P.
Pierce, Henry
Pothier, C. A.
Powis, A.
Roach, Geo.
Robinson, W. A.
Rounds, W. G.
Rogers, Thos. R.
Rutherford, Geo.
Salton, Rev. G. F., B.A., Ph.B.
Schuler, J.
Scriven, P. L.
Shannon, E. S.
Slater, James
Small, T. Chas.
Somerville, Wm.
Souter, D. A.
Street, F. A. B.
Strathy, Stuart
Strong, Roy
Sweet, J. C.
Tansley, Harry
Thompson, R. A., B. A.
Thompson, W. C.

Tolton, Stewart
Tyrrell, J. B., C. E.
Wegoner, Wilhelm
Wheatley, E. J.
Whitney, H. A.
Whitton, F. H.
White, Wm.
White, J. T.
Wilson, T.
Wilson, Wm.
Witton, H. B.
Witton, H. B., Jr., B. A.
Witton, W.
Williams, J. M.
Wodell, J. E.
Woolverton, Mrs. Dr.
Young, J. M.
Young, Rev. Jno., M. A.

OFFICERS FOR 1902-3.

President.

J. M. DICKSON.

1st Vice-President.

ROBT. CAMPBELL.

2nd Vice-President.

W. A. CHILDS, M. A

Corresponding Secretary.

F. F. MACPHERSON, B. A.

Recording Secretary.

G. L. JOHNSTON, B. A.

Treasurer.

P. L. SCRIVEN.

Curator and Assistant.

ALEX. GAVILLER.

J. SCHULER.

Council.

GEO. BLACK.

J. F. BALLARD.

J. H. LONG, M. A., LL. B.

J. R. HEDDLE.

J. M. WILLIAMS.

Auditors.

H. S. MOORE.

F. HANSEL, D. D. S.

JOURNAL AND PROCEEDINGS

OF THE

...Hamilton...
Scientific Association

SESSION 1902-1903.

NUMBER XIX.

CONTENTS.

AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR STATEMENTS MADE AND OPINIONS EXPRESSED THEREIN.

PRINTED FOR THE HAMILTON SCIENTIFIC ASSOCIATION BY SPECTATOR PRINTING COMPANY, LIMITED.

1903.

Journal and Proceedings

OF THE

HAMILTON SCIENTIFIC ASSOCIATION

FOR SESSION OF 1902-1903.

NUMBER XIX.

AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR STATEMENTS MADE AND OPINIONS EXPRESSED THEREIN.

PRINTED FOR THE HAMILTON ASSOCIATION
BY SPECTATOR PRINTING CO.

1903.

OFFICERS FOR 1902-1903.

President.

J. M. DICKSON.

1st Vice-President.

ROBT. CAMPBELL.

2nd Vice-President.

W. A. CHILD, M. A.

Corresponding Secretary.

F. F. MACPHERSON, B. A.

Recording Secretary.

G. L. JOHNSTON, B. A.

Treasurer.

P. L. SCRIVEN.

Curator.

ALEX. GAVILLER.

Assistant Librarian.

J. SCHULER.

Council.

J. M. WILLIAMS.

GEO. BLACK.

J. F. BALLARD.

J. H. LONG, M. A., LL. B.

J. R. HEDDLE.

Auditors.

H. S. MOORE.

F. HANSEL, D. D. S.

OFFICE-

	President.	First Vice-Pres.	Second Vice-Pres.
1857	Rev. W. Ormiston, D.D.	John Rae, M.D., F.R.G.S.	J.B.Hurlburt, M.A., LL.D.
1858	John Rae, M.D., F.R.G.S.	Rev. W. Ormiston, D.D.	J.B.Hurlburt, M.A., LL.D.
1859	Rev. W. Ormiston, D.D.	J.B.Hurlburt, M.A., LL.D.	Charles Robb
1860	Rev. W. Inglis, D.D.	T. McIlwraith	Rev. W. Ormiston, D.D.
1861	Rev. W. Ormiston, D.D.	J.B.Hurlburt, M.A., LL.D.	Rev. W. Inglis, D.D.
1871	W. Proudfoot	Judge Logie	Richard Bull
1872	Judge Logie	H. B. Witton, M.P.	Richard Bull
1873	H. B. Witton, M.P.	J. M. Buchan, M.A.	A. T. Freed
1874	H. B. Witton, M.P.	J. M. Buchan, M.A.	A. T. Freed
1875	H. B. Witton	J. M. Buchan, M.A.	W. H. Mills
1880	T. McIlwraith	Rev. W. P. Wright, M.A.	H. B. Witton
1881	J. D. Macdonald, M.D.	R. B. Hare, Ph.D.	B. E. Charlton
1882	J. D. Macdonald, M.D.	B. E. Charlton	J. A. Mullin, M.D.
1883	J. D. Macdonald, M.D.	B. E. Charlton	H. B. Witton
1884	J. D. Macdonald, M.D.	H. B. Witton	Rev. C. H. Mockridge, M.A., D.D.
1885	Rev. C. H. Mockridge, M.A., D.D.	Rev. S. Lyle	W. Kennedy
1886	Rev. C. H. Mockridge, M.A., D.D.	Rev. S. Lyle	Matthew Leggat
1887	Rev. S. Lyle, B.D.	B. E. Charlton	W. A. Child, M.A.
1888	Rev. S. Lyle, B.D.	T. J. W. Burgess, M.B., F.R.S.C.	W. A. Child, M.A.
1889	B. E. Charlton	T. J. W. Burgess, M.B., F.R.S.C.	J. Alston Moffat
1890	B. E. Charlton	J. Alston Moffat	A. T. Neill
1891	A. Alexander, F.S.Sc.	A. T. Neill	S. Briggs
1892	A. Alexander, F.S.Sc.	A. T. Neill	S. Briggs
1893	A. Alexander, F.S.Sc.	A. T. Neill	T. W. Reynolds, M.D
1894	S. Briggs	A. T. Neill	T. W. Reynolds, M.D.
1895	A. T. Neill	T. W. Reynolds, M.D.	A. E. Walker
1896	A. T. Neill	T. W. Reynolds, M.D.	A. E. Walker
1897	A. Alexander, F.S.Sc.	T. W. Reynolds, M.D.	A. E. Walker
1898	T. W. Reynolds, M.D.	A. E. Walker	J. M. Dickson
1899	T. W. Reynolds, M.D.	A. E. Walker	J. M. Dickson
1900	S. A. Morgan, B.A., D. Pæd.	J. M. Dickson	Wm. C. Herriman, M.D.
1901	S. A. Morgan, B.A., D. Pæd.	J. M. Dickson	Robt. Campbell
1902	J. M. Dickson	Robt. Campbell	W. A. Child, M.A.

BEARERS.

Cor. Sec.	Rec. Sec.	Treas.	Lib. and Cur.
T. C. Keefer, C.E....	Wm. Craigie, M.D...	W. H. Park.........	A. Harvey.
T. C. Keefer, C.E ...	Wm. Craigie, M.D...	W. H. Park.........	A. Harvey.
T. C. Keefer, C.E....	Wm. Craigie, M.D...	W. H. Park.........	A. Harvey.
Wm. Craigie, M.D...	Wm. Craigie, M.D...	W. H. Park.........	Chas. Robb.
Wm. Craigie, M.D...	Wm. Craigie, M.D...	W. H. Park.........	T. McIlwraith.
J. M. Buchan, M.A..	I. B. McQuesten, M.A.	W. G. Crawford.....	T. McIlwraith.
J. M. Buchan, M.A..	I. B. McQuesten, M.A.	W. G. Crawford.....	T. McIlwraith.
Geo. Dickson, M.A...	Geo. Dickson, M.A...	Richard Bull..... ..	T. McIlwraith.
Geo. Dickson, M.A...	Geo. Dickson, M.A...	Richard Bull........	T. McIlwraith.
Geo. Dickson, M.A...	Geo. Dickson, M.A...	A. Macallum, M.A...	T. McIlwraith.
R. B. Hare, Ph.B....	Geo. Dickson, M.A...	Richard Bull........	A. T. Freed.
Geo. Dickson, M.A...	A. Robinson, M.D...	Richard Bull........	W. H. Ballard, M.A.
Geo. Dickson, M.A...	Wm. Kennedy.......	Richard Bull........	W. H. Ballard, M.A.
Geo. Dickson, M.A...	Wm. Kennedy.......	Richard Bull........	W. H. Ballard, M.A.
Geo. Dickson, M.A. .	A. Alexander........	Richard Bull........	Wm. Turnbull.
Geo. Dickson, M.A...	A. Alexander.......	Richard Bull........	A. Gaviller.
Geo. Dickson, M.A...	A. Alexander, F.S.Sc.	Richard Bull........	A. Gaviller.
H. B. Witton, B.A...	A. Alexander, F.S.Sc.	Richard Bull........	A. Gaviller.
H. B. Witton, B.A...	A. Alexander, F.S.Sc.	Richard Bull........	A. Gaviller.
H. B. Witton, B.A...	A. Alexander, F.S.Sc.	Richard Bull........	A. Gaviller.
H. B. Witton, B.A...	A. Alexander, F.S.Sc.	Richard Bull........	A. Gaviller.
Thos. S. Morris......	A. W. Stratton, B.A.	Richard Bull........	A. Gaviller and G. M. Leslie.
Thos. S. Morris......	C. R. McCullough ...	Richard Bull........	A. Gaviller and G. M. Leslie.
W. McG. Logan, B.A.	S. A. Morgan, B.A...	Thos. S. Morris......	A. Gaviller and W. Chapman.
W. McG. Logan, B.A.	S. A. Morgan, B.A...	Thos. S. Morris......	A. Gaviller and W. Chapman.
Rev. J. H. Long, M.A., LL.D.	S. A. Morgan, B.A...	J. M. Burns.........	A. Gaviller and W. Chapman.
Rev. J. H. Long, M.A., LL.D.	S. A. Morgan, B.A., B.Pæd.	P. L. Scriven........	A. Gaviller and H. S. Moore.
Wm. C. Herriman, M.D.	S. A. Morgan, B.A., B.Pæd.	P. L. Scriven........	A. Gaviller and H. S. Moore.
Thos. S. Morris......	S. A. Morgan, B.A., B.Pæd.	P. L. Scriven........	A. Gaviller.
Thos. S. Morris.	S. A. Morgan, B.A., D.Pæd.	P. L. Scriven........	A. Gaviller and J. Schuler.
Thos. S. Morris.	G. L. Johnston, B.A.	P. L. Scriven........	A. Gaviller and J. Schuler.
F.F.Macpherson, B.A.	G. L. Johnston, B.A.	P. L. Scriven........	A. Gaviller and J. Schuler.
F.F.Macpherson, B.A.	G. L. Johnston. B.A.	P. L. Scriven........	A. Gaviller and J. Schuler.

Members of Council.

1857—Judge Logie ; Geo. L. Reid, C. E. ; A. Baird ; C. Freeland.

1858—Judge Logie ; C. Freeland ; Rev. W. Inglis, D. D. ; Adam Brown ; C. Robb.

1859—Rev. D. Inglis, D. D. ; Adam Brown ; Judge Logie ; C. Freeland ; Richard Bull.

1860—J. B. Hulburt, M. A., LL. D. ; C. Freeland ; Judge Logie ; Richard Bull ; Wm. Boultbee ; Dr. Laing.

1871—Geo. Lowe Reid, C. E. ; Rev. W. P. Wright, M. A. ; A. McCallum, M. A. ; A. Strange, M. D. ; Rev. A. B. Simpson.

1872—Judge Proudfoot ; Rev. W. P. Wright, M. A. ; John Seath, M. A. ; H. D. Cameron, A. T. Freed.

1873—Judge Logie ; T. McIlwraith ; Rev. W. P. Wright, M. A. ; A. Alexander ; I. B. McQuesten, M. A.

1874—Judge Logie ; T. McIlwraith, Rev. W. P. Wright, M. A. ; A. Alexander ; I. B. McQuesten, M. A.

1875—Judge Logie ; T. McIlwraith ; Rev. W. P. Wright, M. A. ; A. Alexander ; I. B. McQuesten, M. A.

1880—M. Leggat ; I. B. McQuesten, M. A. ; A. Alexander ; Rev. A. Burns, M. A., LL. D., D. D.

1881—T. McIlwraith ; H. B. Witton ; A. T. Freed ; Rev. W. P. Wright, M. A. ; A. F. Forbes.

1882—T. McIlwraith ; H. B. Witton, A. T. Freed ; A. F. Forbes ; Rev. C. H. Mockridge, M. A., D. D.

1883—A. Alexander ; A. Gaviller ; A. F. Forbes ; T. McIlwraith ; R. Hinchcliffe.

1884—A. Gaviller ; A. F. Forbes ; T. McIlwraith ; R. Hinchcliffe. ; W. A. Robinson.

1885—W. A. Robinson ; S. Briggs ; G. M. Barton ; J. Alston Moffat ; A. F. Forbes.

1886—J. Alston Moffat; Samuel Slater; Wm. Milne; James Leslie, M. D.; C. S. Chittenden.

1887—J. Alston Moffat; James Leslie, M. D.; P. L. Scriven; Wm. Milne, C. S. Chittenden.

1888—J. Alston Moffat; B. E. Charlton; T. W. Reynolds, M. D.; S. J. Ireland; Wm. Kennedy.

1889—T. W. Reynolds, M. D.; S. J. Ireland; William Turnbull; A. W. Hanham; Lieut.-Col. Grant.

1890—Col. Grant; A. W. Hanham; W. A. Robinson; A. E. Walker; Thomas S. Morris.

1891—Col. Grant; W. A. Robinson; J. F. McLaughlin, B. A.; T. W. Reynolds, M. D.; Wm. Turnbull.

1892—T. W. Reynolds, M. D.; W. A. Robinson; P. L. Scriven; Wm. Turnbull; Wm. White.

1893—James Ferres; A. E. Walker; P. L. Scriven; Wm. White; W. H. Elliott, Ph. B.

1894—James Ferres; A. E. Walker; P. L. Scriven; J. H. Long, M. A., LL. B.; W. H. Elliott, B. A., Ph. B.

1895—J. E. P. Aldous, B. A.; Thomas S. Morris; W. H. Elliott, B. A., Ph. B.; P. L. Scriven; Major McLaren.

1896—J. E. P. Aldous, B. A.; Thomas S. Morris; W. H. Elliott, B. A., Ph. B.; George Black; J. M. Burns.

1897—W. H. Elliott, B. A.; Thomas S. Morris; Robert Campbell; J. R. Moodie; Wm. White.

1898—W. H. Elliott, B. A.; Robt. Campbell; W. A. Childs, M. A.; Wm. C. Herriman, M. D.; W. A. Robinson.

1899—W. H. Elliott, B. A.; Robt. Campbell; W. A. Childs, M. A.; Wm. C. Herriman, M. D.; W. A. Robinson.

1900—Robt. Campbell; W. A. Childs, M. A.; George Black; J. F. Ballard; J. H. Long, M. A., LL. B.

1901—W. A. Childs, M. A.; George Black; J. F. Ballard; J. H. Long, M. A., L.L. B.; J. R. Heddle.

1902—Geo. Black; J. F. Ballard; J. H. Long, M. A., LL. B.; J. R. Heddle; J. M. Williams.

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF

The Hamilton Association

DURING THE

SESSION OF 1902-1903.

NOVEMBER 13th, 1902.

The opening meeting was held with the new President, J. M. Dickson, in the chair.

In his inaugural address that gentleman treated the meeting to an able review of the more recent advances made in chemical and physical sciences.

The Camera Club, assisted by Rev. Dr. Marsh, afterwards gave an exhibition of lantern slides.

NOVEMBER 28th, 1902.

A special meeting held with the President, J. M. Dickson, in the chair.

Dr. Merchant, Principal of the London Normal School, gave an illustrated lecture on "Wireless Telegraphy." The lecturer first described the two realms of matter and energy, and asked to which of these does Light belong. An experiment showed it to be a form of energy. The effect of a prism on a ray of light was shown, and it was explained that the spectrum of color is produced by varying wave lengths. The number of light waves per second varies from 400 million millions to 800 million millions, depending on the color of the light. Electric waves, often known as Hertz waves, are of the same character as light waves, and are transmtited by the same medium. The electric waves, however, are longer, and of these only some hundreds of millions occur in a second.

After referring to the methods by which ordinary telegraphy is accomplished, the lecturer described the essential apparatus for wireless telegraphy, viz., the coherer, consisting of a glass tube into which two metallic plugs are fitted. A small space between the plugs is partially filled with clean metallic filings. One plug is electrically connected to the end of the wire, and the other to the earth or some large metallic body. The method by which the sparks are produced, which send out the electric waves traveling through the ether until they reach the receiver were illustrated. The rate already attained for messages has been fifteen to twenty words a minute, but Marconi claimed that he would soon be able to increase this to 40 words. Although Marconi did not deserve the credit for discovering these waves, or inventing the co-herer for detecting them, he was entitled to credit for perfecting the instruments used in the system. One objection to the system is the lack of secrecy, but this is to be overcome by a system of tuning of the instruments so that they will respond only to waves of a certain length. Each transmitter can be made to radiate waves of anv reauired length. The lecture was fully illustrated, not only by apparatus, but by lantern views.

FEBRUARY 12th, 1903.

The regular meeting held, with President J. M. Dickson in the chair.

Several new members were elected.

Reference was made to the late Thos. McIlwraith, and a resolution expressing the feeling of the loss sustained, and appreciation of the work done by him in years past, was ordered to be entered on the minutes and conveyed to his family.

A paper was read by Mr. E. C. Murton on "Reminiscences of Nome and Romance of Placer Mining," which proved most interesting.

MARCH 12th, 1903.

The regular meeting held, with President J. M. Dickson in the chair.

Rev. D. B. Marsh, Sc. D., was appointed representative to the meeting of the Royal Society meeting in Ottawa on May 18.

Several new members were elected.

Mr. J. W. Tyrrell, C. E., D. L. S., gave a paper on "The Mackenzie River District." Photos and maps were used to illustrate his travels. This paper also will be found printed in full in the Proceedings.

MAY 7th, 1903.

The regular meeting held, with President Dickson in the chair. Sixteen new members were elected.

Dr. S. A. Morgan gave a paper on "Education versus Educational Theories," in which he showed, in a philosophic way, what education really means. The practical trend of the paper was to combat the predominance which present day educational leaders were giving to scientific and utilitarian subjects in contrast to language study.

Annual meeting was organized and reports received from Council and Sections.

The election of officers resulted as follows:

President—J. M. Dickson.

First Vice-President—Rev. D. B. Marsh, Sc. D.

Second Vice-President—W. A. Robinson.

Corresponding Secretary—R. J. Hill.

Recording Secretary—G. L. Johnston, B. A.

Treasurer—P. L. Scriven.

Curator—J. Schuler.

Auditors—Messrs. A. Baker and J. F. Ballard.

Council—Messrs. Jas. Gadsby, J. M. Williams, Robert Campbell, Geo. Black and R. A. Ptolemy.

REPORT OF COUNCIL.

Your Council take pleasure in submitting their report for the session 1902-1903.

During this session there have been held five meetings of Council and five meetings of the General Association, at which the following papers and addresses were given:

November 13, 1902—Inaugural Address—President J. M. Dickson.

November 28, 1902—"Wireless Telegraphy"—Dr. Merchant, of London Normal School.

February 12, 1903—"Reminiscences of Nome, and Romance of Placer Mining"—E. C. Murton.

March 12, 1903—"The Mackenzie River District"—J. W. Tyrrell, C. E., D. L. S.

Mav 7, 1903—"Education Versus Educational Theories"—S. A. Morgan, B. A., D. Paed.

Twenty new members were elected during the year, and the Association was called upon to mourn the death of one of its old and distinguished members, the late Thos. McIlwraith.

We have this year honored ourselves by appointing one of our own members, Rev. D. B. Marsh, Sc. D., to represent this Association at the meeting of Royal Society.

Your Council are pleased to note the increasing activity of various sections of the Association, and hope that the good work may long continue.

All of which is respectfully submitted.

J. M. DICKSON,
President.

G. L. JOHNSTON,
Secretary.

INAUGURAL ADDRESS.

HAMILTON SCIENTIFIC ASSOCIATION, SESSION 1902-1903.

BY J. M. DICKSON, PRESIDENT.

LADIES AND GENTLEMEN:

I thank you for your presence here to-night, the more because you have known beforehand that an address would be inflicted upon you, and as a slight appreciation of your self-denial I will endeavor to make the term of punishment as short as possible.

I desire to thank my colleagues, the members of the Association, for the honor they have conferred, the honor of appearing before you in the office of President. I have accepted this position with some fears for the welfare of the society, fully recognizing my inability to perform, in a satisfactory manner, all of the varied duties which such an undertaking must demand, and this feeling is strengthened when I look back and read the names of talented and scholarly men who have hitherto occupied the chair. It is my regrettable duty to recount the losses which our Association has recently sustained in the deaths of Mr. A. E. Walker, a valued member; Dr. Reynolds, who two years ago occupied the presidential chair; and Dr. Stratton, a former secretary. We pause at the threshold over which they have passed and turn again our wistful gaze from their departed forms to the work which they have left us to carry on, feeling that their influence and the results of their labors will ever remain to encourage and inspire us to better and to higher achievements.

To those who are unacquainted with its workings, I may say that the Hamilton Association was founded in 1857, its object being the advancement of science, art and literature. I need scarcely ask if science has advanced during intervening years, but I may pertinently inquire do we realize the gigantic strides it has taken. The wonderful achievements in electricity, chemistry, bacteriology, surgery, optics, and many other lines are almost incomprehensible, and so closely are some of the branches interwoven that many of the names require to be bracketed or written with hyphens in order to intelligently express our subjects. The application of science to arts has kept pace with the discoveries, and many industries have advanced by leaps and bounds that are simply astonishing.

The utilization of waste material and bye products has commanded much attention, and great results have been the outcome.

When this Association was founded the chimneys of chemical factories belched forth noxious gases to such an extent that the adjacent country was rendered barren, not a blade of grass or green leaf could be found within a radius of miles. Laws compelling an abatement of this nuisance were considered great hardships until science rose superior to the requirements, and to-day these once waste gases supply the sole profits of many enterprises. Heaps of lime and sulphur compounds were likewise thrown out to decompose and pollute the watercourses with every fall of rain; now, by new processes their valuable constituents are recovered and made to enter again upon rounds of duty for the further benefit of mankind. Coal tar and gas liquors have been investigated, producing the brilliant dyes of commerce, sweet flavors to please the palate, medicines to heal the sick, explosives to annihilate enemies at a range of many miles, and valuable fertilizers which make "two blades of grass to grow where only one grew before."

Research laboratories have been instituted, and many products hitherto produced only by plant life have been built up by synthesis, and in keen competition the artificial products have almost driven the natural from the fields of commerce.

The production and consumption of steel have become so enormous that we may be said to live in the steel age.

Electricity, with increased knowledge of its production and application, has entered as a strong factor into chemical work, and we have, within a few miles of us, large works for the direct conversion of common salt into alkali, a commercial success rendered practicable by the dissociating current, while another plant is being installed to manufacture nitric acid by the direct combination of the nitrogen and oxygen of the atmosphere.

For ages the rains and snows have descended upon the adjacent highlands, whence they have trickled down in ever augmented rills to the seas from which they were abstracted by the sun. Our ancestors wisely conserved the energies of these resultant streams and utilized their forces to drive mills, etc., situated at suitable points, but in recent years the problem of transmission of power has been mastered, and now these raindrops and snow flakes, united by gravitation, but harnessed and guided by the ingenuity of man, expend their power upon the terminus of a small cable, which conveys their energies nearly forty miles to set countless wheels in motion; so to-night we are conveyed to our place of meeting and have our proceedings illumined by the light and heat expended by the sun upon the waters in byegone years.

Surely the operations of electricity are marvellous, and as we talk to distant friends or receive cablegrams from other continents do we pause to think of the achievements of Bell, Edison, or Kelvin, or consider with the recent triumphs of Marconi that "Truly day unto day uttereth speech."

Bacteriological workers and physicians have studied the causes of diseases, isolated the germs of many maladies, opened up ways for rational treatment and discovered methods for securing immunity.

The assiduous labors of Professor Abbe and Dr. Schott have produced a new series of optical glasses by means of which the student of nature may make deeper research into her secrets and more fully and critically investigate the delicate structures of things infinitissimal; or annihilate space and resolve the starry mists of the heavens, while our photographic friends catch the shadows of passing objects or events and print them in picture stories for the enlightenment of distant friends or future generations.

In the plant world skilful hybridizing and careful selection have produced new fruits and flowers to nourish the race and beautify the landscape.

The list might be continued indefinitely, but lest I weary you I turn to the affairs of the society. Much valuable work has been done in geology, ornithology, botany, conchology, entomology and other departments, but the demands and press of business, and the march of time have removed many energetic workers from our midst.

Our geological section still continues to decipher the secrets of the rocks, but in biology we are very weak.

The recently organized astronomical section has begun well, and gives great promise, but what we most need is greater general energy.

Pardon my importunity, therefore, if I solicit the active cooperation of interested hearers.

Neither great expenditure of money nor wide travel is necessary to study nature. Too wide a field is simply bewildering to a beginner. Intelligent application is the key to success.

The following paragraph, garbled from Entomological News, may be of interest to those who think their environment is not suitable for nature study: "The Eastern Penitentiary, situated in the heart of the city of Philadelphia, is surrounded by a stone wall about 42 feet high. The corridors run from a common centre, like the spokes of a wheel, thus leaving some ground between them. Most of the cells have a small yard attached, in which the prisoner is allowed a few hours each day for exercise. Some time ago, while on a professional visit to some of the inmates, I was mortified to find a lepidopterist, though interested in his captures, which were all made in the yard attached to his cell. This yard was 14 x 17 feet, but with walls 11½ feet high. In this small space he had caught, during the past summer, 18 species. One of the species is a great rarity and a second is surely less so." A volume has been filled with an account of discoveries made in a tour around a back yard. Fifty species of plants have been taken by a botanist in the old cellar of a demolished house. The little pools formed by the hoofs of cattle in swampy ground furnish numerous species of diatoms, dismieds and other microscopic forms of life, and the iridescent film often seen floating upon rain water is composed of beautiful forms whose life history has probably not been worked out. Who among us cannot command such a field ?

Few great discoveries or inventions have been the result of a single act, but have consisted rather in the aggregation and patient reconstruction of scattered material.

Let us not, therefore, be discouraged though great success does not immediately crown our efforts, but push steadily forward, endeavoring at all times, in the face of seeming obstacles, to live up to the motto of our society, to penetrate further into the borderland of mystery which surrounds us, guided by the ever-increasing light, until, e'er we are compelled to lay down the burden, we shall at least have contributed some small particles which, collected and cemented by master hands, will assist in building up the mighty edifice of knowledge a structure which is steadily rising and must continue to rise until the keystone shall have been adjusted and the superstructure completed so far as time is concerned.

IN THE MACKENZIE RIVER DISTRICT.

Read before the Hamilton Association March 12th, 1903.

BY J. W. TYRRELL, C. E., D. L. S.

'Twas the 1st of April (All Fools Day) of the year 1900, when during the early morning hours, a motley procession of white men, Indians, and dog teams, might have been seen wending their way northward along a narrow winding woodland trail towards the southern shore of Great Slave Lake. Winter had about taken its departure, and given way to Spring, for the air was mild and balmy, and in passing it was observed that the red willows were already in bud.

The melting snow had disappeared so rapidly that it had been a close race with us to gain the ice of the Great Lake before the ground should become entirely bare, and it was therefore with feelings of relief and mutual congratulations that we emerged from the woods and exchanged the heavy wet and muddy trail for the firm, broad, boundless expanse of white ice which spread out before us.

Much though we appreciated the change, even more so did our six teams of noble dogs enjoy it, for as they reached the ice they broke off into a furious gallop straight across a great bay, on the other side of which could be faintly discerned the buildings of the Hudson's Bay Post—Fort Resolution. There was still a little snow upon the ice, though more slush and water, but our sleds now ran so easily that the dogs seemed to fly, and in a very short time we found ourselves landed at the gateway to the Fort.

Here we were most heartily welcomed by M. Gaudett, the H. B. officer, and his clerks, who very kindly took us in charge and provided the best accommodation at their disposal. Naturally one of my first questions after finding myself settled at the Fort, was in regard to my supplies—some 6,000 pounds which had been shipped thus far the previous summer, and I was not a little relieved to learn that they had all arrived in good shape and were safely stored in the Company's warehouse.

The problem next confronting me was the transport of this 6,000 pounds of outfit to Old Fort Reliance at the northeastern extremity of the lake, a further distance of about two hundred and fifty miles.

As 400 pounds (besides dog food) represented the extreme capacity limit of the native flat sleds or toboggans, it was clear that for the transport of my outfit at least fifteen sleds and dog teams would be required, and this number was not available. I was persuaded by everyone at the Fort that the only possible way of taking such an outfit up the lake was by boat about the first of the following July, and this was most consoling information, as I had based my calculations upon being far into the interior by that date.

I had not gone out unprepared for such an emergency as now presented itself, but had with me several parcels containing thin steel sled shoeing, and with this and such other materials as could be procured, I proceeded, with the help of my assistant, Mr. Fairchild, and good friend, Percy Acres, of our own city, to build long light sleds of such a design that I considered I could haul 1,000 pounds instead of 400 with each team of four dogs.

Our operations were watched, by both H. B. officers and natives, with much interest and even amusement, for as our sleds assumed their unusual shapes and proportions, many were the smiles and jests of our critics. My contention that a team could haul more than twice as much upon our sleds as on those of the native design was received with ridicule ; but when the day came for making a test, and four of my dogs were hitched to a load of 1,000 pounds, interest reached a climax. The load looked so big and the dogs so small that my own faith was tried for a moment, but upon the first crack of the driver's whip the load was started, and away it went with the dogs on a trot. A few moments later the driver whipped them into a full gallop and called for all hands to jump on, whereat three men did jump on and the team continued until the steep bare shore was regained. Criticism was now changed to admiration, and one Indian was overheard saying, " It is wonderful how these white men understand the building of sleds."

Well, it was chiefly due to the acquisition of these sleds, that after waiting about three weeks at Resolution for the most suitable time and condition of ice, we were again able to proceed with our complete outfit up the Lake towards Old Fort Reliance:the ruins of a post where Sir George Back spent the winters of 1833-34 and 1835. Each of our long sleds being loaded with about 1,500 pounds, we managed to move forward our whole outfit, including three large canoes, but the next difficulty was to provide food for our dogs for so long and slow a journey, for there were no dining cars in that country. Upon leaving the Fort our sleds were loaded with every pound of dog food that could be procured, but it was impossible for us to carry enough from the start for the whole journey. So about half way, or less, up the lake a fishery was established by setting nets under the ice, and some of those immense Slave Lake fish known as " Inconnu," were caught, and contributed to the support of our teams. We had trusted that at some points we should meet with Indians from whom we might replenish our supply of dog food, but in this we were quite disappointed, as every Indian encampment sighted was found to be temporarily or permanently deserted.

When, therefore, on the 8th of May, Reliance was reached, our dogs were in a deplorable condition, and worse still, their supplies of food were entirely gone. So far as my requirements were concerned, they had fulfilled their mission in landing our outfit at the head of the lake, but having served us so faithfully it now distressed me to see them suffer. We hunted far and wide for deer upon which to feed them, but all efforts failing, I was obliged to end the miseries of our worst specimens with my rifle. For the sustenance of the survivors on their way back to Fort Resolution, I sacrificed a quantity of bacon and half a dozen boxes of hard tack, and thus ended our dog sled journey of eleven hundred miles.

Dog teams having been sent back to Fort Resolution in charge of two men employed for that purpose, we were now dependent upon human power as our propelling force. Accordingly my Indian voyagers were at once set to work transporting outfit in a northeasterly direction, over a portage to Artillery Lake, and whilst they were thus engaged I and my assistants had ample time to explore that part of the district.

Old Fort Reliance—of which I have already made mention—was found to be a mere ruin, consisting of five stone chimneys, around one of which an enterprising hunter has recently built a small log cabin, but the location of the Old Fort is one of the most lovely spots imaginable—on the shore of Charlton harbor just east of the mouth of Lockheart River. The land rises from the shore in regular and beautiful park-like terraces, and forms one of the loveliest camping grounds I have ever seen. It is mostly covered by open spruce woods, through and about which various kinds of wild berries grow in great profusion, and at certain seasons of the year game is very abundant—particularly caribou—whose well beaten trails are everywhere to be seen.

Historically, Fort Reliance is of interest chiefly as having been the headquarters of Sir George Back and his party during the three years of their exploits when they were supposed to be searching for traces of Sir James Ross, who, shortly after Back's departure, turned up safely in England.

Back, like myself, wrote a book descriptive of his discoveries, and I have sometimes thought, since reading it, and having gone over portions of his stamping grounds, that if knighthood was conferred upon him as a result of his published narrative and maps, that he did certainly earn the distinction as a writer of fiction rather than as a recorder of facts.

So inaccurate and misleading did we find his descriptions and maps, that with our party the term of "Backite" became a synonym for falsehood.

Just one instance to prove my grounds for so severe criticism. Not far from the Old Fort upon the Lockheart River there occur several beautiful waterfalls, and the highest of these

—named by Back, " Parry's Falls "—is described by him in the following words :

" From the only point at which the greater part of it was " visible, we could distinguish the river coming sharp round a " rock and falling into an upper basin almost concealed by in- " tervening rocks, whence it broke in one *vast* sheet into a " *chasm between four and five hundred feet deep,* yet in appear- " ance so narrow that we could almost step across it. Out of " this the spray rose in misty columns several hundred feet " above our heads, but as it was impossible to see the main fall " from the side on which we were in the following spring I paid " a second visit to it, approaching from the western bank. The " road to it, which I traveled in snow shoes, was fatiguing in " the extreme and scarcely less dangerous, for to say nothing of " the steep ascents, fissures in the rocks, and deep snow in the " valleys, we had sometimes to creep along the narrow shelves " of precipices, slippery with the frozen mist that fell on them. " But it was a sight that well repaid any risk. The whole face " of the rocks forming the chasm was entirely coated with blue, " green, and white ice, in thousands of pendant icicles, and there " were, moreover, caverns, fissures and overhanging ledges in " all imaginable variety of forms, so curious and beautiful as to " surpass anything of which I have ever heard or read.

" The immediate approach was extremely hazardous, nor " could we obtain a perfect view of the lower fall in conse- " quence of the projection of western cliffs.

" At the lowest position which we were able to attain, we " were still more than one hundred feet above the level of the " bed of the river beneath, and this, instead of being narrow " enough to step across, as it had seemed from the opposite " height, was found to be *at least two hundred feet wide.*

" The color of the water varied from a very light to a very " dark green, and the spray which spread a dimness above was " thrown up in clouds of light gray.

" *Niagara, Wilberforce Falls in Hood's River,* the Falls of " Kacabikka near Lake Superior, the Swiss or Italian Falls, al-

" though they may charm the eye with dread, *are not to be com-*
" *pared to this for splendor of effect.*

" It was the most imposing spectacle I had ever witnessed, " and as the berg-like appearance brought to mind associations " of another scene, I bestowed upon it the name of our cele- " brated navigator, Sir Edward Parry, and called it ' Parry's " Falls.' "

Now, after reading the above fine description by Back, I fully expected to see something extraordinary when I should visit these Falls, and was a little disappointed one day when my assistant, Mr. Fairchild, returned from making a track survey of the Lockhart and reported that the famed Parry's Falls were a myth and had no existence. He had been up the river eleven or twelve miles, and had passed two or three small falls of no particular note, but had seen no Parry's Falls. They were reported by Back to be about six miles up the river, so I could not understand the discrepancy of reports, but concluded to go up next day and see for myself, which I did, being accompanied by Mr. Fairchild and Bishop Lofthouse, who was also a member of my party. At about six miles from the mouth of the river, sure enough we found Parry's Falls, but I did not blame Fairchild for failing to recognize them. There was sufficient truth in Back's description to enable one to identify them as the same to which he referred; but his statements as to dimensions are too far from facts to be allowed to stand unchallenged. Happily for Back, he was not expected to produce photographic views to mar his beautiful word pictures, and so his discoveries were immensely more wonderful than ours. I obtained half a dozen photos of Parry's Falls, as well as actual measurement of their dimensions, which are as follows : Total fall from top to foot of lower rapid, 85 feet (instead of from 400 to 500), and width at crest of fall, 30 feet (instead of 200) though at higher stages of water the width might possibly be increased to 50 feet. Excepting as to the dimensions, Back's description is not so bad, as the Falls are certainly very beautiful. At the time of our visit, on the 15th of May, they were completely bridged over with ice, so that we were enabled to walk over the very crest of the fall and obtain views from every available position.

I am sorry to have to thus challenge the report of so renowned an explorer as Sir George, but such we found to be the facts. By the 8th of June our voyagers had accomplished the task of transporting our entire outfit across the twenty mile portage, and nearly half way up the ice of Artillery Lake, when we came near meeting with a serious mishap. We were using hand sleds on the lake for moving our stuff, but the ice, though still four feet thick, had become so honey-combed or candled as to be dangerous, and the climax came when one of our loaded sleds settled down into the ice and was only prevented from being lost, with all its precious cargo, by the support of a long canoe which was securely lashed on top of the load. As it was, much difficulty was experienced in saving the submerged load, which had to be removed piece by piece, at great personal risk, to a place of safety.

One who has not witnessed the disintegration of this heavy northern ice can perhaps scarcely understand its action, but the process is as follows (the winter ice of the Mackenzie River District being about seven feet thick, for I had occasion several times to observe this when cutting holes for fishing purposes):

The first effect of the warm weather is to melt the snow upon the ice and cause it to be flooded. In a few days the water disappears through the ice and the upper surface gradually becomes candled until it is a bed of sharp spikes, very difficult and painful to travel over without the best of footwear for both man and dogs.

As the warmth of the sun increases, this candling process is continued until at length, when that condition is about reached, one may push a pole through ice four feet thick. Such had become its condition on Artillery Lake on the 8th of June, upon the discovery of which we sought and found a comfortable camping ground, on the east shore of the lake, in a small grove of scrubby spruce timber, which proved to be the last on our out-bound journey until after we had crossed the height of land and neared the valley of Thelon River. Ten days only elapsed between our Winter and Summer modes of travel, for on the 18th of June we embarked in our Peterboros, and two days later, though we were pushing northward, saw the last of ice for the season.

From the bottom of an eastern arm of Clinton-Colden Lake, a portage route (concerning which I had some Indian information), was discovered, and this was followed from lakelet to lakelet until on the 24th the "Grand Divide" was reached, the elevation of which was ascertained to be about 1,300 feet above the sea.

The country here had a very flat appearance (as is not infrequently the case on heights of land), and small lakes and ponds were quite numerous. Summit Lake was found to be a mere pond, but beyond it the waters flowed to the eastward.

On the 27th of June our party had crossed the height of land through a succession of these small lakes, and was following the descent of a small stream, or rather a chain of lakes connected by short stretches of current, towards the east and northeast. We had entered one of these lakes, which I have named after the present Minister of Interior of Canada, and were steering our little fleet of Peterboros northward under full sail, when the wind became so strong that we were unable to weather it, even under shortened canvas, so with some difficulty we made a safe landing upon a long point extending northward from the south shore. Here camp was pitched, for it was already evening, though quite light, for the latitude was 63 degrees 44 minutes north.

Excepting for the high wind, the evening was a delightful one in every way, so that whilst camp was being made Fairchild and I slung our field glasses and prismatics over our shoulders and struck off up the shore towards a conspicuous high sand ridge, where we hoped to obtain a good view of the lake, and if possible ascertain our future course, for upon entering any of these lakes this was always a problem to be solved.

The evening being agreeably cool and free from mosquitoes, we much enjoyed the stroll over the mossy hills, and upon reaching our objective point, some two miles from camp, seated ourselves upon the crest of the ridge and proceeded to sweep the lake and its deeply indented shores with our powerful glasses. We had not been thus occupied many minutes when there fell within the limited disc of my vision some dark moving specks away on the north shore. An instant's scrutiny convinced me that they were Musk Oxen, though we had not expected to meet with these animals for some time yet. Yes, they were certainly Musk Oxen, as their appearance and movements were quite different from deer, but whatever they might be, a more intimate acquaintance with them was immediately desirable, as we were now quite out of fresh meat and rapidly reducing our limited stock of bacon.

We had no rifles with us, nor had we canoes to cross the lake, but a quiet hunt was decided upon, and we returned to camp to prepare ourselves for it.

Arriving there, the hour now being 10 p. m., we found the tent empty, our two companions, the Bishop and Acres, having gone off picking berries, so we provided ourselves with two .303 Winchester repeaters and a supply of cartridges, and were about to launch one of the canoes when two of our Indians, noticing our movements, and anticipating our object, stepped to the shore and saved us the trouble. As we took our places in the middle of the canoe, the Indians took charge at bow and stern, and in a moment, with scarcely a word spoken, or the least noise save the slight splash of the paddles, we were off. Our steersman whispered, "You see deer?" to which I replied, "Strange big black deer," the meaning of which he quite understood, and I directed him to a point about three miles distant on the opposite shore. The lake, which a few hours before had been whipped into foam, was now like a sheet of glass, and the sun had just disappeared below the northern horizon, leaving the firmament one gorgeous glow of ruddy light. It was a glorious sub-arctic night, and as we sped swiftly, but noiselessly, through the water towards the long shadow of a dark hill, where we expected to land, the whole environment was to me most enchanting, almost to intoxication.

In less than an hour we had gained the shore and hauled out the canoe on a sand beach at the foot of an abrupt high bank. We were now in perfect concealment from our enemies and to the leeward of them, so proceeded to climb the steep bank to the plateau where the Musk Oxen were feeding.

Nearing the top we found ourselves much out of breath and unsteady, so lay down at full length for a time until we had recovered our wind and nerve. Then crawling up the bottom of a little valley a short distance further, brought us to the crest of the hill from which vantage ground we came within full view, at ranges from only sixty to one hundred yards of the huge dark forms of nine Musk Oxen.

They were browsing upon the grass, and all unconscious of our presence, until "crack" went our two rifles at the same instant, and two of the foremost bulls commenced to stagger and tear madly about, whilst the others were thrown into wild confusion and galloped hither and thither, not knowing which way to flee.

Several more bullets were required to bring the wounded bulls to earth, and as we were administering these from our concealment, the remainder of the band, seemingly having located us, made a furious charge straight for our position. Springing to our feet, for things had now become exciting, we met the furies with so deadly a volley that two more were sent to earth, and other four so crippled as to check their charge.

One young one only escaped unhurt, and he was allowed to go, whilst we completed our act of slaughter upon the wounded animals. Nor was this easily accomplished, for they put up a desperate resistance, making several frenzied charges upon us before they were completely overcome.

One huge old bull seemed to defy the power of my lead in a most astonishing manner, for bullet after bullet was sent singing through his carcass with apparently little effect, but at length he too swayed, staggered, and came to earth. On skinning and cutting up his carcass, I examined his wounds and found that three bullets had pierced his heart before he had fallen.

During the excitement of the battle we had paid little attention to the movements of our Indians, other than to notice that they had kept close to our heels.

Between Fairchild and myself honors were about even, as we were each responsible for the *lives of four monarchs of the plain.*

We certainly now had an abundance of fresh meat (such as it was), and the Indians were set to work to remove the hides, cut out the tongues, and save any other portion of the carcasses that might be desirable. Meanwhile Fairchild and I returned to camp, where we found all hands in the land of slumber.

Two or three yells soon caused everyone to turn out, and orders were given to move camp across the lake. I explained briefly that we had a quantity of fresh meat on the other side. where two of our men were already caring for it, so, somewhat reluctantly, for it was now twelve o'clock at night, the move was made to a beautiful spot at the base of "Musk Ox Hill."

Those of our companions who had not taken part in the hunt, upon hearing of our experiences, expressed grievous disappointment because of missing the sport, so we tried to comfort them by the assurance that we had not slain the whole band and that they might yet come in for their share. We told them of seeing one young bull go off in a certain direction, so the Bishop and Acres armed themselves with Winchesters and set out for blood; and they had not long to wait, for the young Musk Ox, no doubt, looking for its dead comrades, suddenly appeared around a bluff and let such a roar out of him as to almost freeze the blood in one's veins. A fusilade followed, but away galloped the calf towards a long point of land extending out into the lake. Thinking that we might now effect his capture, we all strung ourselves in a line across the base of the point and thus advanced abreast—thinking that we would be able to drive him into the water and there secure him—but the plan did not work out in that way. Mr. Musk Ox simply sized up the situation, selected his man, which happened to be Fairchild, who was armed only with his Eastman kodak, lowered his head and shot forward with the speed of a runaway locomotive. Fairchild also sized up the situation and lowered his camera. He stood his ground until the little brute was within fifteen feet of him, when he snapped his camera, sprang to one side, and so avoided trouble. If one had any doubts in his mind as to the young Musk Ox's intention he had only to look, as I did, at the tracks of the beast and not how well they covered the spot where Fairchild had stood.

Having thus broken through our line, the fusilade was resumed by our riflemen, and so wildly did the bullets whistle about for a time that every man, acting the better part of valor, lay flat on the ground or sought the friendly shelter of some convenient boulder. Presently there was a cessation of firing, and in its stead there came from the valley below loud shouts for help and more cartridges. Seeing the humorous side of the situation rather than any other, I hurried down with my large camera and found the young Musk Ox, who had received a bullet through the neck and was bleeding freely, playing tag with Acres around a huge boulder. At times the pace around the rock was quite brisk, and once at least did I recognize the exclamation, "Get out you brute," as rifle stock and Musk Ox head came into violent contact.

The hour of the night or morning, as one may choose to call it, was half-past one o'clock, but so good was the light that I was able to obtain a fairly good photo of the Musk Ox, though it is a matter of regret that my picture does not better represent the whole episode. The little beast was ultimately dispatched by a knife in the hand of one of my Indians.

Immediately following this slaughter two days were spent in drying meat for future use, and a fine lot did we cure, after which we proceeded with our survey to the great Thelon River, and down that stream to its confluence with the Doobaunt, which I had surveyed with my brother in 1893.

From the confluence of the Doobaunt, on the morning of July 16th, Mr. Fairchild, with two canoes and party of five, set off for Hudson Bay, whilst I, with the one remaining canoe and two men returned up the Thelon, with the intention of exploring the upper part of the river and possibly getting through to Lake Athabasca, in which case I might be able to catch the last Hudson Bay Company steamer going up to the landing, and get out somewhat earlier than Mr. Fairchild. However, this was all uncertain, as it was impossible for me to know what I should be able to do in these regards. At "Ping-a-wa-look's" camp on our way up stream I procured the few moccasins they had for us, and they were much needed before we got out of the country, for, as my men tracked the canoe up stream, the sharp rocks and stones over which they had to walk cut through two or three pairs of shoes a day.

The weather, which turned rough about the middle of the month, continued so for two weeks, causing us some delay, and a more unpleasant trip up the river than we would otherwise have had.

In passing some of our former camping places it was observed that the water of the river had fallen about two feet from its level of two weeks previously.

On the 28th we reached our old camp at the Forks, and there remained for a day or two in order to get a rate for my chronometer. On the last day of July I turned my attention to the upper portion of the Thelon, which was found, from the Forks up, to be obstructed in several places by shallow rapids. The general trend of this part of the river is southerly, and its banks, which are more thinly wooded than farther north, are comparatively low and sandy, with grassy flats at some places—particularly towards Eyeberry Lake—about fifty miles up. This lake was so named because of the abundance of eye-berries which we found on its shores and islands. About ten miles above or south of Eyeberry Lake a small river fifty yards wide was observed emptying into the Thelon, and south of it the river banks became suddenly much higher and the river channel more confined and tortuous.

Spruce and tamarac groves were also becoming more frequent, though still scanty enough. The average elevation of land was from 50 to 80 feet above the river, which in width varied from 100 to 250 yards, and in depth from two to six feet.

Its mean velocity was about three and one-half miles per hour. Flood water marks here, as well as on the lower part of the river, were observed as high as thirty feet above ordinary water level.

In August it was observed by Fairchild to be three feet higher.

At about ninety miles the country again becomes more open and prairie like, with low sandy river banks. A few miles further up the banks are composed of coarse gravel, and rise to a height of eighty or ninety feet. The rock formation, which makes its appearance at several points along the river banks, was observed to be sandstone, and so on the general character of the river and country continued much the same for a distance of 128 miles, when the stream becomes divided again, and both branches rapid and shallow. At their confluence was also observed the junction of sandstone and granite rocks. It was now August 9th, and judging from my progress during the last two weeks, and the prospect of increased difficulties ahead, I came to the conclusion that it would be unwise to attempt to push through to Lake Athabasca—a probable distance of 500 miles further by my route. It seemed to me preferable that I should rather endeavor to explore a second route across the "Divide" to Artillery Lake, and recollecting the small river flowing in from the west at the Sixty mile, I determined to return thus far, ascend it as far as possible, and thence cross by the easiest route to Artillery Lake.

Having decided upon the above plan of action, we easily returned down stream to my new point of commencement, and on the 13th began to ascend my west branch. Its course took me as nearly as could be in the direction of Artillery Lake, but I was not long to follow it, for by noon of the same day we had reached the head of navigation for so heavily loaded a canoe as ours. Not wishing to be thwarted in my object, I now decided to send my two men with the canoe around by the way we had come, to Artillery Lake, and that I would walk across alone.

It seemed that there could be no great difficulty in doing so, for the distance in a straight line I knew to be only about eighty miles; the season was still early and there were plenty of deer roving over the country. Thus viewing the problem, I sent my men back with the canoe and its contents, and having selected my necessary outfit for the tramp, bundled it up into a neat pack of about fifty pounds and started off. It did not feel heavy at first, and the weather being fine I made fair progress, but as the day wore on my pack became burdensome, and by evening I was quite ready to lay it down and creep into my sleeping bag. This first day's march, which covered thirteen miles, was along the course of the stream, over rough hills of gneiss sparingly wooded for a distance of ten miles only from the Thelon. At a point eight miles distant I discovered a beautiful little fall of 50 feet drop, and it was here that the gneiss formation was first noted. Its strike was observed to be north 75 degrees east (astronomical) and dip 70 degrees east.

My first day's march took me to the shore of a small lake, which of itself formed no serious obstruction to travel, but may be mentioned as the first link of a chain which was to cause trouble. The lake is about four miles long, but of very irregular shape. Its east shore is conspicuous because of a high ridge of white sand which has a bearing of south 63 degrees east. Because of the irregularities of the shore, and the impossibility of seeing any great distance ahead, it required a twelve mile tramp to get free from this lake, and that represented my second day's journey. My rations were obtained from the carcass of a deer which I shot, and some biscuits which I had brought in my pack.

On the morning of my third day, only three miles from my "camp," I came upon a large lake—to which I have taken the liberty of attaching my own name—since I am sure it has never been, and perhaps never will be, of as much interest to any one else as it proved to me.

Ascending the highest convenient hill I examined the lake as critically as possible with my fine field glasses. Its general bearing lay nearly northeast and southwest. Its southerly shores appeared to be only five or six miles distant, but its northerly boundary I could not determine, being apparently limited only by the blue hazy distant hills. Having no boat or timber of any description with which to make a raft, I turned my steps towards the south as the seemingly easiest way of getting past this obstacle, and for three miles or thereabouts I got along all right. Then I was suddenly confronted by a large stream forming the outlet of the lake. This I descended for some distance in the hope of finding a ford, but finding none, I stripped myself and waded in, hoping to find some place where I could get my outfit across, but in this I was disappointed, and the water, too, was very cold.

I had no alternative but to return and try the north end of the lake, which I did, and, to make a long story short of a long weary tramp over rocky hills and through soft muskegs, ankle deep in water, after three days of coasting it, I reached the northwest angle of Tyrrell Lake, and there was no love lost in parting. I had now been five days on my tramp, but out of a distance of sixty-three miles covered I had only made sixteen miles westerly out of a necessary eighty, and the contemplation of this was anything but encouraging, for I had counted on reaching Artillery lake within ten days at the longest. There was, however, no possibility of rejoining my canoe now, so my only possible course was to push ahead regardless of what time the journey might take, or what new difficulties it might present.

The character of the country continued much the same, the rounded bare hills of gneiss being separated by wet muskegs, or as commonly, small lakes and ponds which covered a large percentage of the country and formed a great impediment to travel.

The morning of my sixth day set in with chilling northeast wind and pelting rain, which not only saturated my clothing, but also the moss, so that I could make no fire. Having a small flask of brandy with me, I refreshed myself with a little of it in water, and a biscuit, and tramped on, making thirteen miles during the day. The night being dark at this season, it was not possible to travel continually, so, wet and shivering as I was, I lay down on the rocks in the pelting rain to try and sleep, but this was not to be, for my bed soon became a puddle of water, and I was uncomfortable indeed. I earnestly longed for the daylight so that I might get up and travel, and at length it came, but still the cold rain came down, so that I could only wring out my single blanket and start on without breakfast. A deer skin, which I had carried in addition to my blanket, had become so water soaked as to be too heavy to carry, and was left behind. Fortunately by noon on the seventh day the clouds broke and let the warming sunlight stream through upon me. Thus I was enabled to dry my clothes, and still better, ere long, to make a fire and cook some venison, which was much appreciated. At night, as I went into camp (more properly my blanket), I shot a fine fat buck and cooked as much of it for future use as I could with the little moss I could find.

The 20th of August was my eighth day out, and I had made only thirty-three miles of westing, but now the weather seemed to have cleared, so I pushed on with fresh courage, passing several small lakes and bringing up on the summit of a hill overlooking a larger one.

Here, observing the approach of a heavy storm, I proceeded to fortify myself, as well as my blanket and canvas wrapper would admit of, and so fairly well weathered out a bad night. But the next day was intolerable. I endeavored to push on, but so cold and drenching was the rain that I shivered even as I travelled under my water-soaked burden. Later in the day the weather became so thick that I was as one walking in the dark—not knowing what was before me—and soon found myself almost entirely surrounded by water. I was now forced to wait an improvement in the weather, and so, partaking of a wet biscuit, for I had nothing dry, and a drink of brandy, I lay down on the sand.

All night the cold rain came down in torrents, so I was perfectly saturated. As the morning dawned conditions were not improved, for the rain had changed to snow and clothed the landscape in her chilling garment of white. It left me in an extremely uncomfortable condition, to say the least, being without shelter, fire or cooked food, but the worst seemed to have passed, for at eleven o'clock the next day the sunlight broke forth again and brought me much-needed relief.

With the clearing weather I found myself to be on a long high point of sand, reaching far out into a lake, from which it would be necessary to retreat and make a detour, but anything was better than lying shivering in the darkness and rain, so I resumed my tramp, or track survey, as a real pleasure, and hoped for better days, but they were not to come just yet. I took advantage of all the daylight the 22nd could afford me for travel and made a good day, but the next brought a repetition of the storm, a gale from the northeast, with driving rain and sleet, so severe that I was forced to seek shelter, which to some extent I found on the lee side of a rock. Here I spread my canvas, and wrapping my wet blanket about me, remained for two days until the storm of wind, rain and snow had spent its fury. My biscuits were now all gone, and the only stimulant I had at this camp was the remainder of my flask of brandy, of which I gladly availed myself.

My condition had become decidedly serious. I had not slept a night since I had left my canoe, and this wretched weather and lack of food was already telling seriously upon me. The barren ground is a most inhospitable place in bad weather, but having exposed myself to its inhospitality there was only one thing for me to do, and that was to get out again as best I could, and this I was quite resolved to do.

The morning of the 25th brought a slight improvement in the state of the weather, so that I was able to get on my feet again and stagger along under my load made doubly heavy by its weight of water. By noon the rain ceased entirely, when I was able to make a heather fire and cook some venison, which revived me. The next morning I found a quarter of an inch of new ice on the pond, but getting under way I soon came to the shore of a very large lake, the one I believe shown by Back on his Indian sketch, and recently named Campbell Lake.

Its shores are formed of high white sand ridges and afforded good travel, which was most acceptable to my sore feet and worn-out moccasins. The country in the vicinity of Campbell Lake presented a less rugged and more pleasing appearance than it had done since leaving the Thelon. Berries of several kinds had again made their appearance, and deer trails were well defined and deep, although it might be noticed that these latter were everywhere to be seen throughout my journey.

Fifteen miles were traveled during the day, chiefly along the shores of Campbell Lake, and the next day, my fifteenth out, a similar distance was covered, and my first sight of a growing tree obtained since leaving the Thelon valley. There was but a small grove of them, but they meant much to me, not only in administering to my immediate comfort, but as foreshadowing the end of my difficult journey. Before noon of the following day I had reached my supply cache on the shore of Artillery Lake, and completed an uncomfortable tramp of 180 miles.

A rest of several days was now indulged in, since the weather continued very bad, but it gave me an opportunity of overhauling my outfit, repairing moccasins, and packing specimens for shipment home. On September the 4th and 5th I was able to complete my unfinished survey of the northern end of Artillery Lake, and having done so, I left a letter at the mouth of the Casba River for Fairchild instructing him where to meet me, and turned out to proceed to Fort Reliance.

A head wind springing up, however, I was induced to go ashore until it might moderate, and meanwhile was overtaken by Fairchild, who had received my note within an hour of the time I had posted it. We were now again a united party, and all in the best of health and spirits, and there was nothing left for us to do but get home as quickly as possible. High winds in Artillery Lake caused us some delay, but by the evening of September 13th we were all once more at camp at Old Fort Reliance.

RETURNING HOME.

As arranged with M. Gaudette in the spring, we were met by him in his steamer, the Argo, at the Old Fort on the 15th, and the next day were taken in tow bound for Fort Resolution and Smith. Unfortunately, on the 20th, at Stony Island, only 25 miles from Resolution, we encountered a gale which drove the Argo on the rocks and smashed our keel and rudder.

Fortunately no further damage was done, and after effecting temporary repairs we got her into Resolution on Sunday morning, September 23rd, three days behind time.

Four more days were spent in repairing the Argo more substantially, for her trip up the Slave River to Fort Smith, so that it was late on the 27th before we were again under way.

At Resolution I learned with regret that many of my faithful dogs had died during the summer under the care which they had received, but the survivors were placed in our canoes and taken with us.

On the evening of the 30th, when about half way to Fort Smith, we were again doomed to misfortune. This time it was our engine that broke down, and one day was lost in repairing it. Besides, her steam capacity was seriously affected through the accident, so that it was the evening of the 4th when we reached Smith, and the 10th, when with our three canoes, we sailed up to Chippewyan. Through our unfortunate steamboat experiences we had lost just ten days on our reckoning and were consequently too late, by all accounts, to reach Athabasca Landing by open water. I decided, therefore, to accept what seemed the inevitable and remain at Chippewyan, where we could obtain supplies and lodgings until such time as we might be able to proceed with our dogs. This we did, and through the kindness of Mr. Drever, Colin Fraser, Rev. Mr. Warwick and others, our stay was made very pleasant indeed.

By November 14th the lake ice had become set and sufficiently strong to admit of our passage, so with three teams of our own and two others which I hired to assist us, we set out upon the final stage of our journey, and without entering into details thereof arrived at Edmonton on December 6th, nine months and twelve days from the date of our departure.

SUMMARY NOTES.

Two more important material results derived from my explorations are briefly as follows:

The obtaining of a correct topographical map of the routes traversed, in connection with which may be mentioned the discovery of the Thelon River—one of the finest in Canada—navigable for river steamers or other boats of light draught all the way from Hudson Bay to the forks of the Hanbury River, a distance of 550 miles, excepting perhaps the two rapids on the river above Baker Lake, where some improvement to the channel might be made.

Just what length of time this route may be opened for navigation I am unable to say precisely, but would judge that the river portion must be open at least five months, and the inlet and larger lakes about a month less, that is, during the months of July. August, September and October. Thus the possibilities and expense of navigation from Hudson Bay towards the west by way of Chesterfield inlet have been pretty well determined.

In the Mackenzie basin, Charlton Harbor, at the head of Great Slave Lake, limits navigation from the west, and on its northern shore, by the mouth of the Lockhart River, is as pretty a town site as can be found in Canada. Between these two terminal points the only existing way of communication is by means of the excellent canoe route followed by our party.

For heavy commercial traffic a railway could be constructed without serious difficulties by avoiding the lakes along the Hanbury river route, there being no great elevations or other difficulties to overcome unless it be the remoteness of the district and the scarcity of timber.

Should any kind of electric transmission become desirable the two grand water powers of the Lockhart river and Dixon Canyon could be utilized to great advantage during the open season.

Besides the discovery of the Thelon as a commercial waterway, the resources of its valley are of great interest, particularly its timber supply and herds of musk oxen, both of which are of great value to Canada.

For the preservation of the musk oxen, which may be so easily slaughtered, and are already rapidly diminishing in numbers, I would suggest that the territory between the Thelon and Back rivers be set apart by the Government as a game preserve.

The chief food supply of the country lies in its great bands of caribou, and its fish of various kinds, which are abundant in all the lakes and springs of the district.

The Thelon valley, though affording fine grazing lands for musk oxen and caribou, can scarcely be looked upon as a desirable agricultural district, although I judge from the growth and great variety of plants obtained there, that some of our cereals and most of our hardy vegetables could be grown in the Theron Valley.

As to mineral products, from what mention has already been made of the rocks, it may readily be judged that the Thelon valley has little to offer, although with the Esquimos many articles such as arrow heads, spear heads, skinning knives, etc., were observed, which have been beaten into form from native copper, which, as they had explained to me, had been picked up as pebbles from the ground, far to the northward near to the salt water.

ANNUAL REPORT OF THE ASTRONOMICAL SECTION.

The Astronomical Section report having had a most successful season.

Meetings at which papers have been read, fifteen. These include papers read by visiting scientific gentlemen and our own members, and have been in touch with the science of Astronomy, of good educational value, and were very much appreciated by the large audiences, which have been a special feature of our meetings.

We report a membership of forty-five (45).

We ask that the suggestion, which will be presented by our Secretary, be taken into your consideration, as we feel that some action must be taken in regard to better accommodation for audiences which we invite to our meetings. We ask that you appoint a committee, if necessary, to deal with any improvement that may be decided on.

J. M. WILLIAMS,
Secretary.

MEASURING THE WAVE LENGTHS OF LIGHT.

(Illustrated.)

Read before the Astronomical Section of the Hamilton Scientific Association, February 20th, 1903.

BY C. A. CHANT, M. A., PH. D., LECTURER IN PHYSICS, TORONTO UNIVERSITY.

At the present time there is no need to demonstrate the existence of waves of light since the undulatory theory of light has been for many years considered as well established as the laws of universal gravitation.

A principal characteristic of the phenomena attending wave-motion is what is known as interference. If a stone be thrown upon the quiet surface of water there spread from the centre, where it struck, ever-widening circles, alternate ones being elevated above and depressed below the ordinary level surface. If instead of throwing a stone some means be taken to keep up the disturbance of the surface, circular waves will continually spread from the centre, and as they reach any point of the surface the water there will be continually moved up and down with a harmonic motion.

Suppose, now, waves be made to continually spread from a second centre as well, when the two sets of waves meet each passes along just as though the other were not there. But it will be easily seen that the point referred to the water may be elevated by both sets of waves, or it may be depressed by both sets; or, again, it may be depressed by one set and elevated by the other, in which case there will be no motion at all. Here motion added to motion gives rest. If, further, we count the number of wave lengths from a point of rest to the two centres it will always be found that the difference of the two lengths is equal to an odd number of half wave-lengths, and if we can accurately measure these distances we can determine the length of the waves producing them.

One of the most convenient ways of producing effects such as described is to fasten to a prong of a tuning fork two light styles of glass which end just above the surface of mercury or other liquid. When the fork vibrates the ends of the styles act as centres of disturbance. (Several photographs of such effects were shown on the screen.)

Similar results are producible by light. If light from a narrow source falls on two plane mirrors inclined at an angle a very little less than 180 degrees, each mirror will illuminate a part of the screen, and where these illuminations overlay interferences may be obtained (Fresnel's two-mirror experiment). Or light may be passed through a properly shaped double prism so that one half is sent along a path slightly different from that of the other half, and where the two beams overlap we may secure interference. (Fresnel's bi-prism). Another method is to allow light reflected from a small plane mirror to interfere with that incident directly on the screen. (Lloyd's experiment.) [Photographs of these effects were exhibited on the screen.] Each of these methods may be used to determine the wave-length of the light. In each case it is shown that light added to light may produce darkness.

The action of a lens is of a similar nature. Waves of light spreading from a point on passing through the lens are so altered in form that they run to a point (convergent lens) or spread out more rapidly than before (divergent lens).

It is a common observation that water waves, on striking an obstacle, bend to some extent around behind it. So also in sound, an object placed between the ear and the sounding body does not entirely shut off the sound. Similar effects are observable with light, but on a much smaller scale. If light be admitted into a darkened room through a very small aperture, and an object be put in its path, the shadow will not be sharp. The light bends behind it and dies away gradually. For instance, if the light comes through a small round opening, and a circular disk be put in its path, there will be found in the centre of the shadow, where one would naturally expect the intensest darkness, a bright spot—as bright, indeed, as though the disc were absent. (Arago's experiment.) This result has been obtained and photographed at the University of Toronto with a disc 3½ inches in diameter, though in Arago's original experiment the diameter was 1-12 of an inch.

If the light pass by a narrow straight obstacle (such as a needle), or through a small opening, similar bending effects, often exquisitely beautiful, are obtained. These bending effects are due to diffraction.

The most important example of diffraction is in the grating. A grating consists of lines, usually very straight, very equally spaced and very numerous, scratched on glass or on a polished metallic surface. The scratch is opaque (or non-reflecting) and the interspace is transparent (or reflecting). When light passes through (or is reflected from) a grating it is all broken up, and when re-united on a screen gives beautiful spectra, which, however, are distinguished from spectra produced by a prism in that the red is deviated most and that the colors are spaced in a manner directly variable with their wave-lengths. On account of its uniform nature the spectrum is called normal, and many important investigations have been made by it—pre-eminently by the late Prof. Rowland, of Baltimore, who devised an almost perfect machine to rule his gratings.

If we know the number of lines per inch (from 1 to 20 thousand), and can measure the angle the light is deviated from its original direction, the wave-length can be determined by a very simple formula.

The best measurements are made on a spectrometer, which consists of a graduated circle carrying a collimating and an observing telescope; but very fair results can be obtained with extremely modest apparatus.

Using a grating (made by photographing from the original, just as a lantern slide is made from a negative by contact), with 3,000 lines to the inch, and a simple paper scale, the wave-length of the yellow light emitted by a Bunsen burner, when salt is thrown into it, was found with considerable accuracy. Its true length is 0.000.589 millimetre, or 0.000.023 inches.

JUPITER.

Illustrated Lecture to the Astronomical Section of the Hamilton Scientific Association,

BY REV. R. E. M. BRADY, B. S.

When a person has toiled hard the day long he welcomes nightfall, which brings rest to his weary bones. Not so, however, when he has a day off. He goes out for a day's innocent amusement, and if it happens to be a sunshiny day, it is with regret that he beholds the noble and brilliant orb sinking in the crimson west.

The sunset is beautiful, but it carries with it the dying enchantments of nature, which the sun lighted up and mantled in its golden rays.

The Author of nature, however, offers man some compensation for this momentary loss. Knowing our nature, as a Deity alone can know it, He has broken the monotony and repulsiveness of darkness by giving us the starry heavens and the silvery moon, that "Queen of Night." Thus in the solemn language of the night, as in the golden sunbeams of day, He speaks to us of His immensity reflected in the immensity of nature unfolded to our midnight watch.

In speaking of the creation of the stars one of our poets has said, "on the fourth day of creation, when the sun, after a glorious but solitary course had gone down in the heavens, and darkness began to gather over the face of the uninhabitable globe, already arrayed in the exuberance of vegetation, a star single and beautiful stepped forth into the firmament. Bewildered by its new born existence, it looked abroad and beheld nothing to compare with it in beauty. But it was not long alone. Now one, then another, here a third, there a fourth resplendent companion joined it in its solitary existence until soon the heavens were brilliantly bespangled."

This, more poetic than real in the creation of stars, tells us something, however, of the delights of man who studies those luminous bodies, whether one by one or grouped in their constellations.

Lord Byron has compared the mid-night heavens to the mighty ocean; they are sown with stars as the sands in the sea, and while they twinkle o'er our heads our great desire would be to wing our flight and mingle with their immortal light.

Again here nature has made a compromise. With our rapid wings carrying us at the speed of 100 miles a minute, it would take us 15 years to reach Jupiter, which we are going to visit this evening, and even billions of years to reach some of the stars. Nature has provided a more rapid and less perilous and less fatiguing means of visiting these heavenly bodies. It is by observation, light, the telescope, and the retina of the eye will accomplish this journey and afford us quite a pleasant visit.

Light: A poet has compared light to the sun as heaven's first born and to the Deity from which it radiates. "Light," he says "is the offspring of heaven's first born and of the eternal coeternal beams."

With its volatile and rapid waves it kisses the shores of space and returns to man's eye to reveal to us the great panorama of night with its twinkling stars shining like so many bright souls of the Great Beyond.

But I have been too long in coming to Jupiter. It is the greatest planet in the solar system. Just a short digression here for the benefit of those who may not have studied astronomy. There are many distinctions to be made between a star and a planet. Both light up the heavens at night and appear very much alike to the naked eye. If you watch a star, however, you will find its light penetrating, fine and twinkling. The planet's light is blunt, constant, and never twinkles. This you will readily understand when it is explained that the stars are luminous bodies of themselves, perhaps immense suns more brilliant than our sun. They allow inspection from the naked eye because their brilliancy loses its intensity from the billions of miles their light travels, still retaining something of their majesty in the twinkling light which indicates their power.

(After further details he continued.)

The planet, like the earth we inhabit, is not a luminous body. It gives simply the light it receives from the sun. The sun is the centre around which the planets revolve. The Earth is one, Jupiter is another. In mythology or the history of the pagan gods, the great God of thunder and lightning was called Jupiter or Jove. You have heard the expression, "By Jove."

In the planetary system the name Jupiter has been given to the giant planet. This planet, Jupiter, is so immense that were you to combine Saturn, the earth, and all the other planets it would still surpass them all in size. It is close on 1,300 times as large as our earth and almost half the size of the sun. It is the brightest and largest heavenly body that the naked eye can see at night except the moon. But put Jupiter where the moon is and its disc would extend across one-half of the heavens.

Again, if it appears larger and brighter than the stars, it is because it is only a small fractional distance of the stars from us. It is 483,000,000 miles from the sun and 400,000,000 from us. Let us make our first trip there through the telescope. [Lantern and details: view of Earth and Jupiter.]

Compare with earth's size. You will see here at a glance the comparative sizes of the Earth, the planet we inhabit, with the size of Jupiter. It would require 1,300 Earths to make a planet equal to Jupiter in size. Now, considering that the earth is no small globe, remembering that it is some 25,000 miles around the Earth, by multiplying this by 1,300 you will be able to fancy what a huge body is revolving over your head as you gaze upon the bright and beautiful star Jupiter.

The great pleasure which Jupiter allows us by its brilliant appearance in the Zodiacal constellations we do not reciprocate. Should Jupiter be inhabited neither our own existence nor even the existence of the Earth is suspected by those inhabitants. The Earth, we might say, is comparatively invisible to the inhabitants of Jupiter. A speck, a mere dim speck might be seen once every six months a couple of hours before daybreak, but nothing to awaken their suspicions that there is here an active world of human beings, a great British Empire, much less that there is a Hamilton Astronomical Society giving attention to Jupiter.

Now that we have reached Jupiter, or rather brought it to us, many questions awaken in our minds. What is Jupiter's physical make-up? Is it inhabited? Is there life there and what life?

The scientist has done a great deal to answer those questions, and some are answered accurately. They have weighed Jupiter. It weighs 316 times more than the Earth. Then you will ask me how much the Earth weighs and how can it be weighed. Well, weigh a yard of earth, granite and mineral, and knowing how thick and vast the Earth's crust it, you can soon figure the number of yards. This you multiply by the weight of one yard. Then with the theory that the remaining globe of the Earth is boiling liquid, which weighs so many times less than the solid crust, you can compute the weight of the whole Earth.

Jupiter is known in its volume. Then its satellites or moon that revolve around it, as well as other bodies coming into the range of Jupiter's attraction, scientists have been able to determine the power of its attraction by the deflection it causes in the course of those bodies. Knowing the volume of Jupiter and its power of attraction, it is easy for the scientist to reckon its weight; 316 times heavier than the Earth. But we saw that it was nearly 1,300 times larger. Then why should it not be 1,300 times heavier? This brings to us its physical make-up. Jupiter is yet in a fluid state and gives forth intense heat, then 316 not 1,300, which would suppose it to be solid.

When seen through the telescope Jupiter presents large clouds or belts running from east to west and parallel with its equator. When examined closely those belts are found to be in foment and terribly agitated. This enables us to make many discoveries on Jupiter. [Lantern.]

First it reveals the fact that Jupiter revolves upon itself every 9 hours 55 minutes. This is the length of Jupiter's day. By marking one of its belts we can easily determine that in 9 hours and 55 minutes it returns to its first position.

Like the Earth, Jupiter has also a movement around the Sun, but instead of traveling the path of its orbit in 365 days, as the Earth, it takes 4,300 days, or 12 years. This is natural for keeping at 483,000,000 miles from the Sun, it has a very much longer course to pursue than the Earth. Then its traveling per minute is slower, 480 miles; to the Earth, 1,080 miles a minute. Something very important of notice is that Jupiter has scarcely any declination during its journey around the orbit.

Any person who has not studied astronomy may have gained the knowledge from geography that the earth tapers or declines at the poles and at the equator during its yearly course around the Sun. This brings the Sun's rays sometimes obliquely, sometimes almost perpendicularly on different zones of the Earth, and this causes the four seasons of the year.

V. G. We are now nearer the Sun than at any time of the year. The Earth is at the short radius of its eliptical orbit; yet the Sun, instead of being warmer, is colder, and we have winter because the Sun's rays fall obliquely or less perpendicularly, if you wish, than in summer.

Now all this is done away with in Jupiter. The Sun's rays fall equally perpendicular or equally obliquely on the different zones of its surface the year round. This does not mean that there is perpetual day or perpetual night. Something of this may take place at its poles. But almost universally on Jupiter, darkness and light, sunrise and sunset succeeds one another rapidly every five hours.

Picture if you can the velocity of Jupiter's rotation on itself; 1,300 times larger and revolving every 9 hours 55 minutes makes its speed 27 times greater than the Earth. It is flattened at the poles and bulged out at the Equator, and well it may, being only in fluid state and revolving so fast.

Returning to Jupiter's formation, it bears out in a most striking manner the theory that the Earth was once an immense body of fluid or liquid substance, perhaps once fiery vapor or gases. Passing through millions of ages it formed a crust of Earth wherein we are perched like so many pigmies.

Those belts or zones of Jupiter are clouds of vapor, beneath which there is intense heat and fire. This vapor and fluid state made Jupiter much lighter than the Earth. It is reckoned that 340 million years were spent in the solidifying and cooling the Earth, and Jupiter being much larger, will take 2½ billions of years.

If then the Earth will only cease to exist when Jupiter is solidified and ready to be populated, the end of the world is yet far distant.

The terrible convulsions and motion of the belts of Jupiter, which indicates storms with hurricanes at 200 miles an hour, indicates an internal heat. The heat of the Sun on our atmosphere, which causes our storms, cannot be great enough on Jupiter to cause those great hurricanes. [Lantern.]

Again, this heat is shown in red spots, one particularly, which has been constantly visible since 1878, 26,000 miles long and 8,000 miles wide. This is a certain sign that there is fire. But it is also surmised that it is the formation of a continent which would blanket our whole Earth round and round and extend 4,000 miles to either side of our Equator.

If the spirit of adventure should stimulate any of you, you could closely watch its final formation, then go and conquer to yourselves a vast empire indeed.

Jupiter is not self-luminous like the Sun, but merely reflects the light of the Sun as does the Earth. What a magnificent mirror to become the giant of the starry heavens.

That Jupiter is not luminous is proven by its satellites, as we will see.

Then Jupiter has satellites or Moons. When I first studied astronomy in 1884 Jupiter had only, or was supposed to have only, four satellites, discovered by Galileo, 1610. Since then Mr. E. E. Barnard, of Mount Hamilton, has found a fifth, so you see astronomy is not at a standstill.

Those satellites which offer Jupiter their services, as the

Moon does the Earth, make their trip around their planet from 12 hours to 16½ days. Their service to the astronomer in his researches is valuable. In the first place, it is a magnificent illustration in diminutive way of the Copernican system. Copernicus taught that the Sun was a centre and that the planets revolved around it. Here is Jupiter controlling five bodies revolving around it, with Jupiter as a centre.

Then they assist in computing the bulk, the weight of Jupiter from the attractive power Jupiter exercises over them.

Then they show that Jupiter's light is only borrowed. [Lantern.]

You see a perfect shadow of a satellite on Jupiter. This means that the satellite, coming between Jupiter and the Sun, obstructs the light of the Sun from falling on Jupiter, and that spot remains dark because Jupiter has **no** light of its own.

Finally the satellites have enabled the scientist to reckon the velocity of light.

I will attempt to explain. [Lantern.]

Here we have Jupiter and its shadow. There is a satellite in occultation and here is one in eclipse. Both disappear from us, but for different reasons. Occultation put Jupiter between us and the satellites. The disappearance is short and abrupt.

The other is out of sight, because, though exposed to our view it has no light to reflect. It is eclipsed by the shadow of Jupiter. This disappearance is slow and beautiful and can be watched closely. The time of those eclipses has been determined, and are regular under ordinary circumstances.

It was not long, however, until it was remarked that the eclipse was sometimes delayed, say 5 minutes. Now this was found to be caused by the different positions which Jupiter occupied relative to the Earth. Sometimes Jupiter is 200,000,000 miles further from the Earth when the eclipse takes place than former eclipses. At this great distance the satellite does not disappear from our view until several minutes later, and this number of minutes is the time which it took the last ray of the satellite's light to travel over those extra 200 million miles, and the light shined in our eyes so many minutes longer. [See lantern.] Place the Sun in the centre, Jupiter out on the outer orbit, the Earth where the third Satellite is. When the theory of the Solar or Planetary system was sprung on the world it was a great shock. Galileo was subjected to harsh treatment, though not so bad as some historians claim.

For a moment it seemed impossible to reconcile it, to even the religious belief that Joshua stopped the Sun. How could he, if we were to believe that the Earth and not the Sun moves.

The satellites of Jupiter gave Galileo great arguments in favor of the planetary system. Some philosophers, incredulous to the end, said that if Galileo saw Jupiter's satellites he must have satellites in his telescope or on the brain.

Another philosopher refused to look through the telescope, lest seeing he believed. Galileo wished him luck, and hoped he might get a glimpse at them on his wav to heaven.

Is Jupiter inhabited? In writing on this subject James Wils has tuned his lyre to a pathetic strain and asks, Can we not hope that it is inhabited?

That silvery planet surpassing our Earth a thousand times in magnitude. Its green fields and its thronging commerce may be too remote to allow inspection, its kingdoms beyond he conqueror's reach, and so far distant that they appear but a mere brilliant speck.

Why those five moons to keep watch by night? Is there no inhabitant to enjoy its sunshine? No one to salute its frequent day breaks and watch its sunsets? From what has been said of this planet I fear there are none. Jupiter's unfinished state of formation and its fluid liquid convulsive hot state, seems unfit even for vegetation life .

But may we hope that after the lapse of billions of years it will have its green fields, its mild atmosphere and its intelligent and reasonable inhabitants.

If so, they will have long years and short days. This appears like an Irish bull, but it is true, however. A child of ten years of age on Jupiter would be a centenarian of more than 120 years on our Earth. The year on Jupiter is more than 12 times as long as the year of our planet.

The agitator for short hours will be quite at home there. And a man taking three meals a day, and one hour for each meal, would spend more time eating than working. The day's sunshine is less than five hours. You may say that they would have five moons to our one; yes, but we would have our four seasons to their one. So, taking all in all, we are not so badly located on our own planet, where we have ample time to work, and to eat, and to study astronomy.

Ladies and gentdemen, you have now learned all I know about Jupiter and all I don't know. It took me some time to tell you what I do know about Jupiter, and I apologize for trespassing on your patience.

If I were to detain you until I told you what I do not know and what others, even great astronomers do not know about Jupiter, I would completely wear out the patience of this whole assembly.

A TRIP TO THE PLANET SATURN.

Read before the Astronomical Section of the Hamilton Scientific Association on the 17th April, 1903.

BY W. BRUCE.

On a clear, beautiful and starlit night in the year 1867, 36 years ago, as I was taking a walk on one of the wide streets of the city of London, Ontario, I passed a comfortable dwelling before which was a square of grassy lawn, and sitting on a chair in the centre of it was a fine old English gentleman looking intently through a three-inch telescope pointed to the southern quarter of the heavens, and as I paused, while passing, he said: "Mr. Bruce, would you like to look at the planet Saturn through my telescope?" "Yes, sir," I said "I would be delighted, as I have never seen Saturn through a telescope," and putting my eye to the object glass, I then saw for the first time in my life the grand old planet as it appears through a good 3-inch refractor. I was charmed with the view of it, as it appeared in just the best position for good observation. I was delighted beyond measure, and during the hour I remained with him he showed me many of the wonders of the starry sky, and I look back with the greatest pleasure at that first evening with the telescope in company with that fine old gentleman, who had made astronomy his hobby, as one of the red letter evenings of my existence, for which I will never cease to thank him. And many an evening I spent with him and his telescope after that, until I left London.

Since then I have taken many an imaginary journey through our planetary system, and to-night our worthy president has asked me to give you my trip to the planet Saturn, so I invited all of the members of our Astronomical Society of Hamilton to accompany me in the "Bruce Aerial Ship," which has been very much improved since our last trip to the planet Venus, which I hope some of you will remember.

Our improved aerial ship was beautifully constructed, had every comfort, convenience, had everything we wanted, all we had to do was to wish for what we needed, and lo, we had it, without paying a cent for labor or materials, so we are quite independent of strikes during the manufacture. We did not "kill the goose that lays the golden egg," as so many make the mistake of doing.

On a lovely moonlight night the members of the Astronomical Society boarded the aerial ship, including the honorary president, who hesitated a little while before venturing, as he is a heavyweight, but at last he consented to accompany us, along with our worthy president, who took the chair, and opened the meeting with the following words: "Now, gentlemen, we are going to pay a visit to the planet Saturn, and as we have to travel over 800 millions of miles to get to it, we have to "get a gait on," and to prevent time from hanging heavy on our hands, I will make it a rule that each one of you will either tell us something about the planet Saturn, tell a story, sing a song, or give a recitation."

So under these conditions we started, and away we went flying through space at a tremendous speed, and as we approached the Moon the president called on Mr. Jenkins, F. R. A. S., one of our new members, for a recitation, which he gave charmingly in an address to the Moon, in the following words: [I am only sorry that I cannot render it as he gave it, away up in those clear, calm, ethereal regions, but it was something like this, only much better.]

TO THE MOON.

'Tis a lovely eve, and the Lady Moon
  Is out on her lake of blue,
With its little isles of light and gloom,
  Where the stars are wandering through.

And she sheds her smile like a veil of dreams,
  Athwart the earth and sky,
With its mazy deeps and its golden gleams,
  And its streaks of nameless dye.

Away she sails among the amber isles,
In her lovely lake of blue;
And the glorious golden tinted piles,
Are slowly heaving through.

And the foam-bells follow, pure and bright,
In her eternal track,
As she sails away among the hills of light,
While the stars are trembling back.

She follows on, by a glory led,
With a heavenly calm impressed;
For she bears the souls of the happy dead,
To the islands of the Blest.

After the applause had somewhat subsided the president called on Father Brady for a story, so the good father, in the kindness of his nature, told us the story of an Irishman who visited one of the scientific meetings of philosophers in Dublin, and he gave it to us in the brogue, as he got it from the Hibernian, as follows:

Ladies and gentlemen, I see so many foine lookin' people sittin' before me, that if you'll excuse me I'll be after takin' a seat meself. You don't know me, I'm thinkin', as some of yees 'ud be noddin' to me 'afore this. I'm a walkin' pedestrian, a travelin' philosopher. Terry O'Milligan's me name. I'm from Dublin, where many philosophers before me was raised and bred. O, philosophy is a foine study. Before I kim over I attinded an important meetin' of philosophers in Dublin, and the discussin' and talkin' you'd hear there about the world 'ud warm the very heart of Socrates or Aristotle himself. Well, there was a great many imminent and learned min there at the meetin', and I was there too, and while we was in the very thickest of a heated argument, one comes up to me and says he: "Do you know what we're talkin' about?" "I do," says I, "but I don't understand yees." "Could you explain the sun's motion around the earth," says he. "I could," says I, "But I'd not know could you understand or not." "Well," says he, "we'll see," says he. Sure I didn't know anything how to get out of it thin, so I pulled in, for, says I to meself, never let on to any one that you don't know anything, but make them believe you know all about it. So, I says to him, takin' up my shillalah, this way (holding a very crooked stick perpendicular). "We'll take that for the straight line of the earth's equator." "How's that for geography" (to the audience). Ah, that was straight till the other day I bent it in an argument. "Very good," says he. "Well, says I, "now the sun rises in the east" (placing his disengaged hand at the east end of the stick). Well, he couldn't deny that. "And when he gets up he

Darts his rosy beams
Through the morning gleams.

Do you moind the poetry there? (to the audience with a smile). And he keeps on risin' till he reaches his meriden. "What's that?" says he. "His dinner time," says I. Sure that's me Latin for dinner toime. And when he gets his dinner

He sinks to rest
Behind the glorious hills of the west.

Oh, begorra, there's more poetry. I feel it creepin' out all over me. "There," says I, well satisfied with meself, "Will that do for ye?" "You haven't got done with him yet," says he. "Done with him," says I, kinder mad like, "what more do you want me to do with him. Didn't I bring him from the east to the west? What more do you want?" "Oh," says he, "you'll have to bring him back again to the east to rise next mornin'." By St. Patrick, but wasn't I near betrayin' my ignorance. Sure I thought there was a large family of suns, and they rise one after the other. But gatherin' meself quick, and says I to him, "Well," says I, "I am surprised you axed me that simple question. I thought any man 'ud know," says I, "when the sun sinks to rest in the west—when the sun," says I —"You said that before," says he. "Well, I want to press it stronger upon you," says I, "when the sun sinks to rest in the east, no, the west, why, he waits till it grows dark and then goes back in the noight time."

After our worthy president had smiled all over his good natured face, as well as the rest of the boys, he called upon Mr. Ptolemy, our latest member, to sing one of his astronomical songs, which he did in fine style, only one verse of which, for press of time, I am able to read to you:

Away, away, through the wide, wide sky,
The fair blue fields before us lie,
Each sun with the world's that around us roll,
Each planet poised on her turning pole,
With her isles of green, and her clouds of white,
And waters that lie like silver light.

I never heard him in better voice, which rang out in grand cadences in the soft moonlight, and he richly deserved the rapturous encore that was given him.

After the clapping had subsided the worthy president called upon Lawyer Culham for something, so he told an anecdote he had read that morning in the paper, about Pat and the lawyers, which is pretty hard on the profession, but it was too good a joke to be buried. At all events, it does not apply to Canadian lawyers, at least to Hamilton ones.

PAT AND THE LAWYERS.

While a number of lawyers and gentlemen were dining together at London, some time ago, a jollv son of the Emerald Isle appeared and called for dinner. The landlord told him he should dine when the gentleman were done eating. "Let him dine with us," whispered a limb of the law, "and we shall have some fun with him." The Irishman too his seat at the table.

"You were not born in this country," said one.

"No, sir, I was born in Ireland."

"Is your father living?"

"No, sir, he is dead."

"What is your occupation?"

"Trading horses."

"Did your father ever cheat any one while here?"

"I suppose he did, sir."

"Where do you suppose he went to?"

"To heaven, sir."

"Has he cheated any there?"

"He has cheated one, I believe."

"Was he prosecuted?"

"He was not," said Pat, "but he missed that because the man he cheated searched the whole kingdom of heaven and couldn't find a lawyer."

The president then called on Mr. Cloke for something, so he gave in his usual happy style a recitation on Books, the first verse only I have time to give you.

Books are a blessed dower, when they enshrine
  Thoughts, words and feelings of immortal men,
Gushes of glory from a fount divine,
  Flashes of freedom from the chainless pen,
Mirrors of mental light, condensed and strong,
  Pure treasures of philosophy and song;
Records of truth which all should understand,
  Voices of wisdom heard in every land:
I have a passion for each page of power,
  And love to try its spell at midnight's quiet hour.

(*Soto voice*: And afterwards, during business hours, sell the books.)

The president next called on Captain Hardy for a sea story, and he related the anecdote of The Sailor's Answer to Rufus Choate, the celebrated American lawyer, who in an important assault and battery case at sea, had Dick Barton, chief mate of the ship "Challenge," on the witness stand. Said Choate to him, "Now tell me in what latitude and longitude you crossed the equator." "I shan't," said Barton. "Ah, you refuse, do you?" "Yes, I can't." "Indeed, and you are chief mate of a clipper ship and unable to answer so simple a question?" "Why, I thought that every fool of a lawyer knew that there ain't no latitude at the equator."

The president next called on Adam Brown, Esq., the honorary president of our Astronomical Society, for something to entertain us, when he rose, in all the dignitv of his 6 ft. 2 in., built in proportion, and his fine manly voice gave utterance to the following question, "Who are the great?" and then answered it in these words, one verse only I have time to give you.

WHO ARE THE GREAT?

They who have boldly ventured to explore
  Unsounded seas and lands unknown before;
Soared on the wings of science, wide and far,
  Measured the sun and weighed each distant star;
Pierced the dark depths of ocean and of earth,
  And brought uncounted wonders into birth;
Repelled the pestilence—restrained the storm,
  And given new beauty to the human form;
Wakened the voice of reason, and unfurled
  The page of truthful knowlebge to the world;
They who have toiled and studied for mankind,
  Aroused each slumbering faculty of mind,
Taught us a thousand blessings to create:
  These are the nobly great!

When he had finished the entire poem thunders of applause broke forth and he was encored again and again. When quietness was restored the president called on Manager Strathy for a song, when he arose and said that as he had a slight cold he would not be able to do himself justice, but would tell a short story of a little Scotch boy and a dry pump, which he gave in his own peculiar smiling, good natured manner.

A DRY PUMP.

A small Scotch lad was summoned to give evidence against his father, who was accused of making a disturbance in the street. Said the Bailie to him: "Come, my wee mon, speak the truth and let us hear all ye ken about this affair." "Weel, sir," said the lad, "d'ye ken Inverness street?" "I do, laddie," replied his worship. "Weel, ye gang alang it and turn into the square, and across the square——" "Yes, yes," said the bailie, encouragingly——"on' when ye gang across the square ye turn to the right and up into High street, and keep on up High street till ye come to a pump." "Quite right, my lad, proceed," said his worship, "I ken the pump well." "Well," said the boy, with the most infantile simplicity, "Ye may gang and pump it, for ye'll no pump me."

The president called on all the other members of the society for their contributions to the entertaining program, in which Secretary Williams and Treasurer Green particularly excelled themselves, as well as did all the others, but lack of time tonight prevents me from giving a full account in this paper of what all said and did so happily.

The president then called on your humble servant to say something about the planet Saturn, toward which we were flying with the speed of lightning.

THE PLANET SATURN.

The planet Saturn may be justly considered as the most magnificent and interesting body within the known limits of our planetary system, so far as yet discovered.

With its eight satellites and rings it comprehends a greater extent of surface than even the planet of Jupiter, great as that planet undoubtedly is. Its majestic and magnificent rings are the most singular and wonderful phenomena that have yet been discovered by mortal man, and it mav be called the sovereign planet of the skies.

Each person present has no doubt often seen Saturn with the naked eye, presenting no appearance of beauty, grandeur or brightness, but shining as a dull nebulous star, scarcely worth looking at, as there appears nothing to attract our attention, but the moment we place our eye to a good telescope, it sents a more singular and magnificent appearance than any other body connected with the Solar system, and were it as near to us as Mars, or even Jupiter, it would present a glorious aspect even to the naked eye.

The ancients, with all their close attention and observation of the heavens, could form no idea of the greatness and grandeur of the planet Saturn, as they had no telescope to assist their vision, and their astrologers viewed the planet, on account of its pale leaden color, as a cheerless unfortunate planet that shed an evil influence upon the inhabitants of the earth, but after ages of darkness and superstition had passed away, and man's inventive facilities in optics had invented the telescope, which enabled him to see farther into the mysteries of the blue vault above us, and behold the small, pale, leaden colored nebulous appearing planet, suddenly flash out before the astonished eyes of the beholder as a system of revolving bodies around a planet and a portion of celestial mechanism more glorious and magnificently disclosed to wondering eyes than any other object of our solar system.

During the infancy of the telescope, when it was in an imperfect condition, the early observers with their crude instruments for a long time could not make out the true form of Saturn, the ring or rings surrounding the body of the planet was a subject of great mystery, and gave rise to controversies and conjectures for nearly 50 years after the invention of the telescope, before its true form and nature were correctly ascertained.

One observer said he thought he saw it appear like two smaller globes on each side of a large one, as seen in Fig. 1, Plate 1. After viewing it for two years he thought he saw it change to a round figure without the globes at its sides, and some time afterwards to appear in triple form.

A German astronomer published a representation of Saturn, in which the planet is represented as a large central globe with two smaller bodies, one on each side, partly of a conical form, attached to the planet and forming part of it, as shown in Fig. 2.

An Italian astronomer imagined he saw it is shown in Fig. 3, a central globe with two conical shaped bodies completely detached from it.

Hevelius, a celebrated astronomer, made many observations on Saturn, in which he appears to have obtained different views of the planet, approaching to the truth, but still incorrect. These views are seen in Figs. 4, 5, 6 and 7.

Fig. 4 nearly resembles two hemispheres one on each side of the globe of Saturn.

Another later astronomer thought that the planet was inclosed in an elliptical ring, but this ring was supposed to be fixed to its two opposite sides, as shown in Figs. 8 and 9.

Fig. 10 is a representation of Divini, another Italian stronomer, at a still later date, in which the shades of Saturn and the eliptical curve are incorrect, as the planet does not represent any such shadowy form. Divini seems to have conceived that the curve on each side was attached to the planet, but when Huygens published his discovery of the ring of Saturn, Divini contested its truth because he could not perceive the ring through his own telescope, and so there was a wordy war between the two astronomers for some time, one making assertions about the rings and the other denying the same.

Fig. 11 is the representation given by Fontana, a Neapolitan astronomer, in which he represents Saturn as having two crescents, one on each side attached to its body, with intervals between the planet and the crescents.

Fig. 12 is a view represented by Gassendus, a celebrated French philosopher, in which he represents the planet as a large ellipsoid having a large circular opening near each end, and if the representation were the true one each opening would be 30,000 miles in diameter.

Fig 13 is a very singular form given by Ricciolus (Ret-sho-lus), representing two globes, 30,000 miles in diameter, one on each side of the planet, which he thought were connected to the body of Saturn by curved bands.

Thus it was in the early days of the infant telescope that only two general opinions were formed by the philosophers regarding the construction of Saturn, either that the planet was composed of three distinct parts separate from each other or that the appendage on either side of it was attached to the body of the planet.

The idea of a ring surrounding the body of Saturn at an equal distance from every part of it seems never to have been thought of until Huygens, by numerous observations, proved that the planet is surrounded by a permanent ring, which never changes its position, and accompanies the planet in its revolution around the sun in 29½ years.

All the contentions, arguments and disputes about the planet Saturn that took place some 250 years ago were due to the imperfection of the telescope then in use among scientific men. Galileo's best instrument magnified only about 33 times, and to Huygens belongs the credit of being the first to improve it, for he set to work with his own hands to grind, polish and mount his telescope, and produced lenses more correct and of longer focal distance than any that had been previously accomplished.

He first constructed a telescope 12 feet long, then one 23 feet long, magnifying 95 times, and afterwards made one 123 feet long, magnifying about 220 times. By means of his improved telescopes Huygens discovered the true form of the ring about Saturn, which he found to be completely surrounding the planet and entirely detached from it, thus forever setting at rest the disputes and quarrels of the scientists of those days concerning the mysterious form of Saturn's appendages.

At a later date Herschel came upon the scene with his improved telescopes and made many observations on the planet, and he discovered that the ring revolved around the planet in 10 hours and 30 minutes. Then later astronomers, with still further improved telescopes, having greater defining power, discovered that what appeared one ring around Saturn is really a series of concentric rings entirely separated and revolving at a tremendous speed around the planet, affording a most wonderful combination.

Plate 2 represents the view of Saturn, which I have drawn from a small picture as seen through the Lick telescope. And I may here remark, in passing, that Saturn does not always present this view to us, of our looking upon the surface of the rings. I find that in the Journal of Astronomical Society of Wales, our Mr. Jenkins made an observation on Saturn in 1895, March 9th, at 5.15 a.m., with a power of 180 in a 5-inch Wray telescope, from which he made a drawing of the planet, then showing the under side of the rings just the same as the Lick telescope shows it, only reversed. [Reverse the picture.] The one showing the top surface of the rings, and Mr. Jenkins the under side of the rings, as the planet appeared at that time.

The distance of Saturn from the Sun is 906,000,000 miles, and its diameter is about 79,000 miles, nearly ten times the size of the earth. Our earth revolves around the sun, as you all know, in 365¼ days, or one of our years, but Saturn takes much longer, viz., 29½ of our years to complete the revolution around the sun, and whirling at the speed of hundreds of miles per minute.

The outside diameter of the exterior ring is 204,800 miles, which is nearly 26 times the diameter of the earth; the inside diameter of the exterior ring is about 190,200 miles, leaving the width of the dark space between the outer and inner ring about 2,839 miles, large enough for our moon to pass through .

The outside diameter if the interior ring is 184,400 miles, and the inside diameter is 146,300. The width of the exterior ring is about 7,200 miles, and the width of the interior ring is about 20,000 miles. The interior ring is about three times broader than the exterior ring.

These figures vary somewhat with different astronomers, but they may be taken as an average, more or less.

It is difficult for us to form a just conception of the great magnitude and mechanism of Saturn's ponderous, magnificent and wondrous rings. Imagine, if you can, the immense size of the space enclosed by the inner ring, which is large enough to contain 340 globes as large as our earth, and the outer ring could enclose within its inner circumference 575 globes of the same size, supposing every portion of the space to be filled. The outer ring is large enough to contain a globe containing more than two thousand eight hundred billions of cubical miles, which would be equal to more than 10,800 globes of the size of the earth.

The two rings contain, on one side, above 14,400 millions of square miles, and as the other sides of the rings contain the same extent of surface, the whole superficial area of both rings will amount to more than 28,800 millions of square miles, more than 146 times the number of square miles on the surface of the earth. If these rings were inhabited, or intended to be inhabited, they could accommodate a population of 8 billions of inhabitants, or more than 10,000 times the population of our earth, so that these rings, sized up with reference to their space area would be considered in one point of view eaual to 10,000 worlds.

If we take into consideration the thickness of the rings, which are supposed to be from 100 to 250 miles, the area would be much increased, as the edges alone of the rings is 228,000,-000 of square miles, which is 31 millions of square miles, more than the whole area of our globe; large as it appears to us it is small when compared with Saturn & Co.

It is found that this giant planet of the sky whirls swiftly on its axis, making a complete revolution in 10 hours and 16 minutes, the rings sweeping around the planet in the same direction.

When we approached nearer to the golden ringed planet and perceived its glorious features more clearly, when its ample burnished surface and mighly rolling rings burst on our astonished gaze, we could not help thinking that here was food for the philosopher, the artist, the minister, the poet, the scientist, the astronomer, and last but not least, the camera fiend.

The dazzling grandeur of the planet and its mighty rolling rings seemed to our astonished gaze as the very pearly gates of heaven. A new life seemed to creep into our veins as we neared the golden planet, and all thoughts of our earth and its pleasures were forgotten as we gazed spell-bound before the mightiest display of beauty, magnificence, grandeur and power of the Creator that we had ever dreamed about. It was soul-soothing and awe-inspiring as we sailed towards the planet through the azure sky, glowing with golden beams of beauty as the grand, tremulous and dazzling rings swept majestically around the mother planet as on an axle, and whirling swiftly around it in 10 and one-half hours, and as the outer ring in circumference is about 643,650 miles, you can imagine how fast the ring must move in order to complete its rotation around the planet, in 10½ hours. In figuring it out we found that every point of its outer surface moves with a tremendous velocity of 1,000 miles every minute, or 17 miles during one beat of the clock. It seems to us impossible that such a mass of matter should move so fast, but yet it is so, and it is probable that this rapid motion of the rings is one of the principal causes its great Creator has arranged for sustaining and preventing them from collapsing and falling down upon the planet.

Saturn is 9½ times farther from the sun than we are, in round numbers being 906 millions of miles from the sun, and consequently will receive only one-nineteenth of the light of the sun which we receive, yet Saturn's light is, however, equal to the light which would be reflected from 1,000 full moons such as ours.

Saturn is provided with horizontal belts, similar in form to those of Jupiter, but they cover a larger space on the planet than do those of Jupiter, and do not seem to shift their positions as do those of Jupiter.

On our getting still nearer to the planet our senses became more than overpowered with its increasing magnificence, brightness and grandeur. Imagine the lovely king of planets, swiftly rotating, its grand old gigantic rings whirling so swiftly round it, and occupying one whole quarter of the sky, and its eight moons revolving around the planet and rings, some of the moons 60 times larger in apparent size to our own moon, imagine all these moons appearing in one part of the heavens, sometimes in another, changing their phases and apparent magnitude and distance from each other, every hour, appearing sometimes like a large crescent, sometimes like a small one, sometimes with a full enlightened face, one moon rising, another setting, another in the zenith, all casting different and opposite shadows. Let us imagine these and many other diversified phenomena presenting themselves with increasing variety in the canopy of heaven, and we shall have some faint idea of the grandeur and beauty of the Saturnian sky.

No artist, however great, or talented, could draw or paint the true grandeur and magnificence of Saturn and its rings and moons as they appeared to us in all their beauty of light, form, motion and color.

If the planet is inhabited those who live on the side of the rings will see one-half of the hemisphere of Saturn, which will fill, perhaps, the one-fifth or one-sixth part of their celestial hemisphere, while the other portions of the planet will be hidden by the interposition of the rings. Those who are near the interior edge of the interior ring are only 30,000 miles from the body of the planet. Consequently all the varieties of water, hill and dale will be distinctly visible, very much more so than the moon is to us, the distance being very much less. Those near the outer edge of the exterior ring are about 60,000 miles distant from the planet, which will consequently appear to them four times less in size than to those on the side of the inner ring, but being only 18,000 miles from the first satellite at the time of its opposition to Saturn, that satellite will present an object more than 350 times larger than our moon to us, which will rapidly assume different phases, and will be continually varying in its its apparent magnitude, and at its greatest distance beyond the opposite side of the rings it will appear at least 170 times less than when at the nearest point of its orbit, and all the intermediate varieties of magnitude and appearance will be accomplished within less than two days, so that this satellite will be continually changing its apparent size from an object two or three times the apparent bulk of our moon to one 350 times greater. Just imagine our moon gradually enlarging in appearance from its present size at full moon to 350 times larger in the short space of two days, and you may imagine the glory and grandeur it would convey to our senses in the great variety of its light and shade.

If lovers are accused of admiring the soft silver light of our beautiful moon at the full, which time is usually held to be most favorable for "popping the question" and answering the same, with what rapture they would hail the increased glory and magnificence of the moonlight on Saturn.

The same may be affirmed in respect to the other seven satellites, with this exception, that they will appear of a smaller magnitude, and the periodical times of their phases and the changes in apparent magnitude will be different.

There will be again another object to diversify the firmament of those who are on one if the sides of the rings is the opposite portions of the rings themselves. These will appear proceeding from each side of the planet like large broad arches of light, each of them somewhat less than a quadrant, and will fill a very large portion of the sky, so that the inhabitants of the same world will behold a portion of their own habitation, forming a grand and conspicuous part of their celestial canopy, and at first view may imagine that it forms a celestial object with which they have no immediate connection. Were they to travel to the opposite side of the ring thev would see the habitation they had left suspended in the firmament, without being aware that the spot which they had left forms a portion of the phenomena thev behold.

As the rings revolve around the planet, and the planet revolves on its axis, the different parts of the surface of the planet will present a dissimilar aspect and a variety of sublime scenery will be presented to view.

The eclipses of the sun and the satellites, by the interposition of the body of Saturn and of the opposite sides of the rings, will produce a variety of very striking phenomena, which will be changing every hour and fill the mind of the beholder with wonder and delight.

From the dark sides of the rings, which are turned away from the sun for 15 years, a great variety of interesting light and shade will be presented, and during this period the aspect of the firmament will in all probability be most weird and striking. The shaded side of the rings will not be in absolute darkness during the absence of the sun, for some of the 8 satellites will always be shining upon it, sometimes three, sometimes four, and sometimes all the eight in one bright galaxy of glorious moonlight hundreds of times brighter than our clearest moonlight.

It is probable, too, that the planet itself, like a large splendid crescent, will occasionally diffuse a mild splendor, and in the occasional absence of these the fixed stars will display their radience in the heavens, which will be the principal opportunity afforded for studying and contemplating these remote luminaries.

Those who are on the outermost ring will behold the other ring and the opposite parts of our own like vast arches in the heavens ,and although only 2,800 miles intervene between them, that space may be as impassable as is the space which intervenes between us and the moon.

If the two rings have a rotation around Saturn in different periods of time, as is most probable, it will add a considerable variety to the scenery exhibited by the different objects which will successively appear in the course of the rotation.

As we were rapidly nearing the planet and gazing in wonder and delight at its growing grandeur and magnificence, with its giant rings now appearing to reach across the whole heavens we could not help exclaiming: How beautiful the Saturn sky, whose starry rings and moons now spread amid the purple depths of eve, their glories o'er my head; but now that knowledge great and high, is kindled in man's soul, we know thee, Saturn, but a more glorious part of a more glorious whole.

Then the thought struck us, Oh! for one hour of quiet delight to sit upon the highest peak of the outer ring of Saturn, as on a throne, and muse on the lovely surrounding scenes of grandeur and sublimity, which no picture even seen on earth or in the heavens surrounding the earth, could bear any comparison to.

Our intention then was to land on the outer ring which seemed at that distance to be of the same solid material as the planet itself, and noted that there were actually three rings, one inside of the other on the same plane, and all whirling rapidly around the planet.

We had not proceeded, however, much further on, when all of a sudden a voice seemed to come from the heavens, exclaiming in good English: "Halt; go no further. What seek ye, and whence come ye?" Our car was instantly stopped, and our worthy president, being so conversant with the heavens, was not in the slightest degree afraid, so answered the voice by saying, "We came from that little planet called the Earth, which is shining away in the distance as a little star of the ninth magnitude, just barely visible, and we want to know something more about the glorious world of Saturn and its magnificent appendages, and whether it is the abode of angels or men like ourselves." And the unseen voice spoke again to us, saying: "My friends, we honor your ambitious desire to learn something more of creation's wonders above you, and it is a laudable ambition, but the time is not ripe for your entrance into the celestial regions of our planet and its rings, which are set apart for the spirits of those on your earth who have obeyed the golden rule sent you some time ago, 'Do unto others as you would that they should do unto you.' Then when your fellow inhabitants of all parts of your earth have learned this lesson thoroughly in practice, you will receive a cordial invitation to the celestial regions of Saturn, where you may have a lovely mansion on the outer ring surrounded with every beauty to please, delight and fascinate the mind. Glorious scenes, eminent companionship, everything you wish for, you will get, knowing that you will only ask that which is good for you. Go back and teach your fellow citizens this simple rudiment of proper living, and all things else shall be added unto you. Adieu."

So our aerial ship was turned around and headed for the earth, and as we were starting on our homeward journey the president called upon Rev. Mr. Howitt to say something before leaving the proximity of Saturn, which he did in the following words:

"Roll on, ringed Saturn, forever roll,
Thou giant rushing through the heaven,
Creation's wonder, nature's soul,
Thy golden wheels by angels driven—
Roll on, majestic planet, King sublime,
Thy glorious rings light up the pearly gates of Heaven.
Fare-ye-well till we meet again."

LOOKING UP AND LOOKING DOWN.

Given before the Astronomical Section of the Hamilton Scientific Association, April 3rd, 1903.

BY JULIUS M. WILLIAMS.

This was an object lesson for beginners in the art and science of astronomy. The illustrations covered the phenomena observed by an observer standing in a northern latitude, and showed how the accepted up and down was arbitrary and that there is no up nor down. The phenomena included day and night, winter and summer, sunrise and sunset, moons rising and setting, and phases, eclipses, occultations, morning and evening star, meridian, latitude, longitude, elevation, declination, and many definitions and terms were exemplified by a set of models prepared by the lecturer for the occasion. They were a Sun (a white globe with incandescent light, on which sun spots were to be found as it rotated); the Earth, with a white moon attached; the planets, Mercury, Mars, Venus, Saturn and Jupiter. By means of these models occultation and eclipse, morning and evening stars, were very nicely exemplified and were pronounced very realistic, the moon's quartering being particularly good; the sun in the darkened room illuminated one side only of the moon, there being practically no reflected light. The demonstration was commended by Dr. Marsh and Mr. G. Parry Jenkins, F. R. A. S.

It is proposed to give the demonstration at the commencement of the next season, as being a first lesson in astronomy and being illustrated by models it is thought it will be a good introduction to the season's lectures.

DETERMINATION OF TIME AND THE TRANSIT INSTRUMENT (ILLUSTRATED).

Read before the Astronomical Section of the Hamilton Scientific Association, March 20, 1903.

BY MR. F. L. BLAKE, O. L. S., D. L. S.

In presenting this paper before you to-night I do not intend to advance any new principle or theory but simply to tell in plain language to those members who have not studied or had the opportunity of seeing or handling the transit instrument the method and means by which we obtain time and put the transit instrument in adjustment for that purpose. Most of this paper may be found in any good standard work, such as Chauvenet's Spherical and Practical Astronomy, or Loomis' book on the same subject, and indeed the language and description contained in those books can hardly be improved upon; therefore, I thought that a short description, with illustrations, might be of more interest than poring over the same subject in books without any one to enlighten you upon the difficulties that might be encountered.

First of all, in regard to time, it is of indefinite duration, having no comprehensible begining or ending; in fact, you might say it is a species of motion with no beginning or ending, and to effect any measurement of a portion of this duration or motion we must choose some arbitrary unit. Any succession of events taking place at equal intervals of time, such as the oscillations of a pendulum, the flowing of a certain quantity of liquid from one vessel to another, the diurnal rotation of the earth on its axis or its annual revolution around the sun, would be convenient and useful methods of measuring portions f time. Of the latter two the daily revolution of the earth on its axis is at once the most accurate being uniform, and possessing practically that necessary qualification for a standard unit, namely invariability.

This time of rotation is called a sidereal day, and is measured or determined by two successive transits or passages of a star across the meridian of the place, and is sub-divided into hours, minutes, etc., called sidereal time. The sidereal day may be considered as one revolution of the celestial sphere, and every point of it is twice on the meridian at points which are 180 degrees distant apart, and it is therefore necessary to distinguish between the two transits. The meridian is bisected at the poles of the equator, and the transit over that half of the meridian, which contains the observer's zenith, is called the upper transit or culmination. The transit over the other half is called the lower transit or culminator.

The sidereal day begins when the vernal equinox is on the meridian, and may be more accurately defined as the interval between two successive returns of that point to the same meridian. The interval between two successive returns of the sun to the same meridian is called a Solar day. Owing to the motion of the Earth in its orbit around the Sun it gives an apparent motion to the latter eastward among the stars in the celestial sphere. Hence the Solar day is longer than the Sidereal day by the time necessary to catch up to this daily apparent motion of the Sun. It is also not uniform, owing to the eccentricity of the orbit of the earth, and to the Sun moving in the ecliptic instead of the equator, equal changes of longitude not producing equal changes of R. A. Now to obtain a uniform measure of Solar time a fictitious sun is supposed to move uniformly at such a rate as to return to perigee at the same time as the true sun. Another fictitious sun, called mean sun, is supposed to move uniformly in the equator at the same rate as the first fictitious sun, and to return to the Vernal Equinox at the same time with it. Then the time denoted by the second, or mean sun, is perfectly uniform in its increases and is called mean solar time. The time used in Ontario and Quebec is this time referred to, the 75th meridian, and is commonly known as standard time, and is the time kept by watches and clocks in general use. The time denoted by the true sun is called true or apparent time. This is the time shown by a sun dial. The transit of the true sun is called apparent noon, and the transit of the second mean sun is called mean noon. A knowledge then must be had of the daily differences between the true and mean suns; this difference is called the equation of time, and is tabulated each day of the year in the Nautical Almanac.

Thus, by the revolution of the Earth on its axis we can obtain measures of time of different values according to the reference points in the celestial sphere. By referring the meridian to transits of the stars we obtain sidereal time, to that of the true sun we have apparent solar time, by the mean sun mean solar time, and if we take the Moon, apparent lunar time, and so forth.

Time is almost universally obtained at observations by star transits, occasionally supplemented by solar transits. These observations are made with the meridian transit instrument, which is generally fixed so as to be used as nearly as can be in the meridian only. The ordinary surveyor's transit is in reality a small portable transit, and is capable, when well made and used with care, to give results especially in time work with almost the precision of a large stationary transit in an observatory. There are a variety of forms in transit instruments, but the most common in use is that in which the telescope and horizontal axis bisect each other, and the two ends of the axis, called pivots, are supported on pillars with V-shaped tops, in which the pivots revolve.

In the principal focus of the objective is placed a ring, upon which is fixed five or more parallel threads made from spider lines or very fine drawn platinum wires. Sometimes these are replaced by a glass diaphram with ruled lines. The threads when in proper adjustment should be parallel to the vertical plane of the telescope and perpendicular to the optical axis. This ring is held in place by four screws, by means of which the wires are properly adjusted. The wires are rendered visible at night by light thrown into the interior of the telescope through the hollow rotation axis from a lamp, and is reflected down the telescope by a small silvered mirror at the intersection of the rotation axis and the axis of the telescope. The small mirror does not interfere with the rays from the object glass. The instrument can also be reversed upon its rotation axis to eliminate instrumental errors, that is, to make the east and west ends of the axis change places.

The principal sight line is marked by the centre thread or wire of the reticule, and is a line drawn from the middle of that thread through the optical centre of the object glass. This line is technically called the line of collimation. The optical axis of a lens is the line which joins the centres of the spherical surfaces of the lens, and in a telescope properly constructed the axis of the object-glass and eye-glass should lie in the straight line joining the centres of the object-glass and eye-glass. This line is called the optical axis of the telescope.

Before going further in the description of the transit instrument I will digress a little and tell you of the instruments for measuring time. There are several mechanical contrivances that are now in general use for measuring time, viz., sun dials, watches, chronometers and clocks. Of these the former, simply by means of a gnomen placed at the proper angle, throws the shadow of it cast by the sun on to a dial marked with hours sub-divided generally to five minutes. This gives apparent solar time, and of course can only be read while the sun is shining.

Chronometers are very perfect watches, with a compensation balance wheel to overcome the changes of temperature. They are usually of two kinds, Solar and Sidereal, beating half seconds. In some chronometers an electrical break circuit attachment is provided, to be used in connection with a chronograph.

The ordinarv every-day clock in use records mean solar time, but for astronomical work a better and more perfect clock is needed. The very best workmanship and material is put into its construction and the best of care and attention given it. It is provided with a seconds compensated pendulum, by which the effect of changes of temperature is better eliminated than in chronometers. There are two forms of pendulums in use, the Harrison, or gridiron, and the mercurial pendulum. The latter kind is in use in the Toronto Observatory. In the gridiron pendulum the rod is principally composed of a number of parallel bars of steel and brass so connected together that the expansion of the steel bars tends to lower the bob of the pendulum, and the greater expansion of the brass to raise it, so that when the total lengths of the steel and brass bars are properly adjusted a perfect compensation occurs, the centre of oscillation remaining at a constant distance from the point of oscillation. In the mercurial pendulum the weight which forms the bob is a cylindrical glass vessel nearly filled with mercury. With an increase of temperature the rod lengthens, but the mercury expanding must rise in the cylinder so that when the quantity of mercury is properly proportioned to the length of the rod the centre of oscillation, as with the gridiron pendulum, remains at the same distance from the point of oscillation. To clocks that are exposed to sudden changes of temperature, the gridiron is preferable to the mercurial pendulum, as the large body of mercury takes up the air temperature more slowly than the thin metal rods.

All observatories, as a rule, have at least two clocks, one standard clock keeping sidereal time and one keeping mean solar time of the meridian in use. They are carefully mounted on stone piers, which are disconnected from the walls or floors, and are also protected as much as possible form sudden changes of temperature.

Used in connection with both clocks is an electro chronograph, of which there are various forms, a description of which I will not here enter upon, as it would make my paper too lengthy, but suffice it to say that they are contrivances for recording the clock beats on paper with a pen or pencil held in an electro magnet. The paper is wound on a cylinder about seven inches or more in diameter, driven by clock work at a speed which will make the seconds marks on the paper about an inch apart, and thus enabling the smallest fractional portion of a second to be measured. The connection of the clock with the chronograph is made either with a break or a make circuit. The latter is in use in the observatory here on the sidereal clock, while both circuits are on the mean time clock.

Returning to the transit instrument. The transit instrument should be so placed that the telescope, if turned down to the horizon, points to the north and south, or the axis, H. B., be exactly directed east and west, then the vertical line described by the telescope must be the meridian. This, however, supposes three conditions to be fulfilled with absolute precision:

1st. The axis A. B. must be level.

2nd. The line of collimation must be perpendicular to it.

3rd. It must be directed due east and west.

In the original construction and mounting of the instrument these three conditions are kept in view, and are nearly but cannot be exactly fulfilled in the first instance. In all astronomical instruments the conditions they are required to fulfil are only approximated to in the making and mounting, and a means of adjustment are in all cases provided, by which each of the required conditions, only nearly attained at first, are fulfilled with infinitely greater precision. In all such adjustments two provisions are necessary. 1st, a method of detecting and measuring the deviation from the exact fulfilment of the requisite conditions, and secondly, an expedient by which such deviation can be corrected.

Before proceeding with the principal adjustments just named, a minor one has to be performed, that is to obtain distinctness of vision and parallax. The wires or spider lines should be in the common focus of the object-glass and eye-glass. In order to place them in the focus of the eye-glass, push in or draw out the eye tube until they are seen with perfect distinctness. Now, if the wires are not in the focus of the object-glass when the telescope is pointed toward a distant mark, if the eye be moved a little to the right or left the mark will appear to move with reference to the wires. To remedy this the object glass or the wires must be moved in the tube until the parallax is corrected. If after this adjustment the telescope in the meridian be pointed at a star, and the star allowed to run along the horizontal wire, and if it does not remain perfectly bisected while the eye is moved up or down, the adjustment for parallax is not complete and must be gone over again.

Now to make the axis, A. B., level. This is done by means of a striding level, a glass tube nearly filled with spirit of wine or sulphuric ether, being portion of a ring of large radius. The striding level of the transit instrument of the Toronto Observatory has a radius of about 760 feet. The level is provided with means of making horizontal and vertical adjustments. Each foot of the level has two planes inclined about 70 degrees and forming a V, so as to rest upon the points of the transit. The level should be so adjusted that its axis may be parallel with the axis A. B. of the transit. Place the level upon the pivots of the axis, and by turning the screw which lowers or raises the end of the axis, bring the bubble of the level to the centre of the glass tube. Then reverse the position of the level on the pivots of the axis, and if the bubble settles in the same position as before we can conclude the axis of the transit is horizontal, but if the bubble does not return to the centre the amount of this difference will be equal to twice the inclination of the axis to the horizon. To remedy this turn the screw at the end of the axis so as to move the bubble over half this distance, and then raise or lower the vertical adjustment of the level until the bubble is in the centre of the tube. It is difficult to make this adjustment perfect at a single trial, and the operation must be repeated until the bubble occupies the same place in both direct and reversed positions of the level. When this is done satisfactorily the level will be in a plane parallel to the axis, A. B., but not necessarily parallel to one another. To determine whether such is the case, revolve the level slightly upon the axis of the transit. If the bubble changes its place the axis of the level must be inclined to the axis of the transit, and we must turn the screws of the horizontal adjustment for the level either backward or forward until a slight rotation of the level about the axis A. B. causes no sensible change in the position of the bubble. The former adjustment must now be verified again.

Before proceeding with the second adjustment, that is the line of collimation, the wires have to be made perpendicular. Direct the telescope upon a small, well defined distant object, and if on moving the telescope in altitude the mark is perfectly bisected by the central wire from top to bottom this wire is perpendicular to the horizontal axis A. B., if not the ring or tube containing the wires must be turned around until the mark is bisected by all parts of the wire.

To make the line of collimation perpendicular to the axis, it must be remembered that the line of collimation is a line drawn from the centre of the object-glass to the intersection of the middle wires in the field of view of the telescope. The centre of the object-glass is fixed relatively to the telescope, but the wires are so mounted that the position of their intersection can be moved through a certain small space by means of screws. One end of the line of collimation therefore being movable, while the other is fixed, its direction may be changed at pleasure within limits determined by the construction of the eye-glass and the screws. This line of collimation is called the principal sight line.

To ascertain whether the line of collimation is or is not at right angles to the line joining the points of support, A and B, let any distant point be observed upon which the intersection of the wires falls. Let the instrument be then reversed upon its supports, the end of the axis which rested on *a* being transferred to *b*, and that which rested on *b* to *a*, and let the same object be observed. If it still coincides with the intersection of the wires, the line of collimation is in the proper direction, but if not, its distance from the intersection of the wires will be twice the deviation of the line of collimation from the perpendicular, and the wires must be moved towards the object through half of its apparent distance from it.

To render this more clear, let A B represent the direction of the axis, C D that of a line exactly at right angles to it, or the direction which is to be given the line of collimation, and let C D represent the erroneous direction which that line actually has. Let S be a distant object to which it is observed to be directed, this object being seen upon the intersection of the wires. If the telescope be reversed the line C D will have the direction C D, deviating as much from C D to the right as it before deviated to the left. The object, S, will now be seen at a distance to the left of the intersection of the wires which measures the angle D1, C D2, which is twice the angle D C D1, or the deviation of the line of collimation from the perpendicular D C. In whatever position the instrument may be placed the rotation axis is an imaginary line passing through the central points of the pivots, and the axis of collimation an imaginary line drawn from the optical centre of the object-glass perpendicular to the rotation axis, and describes a great circle in the heavens when the telescope revolves. Now the position of this great circle is fullv determined when we know the position of the rotation axis, or in other words, when we know the altitude and azimuth of the points where the rotation axis produced meets the celestial sphere. The instrument is said to be in the meridian when the great circle described by the axis of collimation is in the meridian. The axis of rotation is then perpendicular to the plane of the meridian and lies in the intersection of the prime vertical and the horizon. Now, if the centre thread on which a star is observed is in the axis of collimation, the time of observation is that of the star's transit over the meridian. The sidereal time at that instant is equal to the star's R. A. The error of the clock on sidereal time is obtained at once by taking the difference between that R. A. and the clock time of transit. These conditions are very rarely exactly fulfilled, but small corrections must be made to the time of observation for small deviations in the three principal adjustments. These corrections are denoted by the small italic letters, *a*, *b* and *c*—*a* is the excess of the azimuth of the axis above 90 degrees (reckoned from the north), and is called the azimuth constant; *b* is the elevation of the west end of the axis, and is called the level constant; *c* is the inclination of the sight line to the collimation axis, and is called the collimation constant. I have already shown how *b* and *c* are reduced to zero, or a very small quantity. To reduce *a* to a small quantity, or to make the approximate adjustment in the meridian, we must have recourse to observation of the stars. The star most suitable for this purpose is the Pole star (Ursae Minoris). Compute the mean time of its transit, and for the purpose of a first approximation your watch may be used. Bring the telescope upon it at the calculated time by moving bodily the frame of the instrument horizontally. Then level the axis and take the time by the sideral clock of the transit of a star very near the zenith. The time of the transit of a star near the zenith will not be much affected by a deviation of the instrument in azimuth, as all vertical circles intersect each other in that point. The difference between the star's R. A. and the clock time will be the approximate error of the clock on sideral time. Knowing the clock error we can repeat the process upon another slow moving star, employing the clock and causing the middle wire to follow the star by moving only the azimuth V. The instrument should now be very close to the meridian and can be further tested by other stars. All outstanding small deviations represented by the small letters, *a*, *b* and *c*, can be found and allowed for by methods which do not concern us in this paper.

TO THE NORTH POLE.

Synopsis of an address to the Astronomical Section of the Hamilton Scientific Association, June 10th, 1902.

BY CAPTAIN J. E. BERNIER.

As a Canadian he felt proud to explain to the people assembled his plans in regard to his proposed trip to the North Pole. Both the north and south poles are attracting universal attention, and by reaching these points not only will a great achievement have been accomplished, but geography will be facilitated, as observations can be taken from the extreme points of the globe.

While over in England in 1898 he became acquainted with an arctic explorer, and contracted the "polar fever," the result being that he has studied the questions ever since.

During the course of his lecture he had a number of charts thrown on the screen, showing the routes taken by former explorers. With these, and other illustrations of a like character, he enabled his audience to gain a clear and comprehensive idea of the polar region.

The route he proposes to take is better, in his opinion, than that taken by former explorers, as his will be a slow drift, while some of the others had to contend with the ice coming from the pole, caused by the rotation of the earth and the discharge of rivers from Siberia.

Referring to other explorers and the great difficulties they had to contend with, he mentioned Captain Parry, Captain Bauendahl, Captain Tyson, Lieut. Peary, Mr. Wellman, the Duke of Abruzzi, Prof. Andree and a few others.

After having referred at some length to these, he came to his own proposed trip. In the first place, he needed money. The Dominion Government had granted him $80,000, and he had received $30,000 from the general public, and as soon as he received $30,000 more he would start.

The boat he would make the trip in would be what is called a three-masted topsail schooner, requiring a crew of only fifteen men, which, he added, would be composed of Canadians. The vessel was to have two boilers, steel lower beams to resist the pressure of the ice, and a large number of bulkheads, which made her practically unsinkable.

He intended to start from Vancouver or Victoria, coast Vancouver Island, and stop at Port Clarence, where he expected to get news of the north from the whalers. Proceeding, he would pass through the Behring strait, and on north to where the ice drift begins. It has been ascertained that the ice in that particular region drifts bodily towards the pole and out by the Atlantic. Captain Bernier proposes to take advantage of this, fasten his ship in the ice, and leave the rest to nature. When he is within about 150 miles of the pole, which can be ascertained by sights and reckoning, he proposes to travel the rest of the distance by sled.

It will take about two years for the drift of the ice to bring him within such a distance from the pole.

He will be well prepared for the final dash, being equipped with aluminum rods filled with compressed food. Each day an officer with a detachment of men will travel towards the pole and stick these rods in the ice at equal distances from each other and then return. This will be continued for a while, after which the final rush will be made, the explorers being guided by the line of rods and encouraged by knowing that food is ahead, although it is compressed in aluminum rods.

When possible he proposes to travel over the ice on a motor sleigh, which is composed of a common sleigh with a revolving roller. He also described the other requisites necessary for an exploration of this kind, and at the close of his lecture was presented with the following resolution from the society proposed by J. A. Culham and seconded by Rev. F. E. Howitt:

"Resolved, that from a physiographical, geological and magnetic standpoint, it is most desirable to complete the survey of the Arctic sea, and we deen Captain J. E. Bernier a most capable person to carry out such an undertaking. We beg, therefore, to recommend him to the Dominion and Provincial governments, and also the general public, and ask for him their support to enable him to carry out his contemplated expedition; and that a copy of this be forwarded to the Dominion and Provincial governments."

ROMANCE OF ASTRONOMY.

Synopsis of a lecture delivered before the Astronomical Section of the Hamilton Scientific Association

BY REV. G. F. SALTON.

The lecturer gave a general definition of the word power. The waters of Niagara were brought great distances and carried over the Falls. This was accomplished by some great power. If the sun were a solid mass of coal it would burn out in 5,000 years. Yet it went on blazing for millions of years. The sun was the active power of Him who said, "Let there be light." The sun is the centre of our solar system; around it all the other bodies revolve. In travelling on railways we might turn in many circles, but would not know this without the aid of the compass. This was so on the earth, but we did not know whether man would last long enough to see the compass make one complete circle. He showed how we were moving from some stars and going nearer others, and explained the development of photographs of the heavens taken at night. Some of the most important discoveries that had been made were accomplished by poor telescopes and amateur observers. The speaker then took his audience on a travel among the heavenly bodies, starting at the sun and touching Mercury, Venus, the Earth and Mars, and then into space, giving statistics of the great distances between each planet.

He said it would require a very powerful telescope to penetrate the milky way in the heavens, but when it was penetrated vast multitudes of stars were beheld. To give an example of the distances apart of some of the planets, he said that if on certain planets they could perceive through the telescope the battle of Waterloo, they would just be beholding it now. He gave a description of temporary and runaway stars, their actions in the heavens, and how some of the most brilliant stars came into view and faded away.

The lecture was illustrated by splendid views.

OTHER WORLDS THAN OURS.

Synopsis of a paper read before the Astronomical Section of the Hamilton Scientific Association, December 5, 1902.

BY G. P. JENKINS, F. R. A. S.

The lecturer, being introduced, began by saying his subject would be Other Worlds Than Ours. He wished it were possible to show them through the telescope itself, but as it was not possible they had a very good substitute in the lantern, as the views were mostly photographs of the actual objects, which he could assure them, from personal observations, looked just like the telescope revealed them.

Mr. Jenkins then proceeded to describe nearly fifty views in the following order: His own Newtonian telescope, relative size of the sun and earth, sun spots, solar eclipses, red flames of the sun, phases of Mercury and Venus, moon at first quarter, Copernicus, full moon, lunar eclipses, chart of Mars, views of Mars, Jupiter, Saturn, Donati's comet, Coggia's comet, Ursamajor, milky way, Germini, as seen by the naked eye and also through the telescope, star clusters, Annular Nebulæ, spiral Nebulæ and the great star cloud in Orion.

Speaking of sun spots, the lecturer showed thirteen views of the sun spot, which he had observed for so many days, and whose size was, according to best measurement, over three times the size of the earth.

In describing the moon he pointed out that there were no seas on it, no more than there was a man in the moon, but was found to be composed of rocky mountains, volcanoes, rills and plains. While the sun was full of fire, energy and change, the moon seemed to be lifeless, silent and changeless. Its distance was arrived at by trigonometry in preciselv the same way as the distance of any terrestrial landmarks were secured. He showed a beautiful photograph of the crescent moon, taken by himself on February 14, 1891, at 9 p. m., through the telescope, the exposure being only one second.

In addition some splendid photographs of the lunar scenery, as taken by the great Lick and Yerkes telescopes, were exhibited. These photographs were kindlv lent for exhibition by the president of the society. Another of the fallacies to which Mr. Jenkins referred was one which is still very general in relation to the bright light which is often seen darting across the sky, and to which the term a falling star is commonly applied. He pointed out that as far back as records went there were reference to these meteors, and that Virgil even thought these shooting stars predicted changes in the weather. It was now known that the light was no star at all that had fallen, but simply a mass of matter attracted from its orbit by the earth, and that its rapid passage through the air had rendered it so hot that it had become ignited. Sometimes such a body was only partially consumed and remained solid until it reached the surface of the earth, accompanied by a great noise. It was then called a thunder bolt. The museums contain many specimens of these meteoric stones. They traveled round the sun as the other planets did, and about every 33 years the earth encountered a great swarm of them, and on such occasions there was a meteoric shower.

APPLICATION OF KELVIN'S THEORY OF THE ETHER TO THE STELLAR UNIVERSE.

Read before the Astronomical Section of the Hamilton Scientific Association.

BY J. R. COLLINS, TORONTO.

Certain experiments with light, electricity and magnetism show that these forms of energy are conveyed to us from their source through a medium by a vibratory and rotary wave motion. The vibrations, being across the line of propagation, are similar to those that occurred in a solid, as when a stretched cord is vibrated at one end and an undulating wave is made to travel up and down its length. The speed of the wave depends on the tension of the cord, the greater the tension the greater the speed of the wave. In the strongest steel a vibratory wave might be made to travel at a speed of several miles per second, but light waves, it can be shown, travel at the rate of 186,000 miles a second. If tension were increased in this way sufficiently to cause a vibration to travel with anything like the velocity of light it would be necessary to suppose that we were dealing with a substance or medium capable of sustaining strains and stresses thousands of times greater than the strongest steel can support. As no material substance can sustain such a strain, we must, for this and other reasons, suppose that a subtle medium not only fills intersteller space but saturates all material things as well, this subtle medium being termed ether. The former theories that had led up to the vortex theory were reviewed and an outline of Kelvin's views of vortices was presented. Kelvin started by supposing the space of the universe (whether limited in extent or infinite) to be filled with a continuous perfect fluid, structureless and without parts, being a single unit and endowed with a property of inertia. If minute vortices, in the form of rings, were once set up in this medium, the rings of whirling ether would stiffen out and exhibit all the properties matter was known to possess, and if the medium were frictionless the rings would be indestructable, thus reducing matter and ether to a single substance.

Experimental vortex rings of salammoniac vapor were here produced to visibly illustrate this. The vortex theory has now found favor with physicists, because it had the virtue of simplicity and offers facilities for explaining certain peculiarities of behavior of ether and matter not otherwise at present explained. Such peculiarities were elasticity, energy of motion, and possibly gravitation and inertia, as well as conservation of energy and the dissipation of energy.

The trend of thought among observational astronomers is to regard the visible universe as limited in extent rather than infinite, as indicated by the remarks of Mr. Isaac Roberts before the British Association for the Advancement of Science in Belfast a few days ago. If a limit were set to the ether envelope of the universe, and a runaway star were to dash against it from the inside, the star would be hurled back as from a catapult, and if a man were to attempt to thrust his arm through the envelope into blank space beyond, the strained ether surface would be found to be harder than a stone wall. If vertical motion in a tangled ring were sufficient to produce a vacuum in the ether of considerable size it would glisten like silver in the light because of reflections from the surface, and if struck with a hammer it would offer resistance greater than steel to the blow, nothing in this case appearing harder than something. It was stated that the available aperture for light in the human eye was about one-fifth of an inch, with a focus of one inch. The new glass for the Paris Observatory will have an aperture of five feet, and an equivolent focus of 50,000 inches. This optical power, if regarded as an eye placed in a being, built on the same plan as man, in like proportions, would require a head about six miles broad to contain it, and a body totalling sixty miles in height and weighing a million tons, whose bulk, if converted into anthracite coal at present value of $10 per ton would represent a being worth ten times that many million dollars. If we take the microscope, on the other hand, and peer into the kingdom of the minute, the focal vision will be reduced so that we can see and appreciate the manners and customs of the microbe, and approach the very essence of material structure. Man, therefore, can now, at will, with these optical aids, rise until his head literally towered among the stars and shrink again down to the mathematical point and associate with life in a water drop. This thought was presented as a crumb of comfort to those who worried about the insignificance of man rather than an apology for the Artificer of the universe.

In closing, it was stated that it was to be understood that whilst there could be no doubt of the existence of an ether of some sort, theories in regard to its structure were put forth provisionally in order that an intelligent view of the subtle workings of nature might be had, and that the facts as they became known might be arranged in something like rational order.

THE SUN.

Synopsis of an Address Delivered by Mr. Arthur Harvey, F.R. S.C., Honorary President and Director of La Institutio Solar Internacional, Monte Video, Uruguay, before the Astronomical Section of the Hamilton Scientific Association.

80 Crescent Road,
TORONTO, October 1st, 1903.

DEAR MR. MARSH :

The address I delivered to the Hamilton Astronomical Society was not written. It was designed to bring to the society's notice the new views which have been formed in recent years as to the constitution of that mighty orb, and with the aid of your officers I was privileged to show a number of photographs of his spots, prominences and corona. I only touched briefly on my own investigations, which relate chiefly to the connection between sun spottedness and terrestrial magnetic storms, also to solar cartography, and I showed some of the maps made from Swiss and Italian records, which I have been drawing for many consecutive years, and which indicate how the zones of solar excitement move to or from the equator as the spot period progresses from minimum to maximum and back again, in a regular pulsation averaging a little more than eleven years.

Almost every great spot is associated with a magnetic disturbance, shown by violent oscillations of the compass, though, as the spot is only the effect of some change in solar conditions, it is incorrect to say the spot causes the disturbance, and wrong to expect a precise concordance in time. The magnetic shock is usually felt when the spot is near centrality on the disc. That the connection is clearer than has usually been admitted by the few astronomers who have given attention to this subject was shown by diagrams in which I reproduced Prof. A. Wolfer's (Zurich) curves of spottiness for each month for several years past, and drew under them the magnetic curves of H. F. given me by the Toronto Observatory. There seems to be a fairly regular "lag" in the curve of magnetic disturbances; *i. e.*, the magnetic effect is often from two to three days behind the spot record. Pro. Wolfer and I have not yet arrived at a concordant view as to the cause of this lag—indeed, it is too novel a feature to be yet definitely accounted for, but we are both working on the subject and may in a few years arrive or help others to arrive at a conclusion.

In my address I touched on the discovery that the Sun's rotating rate is not the same in all latitudes, but that spots near the equator move around more rapidly than those at a distance from it. I showed maps of the spot zone, with all the spots of several years marked upon it. The whole of the zone was shown to have been in a state of violent agitation, but that there were regions of special activity seemed clear. Spots breaking out in such regions would repeat again and again, for six or seven rotations, often with an interval of one or more rotations between each outbreak. And one drift appeared to be towards the equator, especially when the Sun-spot period was progressing towards a minimum. It seemed likely that in the immediate neighborhood of the equator, but not always coinciding with it, there was a strong current which prevented spots from being frequent there. Very few spots, indeed, were placed just on the equator.

The prominences were shown to be distributetd in belts, somewhat resembling those of Jupiter and Saturn, and these belts moved in the reverse way to the region of spot pregnancy, which approached the equator towards minimum, whereas the prominences receded from it at that time.

Such composite charts of the solar features have not before been made, and they are curiously interesting. They suggest convincingly that the Sun's atmosphere is very tanuous, that there is no solid beneath it, but that the whole great Sun is a gaseous body, in a high state of compression, but not capable of becoming liquid or solid, owing to its intense heat. There can be no crust, as on the earth. They also suggest that there should be a science of the meteorology of the Sun and his planets, higher in its aims than that of observatories, which have until very lately confined themselves to observing the restricted phenomena recorded on the surface only of the earth. There is an accord between solar astronomers and the observers of terrestrial conditions at high altitudes which presages the discovery of analogies and observation of solar features is not unlikely to teach us much about the earth's air, clouds, winds, climate, etc.

The close connection between solar spot phenomena and auroral displays was enlarged upon, the rather because I showed you, the first time they have been seen in Canada, the official report of the "Belgica" expedition to the Antarctic, where she wintered. Mr. Henryck Arctowski was the meteorologist an board, and gave tables of auroral displays in the extreme southern latitudes for the years of his sojourn. He appealed to northern observers to examine his figures and inform him if there was any correlation between aurora in the two hemispheres. I was fortunate enough to see his appeal, and to be able to respond to it, showing the complete concordance, to the day, of all the auroral lights seen by him with those we witnessed. The two auroral curves are all but identical.

You, my dear Dr. Marsh, delight chiefly in the observation of celestial objects through your fine telescope. My work is not largely observational, and I remark upon the difference for the benefit of some of your members who may not have access to an "Optick tube." No amateur, and few astraphysical professionals, can now work singly, depending only on what an individual sees and records. There are observers paid by States or by private endowments to note a variety of natural phenomena, such as the number and size of solar spots, the swinging of the magnetic needles, the occurrence of auroræ, the temperature, and insolation of particular regions, and so forth. By their statistics the student in such matters is guided to conclusions, correlating a row of facts here with another there, comparing or contracting what the French, Russian, Italian or other directors do with what is recorded in Canada or in India. Sometimes these patient observers venture on deductions themselves, but their work is available for others, and herein is a field for those who choose to labor in it. It is very fertile. Since I addressed your society I have been investigating the question whether magnetic storms do not intensify local compass attraction, and endanger vessels navigating near basaltic rocks like those of Cape Sable, N. S., and the Newfoundland capes. I send you a paper I read to the Land Surveyors' convention on a branch of this subject. which offers plenty of room for much more investigation. Again, I think I have discovered proof that the movement of the northern magnetic pole westward, which is by no means regular, as generally assumed, is regulated by the annual excess or defect of heat over the average of the North American continent, but the conclusion cannot be confirmed until we have magnetic observations and temperature observations at such places as Chicago, Minneapolis, St. Louis, Omaha, Spokane, as continuous as those furnished by Toronto, so here is a fine opportunity for your younger members after I have done with finite figuring.

If these remarks will stand instead of an abstract of my address, you are quite at liberty to use them in your transactions, and if you are short of a paper this coming session I will try to supply one, as I feel much interest in the work of the astronomical societies. I am, dear Mr. Marsh,

Very faithfully yours,

ARTHUR HARVEY.

Dr. D. B. MARSH, President,
258 Aberdeen avenue, Hamilton, Ont.

THE MOON.

Read before the Astronomical Section of the Hamilton Scientific Association.

BY J. E. MAYBEE.

Before entering on the main part of the subject, perhaps it may be as well to say something in general on the body we are to discuss to-night.

What is the Moon ? is a question probably as old as the human race. Man, very early in the life of the race, as now in the life of the individual, propounds the question, "What is this?" and "What is that?" Then the young race or the young man begins to ask, "Why is this" and "Why is that," and as no answer is forthcoming from without, an answer is evolved from man's inner consciousness. Thus myths arise, explaining not only what things are, and how they have come to be what they are, but also why they are.

By and bve the race grows wiser, or at any rate individuals do, and we come to see that human knowledge has its limits. We can arrive at some knowledge of the constitution of the material universe. We have also made great advances in understanding the method of its building, but when we enquire, "Why are these things so?" nature turns to us a face as inscrutable as the stony features of the Egyptian Sphynx. Science then knows the futility of reaching further than the What and How. "What is the Moon?" will serve my purpose to-night. To the "man on the street" the moon is only a luminous body, which appears and disappears at intervals marked on the almanac, and is useful for moonlight excursions and lovers' promenades. The poet sees the moon beams bathing hill and dale, and his fancy pictures Selene, chaste and fair stooping down from heaven to kiss the young Endymion sleeping on the mountain top. To the man of science the Moon is a sphere of like material to the earth, some 2,160 miles in diameter, and revolving round the earth in an orbit of some 239,000 miles in radius. This much being known, a further natural enquiry is, what is the condition of its surface? Like on earth, we see plains, plateaus, mountains, craters, and also enormous ring plains in size at least quite unlike anything on earth. Further, we find that unlike the earth there are no immense bodies of water on the moon, nor any ocular evidence of lakes or running streams.

This much in introduction, now let us turn to the question I have chosen as the title of my address.

IS THE MOON A DEAD WORLD?

Perhaps there is no question which exerts a stronger fascination on the popular imagination than the old problem as to the possible or probable existence of other worlds than our own. By "other worlds" is, of course, meant celestial bodies, where organic life is flourishing and where sentient beings akin to man may be found.

To "the man in the street," and indeed to many astronomers, the chief interest in Mars centers in the evidence, pro. and con., which may be adduced on the question of its being inhabited or being habitable bv other children of the All-Father. The interest is an excusable one, for a knowledge of the conditions of intelligent life in other worlds would doubtless help much to solve the problem of pain and evil, the old problem, as to whether evil exists, because the Lord is not all good or because He is not all powerful.

I propose to consider the case of the Moon under three headings:

Is there animal life on the Moon?

Is there vegetable life on the Moon?

Is there physical life on the Moon?

Perhaps it may seem superfluous to investigate the first problem, for everyone can tell you off hand that animal life cannot exist on the Moon. But while everyone can tell you this *fact,* there may be some who cannot give the reasons for the faith which is in them, and to these I shall speak for a little while. Now let me briefly set out the requirements of higher animal life as we know it, sufficient air, moisture, a suitable temperature, light and food. If the first four be provided, the last is practically assured, as vegetable life would, under such conditions, certainly exist also to provide it. On earth man, for example, requires on the average a lung capacity of 20 cubic inches of air to supply the necessary oxygen to sustain life. He finds his lung capacity ample under ordinary circumstances, but let him ascend about 16,000 feet above sea level and he will find that it is very difficult for him to get enough air into his lungs to keep him comfortably warm; and putting on clothes is a good deal like trying to keep up the heat of a stove by shutting off the drafts and covering the metal with an asbestos jacket.

Now, according to Prof. G. C. Comstock, of the observatory of the University of Wisconsin, the Moon's atmosphere is at most only one ten thousandth part of that of the earth, so that on the moon a man would require, supposing the composition of the air there to be the same as here, a lung capacity for 200,000 cubic inches (20 cubic inches x 10,000), or if we suppose the Moon's atmosphere to be all oxygen, instead of about one-fifth oxygen, as on earth, a lung capacity for 40,000 cubic inches (23 cubic feet) would suffice. Fancy a 6-foot man needing a chest from 2,000 to 10,000 times greater in capacity than he now owns in order to pick up enough oxygen to keep the blood red in the remainder of his somewhat overshadowed body. Even for cold blooded animals such an atmosphere would not suffice, and, supposing that by some change in structure an animal could exist in such an atmosphere, the second condition, moisture, would be unattainable. Protoplasm, the ultimate constituent of all living organisms, contains 80 per cent. to 85 per cent. of water and 15 per cent. to 20 per cent. of solids, and this water is necessary for the maintenance of the metabolic processes constituting its life. Now water, at ordinary atmospheric pressure of about 30 inches, or 760 MM. mercury can exist in either the solid, liquid or gaseous conditions. It, however, we reduce the pressure below 4.6 MM of mercury (the critical pressure) we will find that the liquid condition is impossible. According to the temperature, we will have either ice or vapor. Now the pressure of the Moon's atmosphere is only .0760 millimeters, so that on the Moon no water can exist as liquid. There one's blood would be either ice or steam, according to the temperature, a state of affairs hardly conducive to health.

Further, all life requires a suitable temperature.

Prof. Huxley, summing up the experiments made previously to the issue of the ninth edition of the Encyclopædia Britannica, places the limits of temperature between —60 deg. Centigrade and about +60 deg. Centigrade. In the case of some Algæ a temperature of within a few degrees of ordinary boiling point seemed quite congenial.

We are not much concerned, however, with the upper limit, as according to Prof. S. P. Langley and F. W. Very, the temperature on the Moon does not rise above zero Cent., and probably falls as low as —200 deg. Cent. The lower limit is, however, important, as recent experiments, conducted by Dr. Macfadyen and Mr. Rowland, and described by them at the last meeting of the British Association, show that certain primitive organisms, such as Bacillus Anthracis, certain ferments and photogenic bacteria can withstand a temperature of —252 deg. Cent. for as much as ten hours. Some of these organisms were kept in liquid air (—190 deg. Cent.) for six months without impairing their vitality. They say "The ordinary manifestations of life cease at zero, but at —190 deg. Cent. we have every reason to suppose that intracellular metabolism must also cease as a result of the withdrawal of two of its cardinal physical conditions, heat and moisture. It is difficult to form a conception of living matter under this new condition, which is neither life nor death, or to select a term which will accurately describe it. It is a new and hitherto unobtained state of living matter—a veritable condition of suspended animation."

It will be seen that very low organisms may thus sustain a temperature comparable with the lower limit assigned to the Moon by Prof. Langley, and for a period much longer than the length of night upon the Moon, but I think I am safe in saying such temperatures would be fatal to highly organized animal life, even leaving out of account the insufficiency of air and the impossibility of having water in the liquid condition. It may be urged that we cannot say that life must always and everywhere exist in the manner and under the conditions which obtain on earth.

To this I would say that life here is always manifested as a function of protoplasm, that peculiar combination of carbon, nitrogen, oxygen and hydrogen. Now, in all our experience of the properties of matter we do not know of any chemical element or chemical combination which possesses identical properties with any other element or combination. It therefore seems improbable that any other combination of elements is possible, as things are constituted, which will possess the property of life.

I think, then, we are justified in assuming that life, wherever existent, will be found dependent on protoplasm, and therefore, on heat, moisture and other conditions, which obtain on earth. This being so, highly organized animal life must be absent from the Moon. It would also seem improbable that the higher forms of vegetable life could exist there. They also need heat. In our own Arctic regions trees mostly cease when the mean average temperature for January is —30 deg., and for July + 50 deg. F. They seldom, indeed, reach as far north as the Arctic circle. Plants do indeed grow very far to the north, though the number of species is wofully diminished, showing clearly that the limit is nearly reached, and that in a latitude where the mean temperature perhaps does not rise above —37 deg. F. for the winter months, and + 33 degrees F. for the summer months. Compare these temperatures with —200 deg. C. and 0 deg. C. on the Moon (—328 degrees and —32 degrees F.)

It is most important to note that while in low latitudes on earth the phanerogams or seed bearing plants vastly predominate over the cryptogams; in the Arctic regions the cryptogams take the lead in the proportion of 1687 to 762. This shows clearly that the lower forms of plant life stand cold the best. Among the cryptograms are included those curious plants, the lichens, well known to Muskoka visitors, and all who frequent those regions of pure air and sunshine, which are the favorite habitat of this species. Of all plants these are the hardiest. According to the Rev. J. M. Crombie the proportion of lichens to phanerogams in different regions increases in a regular ratio from the equator to the poles, and from the base to the summit of lofty mountains, till at length in Arctic and alt-Alpine tracts lichens constitute almost all and sometimes the sole vegetation. If plant life does exist on the Moon it is therefore probable that it would be more like our lichens than any other of our terrestrial vegetable species. If a lichen could be found capable of absorbing its water in the solid or gaseous form, and capable also of holding the water in its cells under pressure, so that it might assume the *liquid* form, and able further to stand a temperature of —200 degrees C., then of such lichens would the vegetation of the Moon be composed.

Now I have led up to this point for a particular purpose, and it is this: Many observers, in seeking evidences of vegetation on the Moon, look for bright green patches or regions.

Prof. Klein, of Cologne, notes as remarkable "the intensely green color of the whole surface, which is surrounded by the great Rill (near Herodotus), a coloring which is recognized immediately, even by an unpractised eye, and has not its equal in intensity on the whole moon. Were one to assume Prof. W. H. Pickering's view of a certain vegetable growth on the Moon one would seek it first of all in the region of the great Herodotus Rill." Of this same region Gruithuisen wrote in 1824 that he saw "in the east and northeast of Aristarchus a mingling of all kinds of colors in small spots, which gave an indistinct impression of plantations. That with us, vineyards, meadows, summer and winter grain fields and woodlands, all mingled, would have this appearance, were one to view them from the Moon." Now lichens are usually yellow, orange, red, brown, grey, grey green, olive or black in tint, and never as far as I know vividly green.

We will never, I think, find vegetation on the moon by seeking with the telescope for appearances such as our terrestrial forests and fields present to the observer from a balloon. Another peculiarity which these lichens possess is the extreme slowness of their growth. One specimen observed by Mr. Crombie had not arrived at its maturity in 45 years. They are perennial plants in the widest sense of the term, and many defy the ravages of time for many hundred years. Indeed, "the life of lichens bears in itself no cause of death, and is only to be ended by external injuries," or by the alteration of climatic and atmospheric conditions. Hence the assumption is not unwarranted that individuals of such confessedly long lived species as Lecidea Geographica, growing on rocks upon the summits of lofty mountains date from more than "fabulous epochs," and probably outrival in longevity the ages assigned to the oldest trees on the surface of the globe.

If, as I believe, vegetation on the moon must be akin to the lichens, it is not at all likely it would possess the characteristics of growing to maturity and fading away again in the short space of 14¾ days, possessed by the spots on the Moon, observed by Prof. W. H. Pickering and ascribed by him to vegetation. Such growth is almost inconceivable of any vegetation when the thermometer does not rise above freezing point, and quite inconceivable of the forms of vegetable life found on earth to be associated with low temperatures. The variable spots ascribed by Pickering to vegetation were found between 55 degrees N. latitude and 60 degrees S. latitude. "The general phenomena exhibited by a variable spot," he says, "are a rapid darkening followed by an equally rapid fading towards sunset." "At their maximum some of these spots are intensely black, some are a dark grey, and others a light grey." I illustrate these spots by a series of drawings by Pickering, showing the gradual growth and fading of various dark spots in the interior of the crater Franklin. Whether the changes of these spots are due to real changes of the surface, or are due simply to shifting shadows I do not profess to say, but I do not think they are due to organic growth.

Now let us consider particularly the evidences of physical life on the Moon's surface. By physical life I mean changes due to internal or external heat, such as volcanic action or earthquakes, the formation of snow or the disintegration of lofty peaks. On the Moon heat cannot produce the grand phenomena we are accustomed to on earth. No raging cataracts pour down its rocky heights; no mountain streams brawl to the plains beneath; no placid rivers roll through fertile plains to join the heaving sea; no furrowed waters lash the shores of its wide spread oceans; no clouds obscure the heavens or trail grateful shadows over the lunar plains; no blinding snow storms can ever sweep the land, or gentle rain revive the parched soil. On the Moon all is barren rock and arid dust. Here a volcano may be puffing up ashes and vapors, but no winds will scatter them abroad. In the most active volcanic regions no hot springs will bubble up from Plutonian realms. Dry water vapor or pieces of hot ice at most, would be the lunar equivalent for a terrestrial geyser. Perhaps a seismograph might indicate tremors every now and then, shaking the rocky frame of our satellite, and every now and then toppling down some crag or opening up new cracks in her crusts. Perhaps, too, a Pelee sometimes there explodes harmlessly over uninhabited wastes and remakes itself for the benefit of prying human eyes.

What evidence have we of changes such as these? Linne is the classic example.

W. H. Pickering speaks thus of Linne: "Early in the last century Lohrman described Linne as being very deep, and as over four miles in diameter. Maedler observed it seven times, and described it as very distinct under the oblique illumination of the sun, when the contrast of shadow was strongest, and as measuring six miles in diameter. Schmidt drew it eight times and represented it as being seven miles in diameter and one thousand feet deep. Schmidt, in 1843 was the last astronomer, apparently, to see it with any such dimensions, and in 1866 he announced that it had disappeared. A few months later, however, he found in its place a small "craterlet" about one quarter of a mile in diameter, which, in the course of a couple of years gradually increased to a mile and one half. Although still visible, its diameter has now shrunk to three-quarters of a mile." It is only fair to say that although the change previous to 1866 is now generally admitted, yet Dr. Klein, of Cologne, strongly queries any changes since that date. Just imagine a crater six or seven miles in diameter and a thousand feet deep being wiped out of existence and replaced bv a mere pimple. Is a globe dead which can still, on occasion, exhibit such powers of destruction and reconstruction?

Our next evidence comes from the observers of the rills and clefts on the Moon. Sometimes a rill has been seen easily, and on other occasions, under similar illumination, appears to have utterly vanished. What could cause this? It may not be unreasonable to suppose that vapors or exhalations accumulating between its rocky walls may have temporarily obsecured it, as rolling mists might hide a river from the sight of a daring aeronaut floating high in the air. Then again a new cleft has been found in a much studied formation which appeared to have totally escaped the ken of earlier observers who had noted much finer and more elusive details. The delicate cleft joining the Ariadæus and Hyginus rills just north of Agrippa is an example of an elusive feature, and a fine cleft on the northern part of the floor of Mersenius was discovered by Elger in 1883, though at that time much more easily seen than finer details which had been mapped by earlier selenographers.

Another apparent case of change is that of Hyginus N., though as the evidence of one man only supports the assumption, many see fit to remain sceptical. Dr. Klein had studied the region of Hyginus for twelve years, and yet on May 27th, 1877, he discovered a dark depression a few miles northwest of Hyginus. Since then the spot, which is by no means a difficult object, has been much studied, and its present existence is undoubted, whatever we may think, of its alleged recent birth.

The greatest contributions to the new selenography, the study of the evidences of change, have been made by Prof. W. H. Pickering, who in 1891-2, at Arequipa, and since then in Jamaica at different times, has been giving special study to the Moon. He believes he has discovered the presence of snow or hoar frost on the Moon. Let us examine his arguments. If we agree that volcanic action on the Moon has not yet ceased, it is evident that gaseous pressure of some kind must exist to produce the effect. On earth, water-vapor or steam is responsible for the explosive energy, and possibly is so on the Moon. This steam rising up into the Moon's atmosphere becomes cooled down and deposited as hoar frost or snow. Surrounding some craters, notably Abulfedae, Censorinus and Linne, are white patches or halos, which are largest at sunrise and gradually diminish towards sunset, only to reappear of their original size at the next sunrise. Then again some of the lunar peaks exhibit a dazzling brightness as though crowned with eternal snows, while equally illuminated surfaces are darker. (See Appennines.) The lunar poles exhibit an unusual whiteness. The same unusual brightness distinguishes a large area surrounding Tycho, and many lunar craterlets are lined with some substance which is dazzlingly bright under suitable illumination. Polar brightness may, of course, be due to snow caps, the linings of craters caused by congealed vapors from their vents, and the mountain caps stolen from the scanty moisture of the lunar atmosphere. But to me the evidence is not conclusive. It does not seem to be asserted or proven that the polar whiteness waxes and wanes in size, as one would expect, if it represented caps of snow or ice. The well known bright rays are also attributed to snow by Prof. Pickering, though no proof is forthcoming. All these appearances might just as well be explained by other hypothesis, except the waxing and waning of the bright spots already referred to about Linne, Censorinus and Abulfedae. Perhaps there, if we could transport ourselves on etherial waves, we might behold dazzling fields of snow, unless closer scrutiny showed the illusion to have been caused by peculiarities of illumination of the rough uneven surface. Plato has also been carefully scrutinized by Pickering, who finds that the relative prominence of the numerous little craters on its central plain is very variable, which he explains by supposing that vapors are emitted by these craterlets which occasionally obscure or even entirely hide some of them. Certain bright streaks also appear which Pickering believes to exhibit a change of form, but which Dr. Klein thinks are due only to a varying illumination. Again near the northeast side of Herodotus similar changes of visibility among some seven or eight small craters and similar variable light streaks and spots were noted. The most reasonable assumption as the cause of these various changes is the theory that the Moon is not yet physically dead, but is still able to faintly and spasmodically breathe forth vapors of water or other gases.

The subject is an interesting one, but no amateur in Hamilton or Toronto need think of contributing to an increase of knowledge relating to it by instrumental means. With all his advantages Prof. Pickering admits that formations less than 200 yards in diameter were beyond his ken, despite the magnificent seeing he enjoyed, so that with our feeble instruments and uncertain atmosphere a whole Vesuvius or Pelee might disappear and we know nothing of it. One curious series of changes is however within the range of the possessor of a good 4-inch glass. I refer to the peculiar changes which take place in the appearance of the twin craters, Messier and Messier A., which are more easily shown than described. The cause of these changes no one can say, unless hoar frost deposits or fogs have something to do with it.

In conclusion then I would say that if animal life exists on the Moon it can only be in the form of bacteria or some of those other low forms of animal life scarcely distinguishable from the vegetable. Low forms of vegetation may possibly exist similar to those which are found in our own polar or alt-alpine regions. Of physical change there appears to be a certain amount of evidence which cannot be ignored. Though not all of it is convincing, enough has been adduced to considerably shake the faith of those who for so many years have confidently asserted that the Moon is a dead world.

Here we have a portion of our satellite's surface as imaged in one of Nasmyth's casts. Let us imagine ourselves transported there just before the dawn. Before us looms the towering rampart of a crater, a chequer work of dead black and yellow-white beneath the beams of a full earth. No half tones, for atmosphere is lacking, and each shallow depression is a pit of blackness. The silence is absolute, though tremors beneath our feet show that the volcano is not dead. Suddenly puffs of vapor shoot our from its cone, rolling off to each side in silvery clouds, which fall about us in showers of tiny ice spicules mingled perhaps with solid carbon dioxide and sulphur. Suddenly, and without warning, the brilliant disk of the sun lifts above the horizon and the lofty crags spring into light. Soon the icy clouds disappear in vapor, and the full blaze of the sun pours down on the rugged landscape. Frightful iagged peaks soar aloft brilliant with frost. White plains stretch out on all sides, setting out in startling relief the long spires of shadow from the crater walls. A few days elapse, with the sun ever growing higher and more powerful. The zone of snow contracts, points of rock everywhere rise dark through the white mantle. Now perhaps we find that many of the rocks in favored locations are painted in rich harmonious colors with a scaly crust of lichens. There an orange yellow garment clings to those round boulders standing so clear against the dark blue sky. Here, ashy green, a field of lichens covers a sunny slope, from which the snow has quietly and invisibly disappeared into thin air. Soon the snow has vanished entirely from all but exceptionally sheltered spots, and the lowly vegetation makes the most it can of its few brief days of sunshine. Now the air begins to chill again as the lengthening shadows point to the west and the growth, immensely slow as it is, once more ceases, and once again the winding sheet of frost wraps all the landscape in silent white.

I have shown that we are justified in supposing that organic life on the Moon would be dependent on a similar environment to organic life on earth, as protoplasm, the foundation of life, is the only combination of chemical elements which possesses or is likely to possess the capacity of living. Some may urge that we must not limit the power of the Creator.

Omnipotence could make a stone live, or set conscious creatures amidst the cold of interstellar space. True, but let us consider a little. Is this a chance world or a world of order? A world of order you will say. Quite right. Having once discovered any fact, physical, mental, moral or religious, we know that always and forever that fact will be truth. Our God is a changeless God. We know, too, that having once formulated a plan the Creator never departs from it unless except it becomes practically unavoidable. Is there any necessity that vertibrate animals should all be built on variations of the one plan? None whatever, except that the Creator has apparently aimed to work along the simplest lines possible and with the greatest possible economy of fundamental ideas. We find, too, that a given effect is always the result of the same cause. Mind is always a function of brain matter. A tree always takes its life from some other tree of the same species. Water is always formed by the union of hydrogen and oxygen, and never in any other way.

Are we not justified then in supposing the same changelessness, the same economy, will be exhibited by the Creator in the rest of the universe of which we are a part? Surely yes. But we can prove it in part. Newton believed the law of gravity on earth held good in the heavens. He proved it as far as the Moon, he proved it as far as the planets, and with faith in God we believe it to the uttermost ends of the universe. The laws of light in space are the laws of light on the earth. The laws of God revealed here we believe to be universal laws.

Our Mr. Millar points his spectroscope at a Nova and says there is hydrogen there. Why? Because he implicitly believes that the same effect always has the same cause whether the effect be found on earth or on a star.

Our Mr. Lumsden will tell you the craters on the Moon are due to volcanic action, because he sees similar formations produced on earth by volcanic action, and he believes the universe is a unity.

Our Mr. Harvey reasons about the Sun's magnetism because he believes electricity and its laws are universally existent.

Everything, in fact, seems to tell us that we are safe in judging of the whole from the part within our reach, so that we are quite within reason in believing that life, wherever found, will be similar to and require similar conditions to life on earth. Thus my reasoning as to the nature of organic life on the Moon stands justified.

Finally, let me say that there does not seem to be any more interesting lunar study than the investigation of the evidence of lunar change. If others follow in Prof. Pickering's steps it will not be long before we will be able to sav more definitely and clearly than we can now that the Moon is not a dead world.

ANNUAL REPORT OF THE GEOLOCICAL SECTION OF THE HAMILTON SCIENTIFIC ASSOCIATION.

Read at the Annual Meeting May 7th, 1903.

To the President, Officers and Members of the Hamilton Scientific Association :

The Section has much pleasure in submitting their annual report for the term ending May, 1903.

The work of the members has been devoted to the collection of specimens from the different formations belonging to the Silurian system, which are revealed at Hamilton, Stoney Creek, Grimsby, Barton Township, and the shingle found on the shore at Winona Beach, Hamilton Beach and Burlington Heights. Two of the members of the section paid a visit to the Grand River at Caledonia, thence proceeded to follow the bed of the stream in quest of the bivalves which are found in large numbers. After proceeding about half a mile in an easterly direction we came upon a large bed of hard concrete holding shells, which appear to be of pretertiary origin. We also collected some Gasteropods and Hetices imbedded in the banks, of Tetiary origin. The ravine at Grimsby has always supplied a large number of interesting Crinoids among the varieties. Stephanocrinus and Pentocumitus have been found in excellent preservation. A very rare specimen of Lingula was also obtained this year from the Clinton beds at Hamilton, only three specimens of it being previously known to Col. C. C. Grant. An effort was made to locate the terminus of the Guelph Dolomites, which thin out toward the southeast several miles from the brow of the escarpment, but owing to the difficulty of obtaining a proper vantage point, because of the superincumbent strata of earth, nothing definite was accomplished.

Col. Grant said that he had been often asked, How far does the Barton beds extend? This question he was not yet able to answer satisfactorily, because the measures lies concealed in both easterly and westerly directions, but he was satisfied that they extended as far east as Stoney Creek because of evidences procured by one of the members of the section who had visited that locality. The section is kept in close touch with the principal museums of the world, as evidenced by the following communications received from E. R. Lankester, Esq., Director of the British Museum of Natural History, directed to Col. C. C. Grant, being an acknowledgment of a number of fossils sent to the above museum :

March 13, 1903.

DEAR SIR: I am directed by the trustees of the British Museum to convey to you the expression of their best thanks for the present mentioned on the other side, which you have been pleased to make to them. I have the honor to be, sir,

Your obedient servant,

(Signed) E. ROY LANKESTER.

He enumerates the different specimens as follows, 68 Palæozoic fossils from Ontario, Canada, viz.: 5 Plonitæ, 1 undetermined, 30 Coctintera and Bryozoa, 4 Brochpoda, 1 Edrioasteoidia, and 9 Mollusoa.

Also an acknowledgment from Prof. J. F. Whiteaves, Assistant Director of the Geological Survey of Canada, acknowledging the receipt of fossils from Hamilton and vicinity, also one from Prof. J. M. Clark, State Palæentologist for the New York State Museum, acknowledging the receipt of fossils from the waterlime beds of the Barton series of rocks and the Niagaras sent to him by Col. C. C. Grant.

During the last term Dr. Ami, F. G. S., Dominion Survey of Canada, was made a corresponding member of the Hamilton Scientific Association, and we are pleased to note that the Royal Society in England had awarded the Rigsby medal to Dr. Ami for his valuable contributions to science.

During the year the following papers were read before the Section by Col. C. C. Grant:

November 27th, 1902—Geological Notes—Winona.

December 26th, 1902—Notes on Specimens from the Season's Collection.

January 26th, 1903—Geological Notes.

February 27th, 1903—Opening of Museums.

March 27th, 1903—Origin of Petroleum.

All of which is respectfully submitted.

A. T. NEILL,
Secretary and Chairman.

GEOLOGICAL NOTES.

Read before the Geological Section of the Hamilton Scientific Association, November 27, 1902.

BY COL. C. C. GRANT.

WINONA.—The writer left the city earlier than usual for Winona Park, and was greatly surprised to find on arrival there that the water of the lake was unusually shallow at so early a date. The conclusion reached after some deliberation was the responsibility for the state of things is due to the diminished snow falls last winter, to the Chicago canal, or both combined. It seems a serious matter as far as lake navigation is concerned in future. On returning to Hamilton, on enquiry I found the lake subsequently reached its level there, even before the heavy rains of the past summer had fallen.

On one occasion, while collecting fossils on the lake shore, I saw no less than five schooners from Toronto (as I was told) busily employed in loading their boats, and transferring to their respective vesssls the boulders in the shallow water and along the shore. I already mentioned how much protection they afforded the land on the south side of Lake Ontario by accumulating drifting sand and thereby checking to some extent the encroachment of the water. It may be difficult to understand the blindness to their own interests of the property holders along the lake shore in this matter, when even our city aldermen were observant enough to see several years ago that the removal of the sand from the Beach was likely to prove so injurious that it required to be in future prevented, and heavy penalties were imposed on trespassers.

Although a large collection of Cambro-Silurian fossils was made along the shore near the park, few new to science were obtained. A fine Cyrtodonta (Cypricardites) Conrad was found soon after my arrival, and as it did not quite correspond with an of the figures given by "Billings" in "The Palæozoic fossils, Canada," I thought it better to forward it to Ottawa for acceptance and comparison. Dr. Whiteaves in reply said the fossil forwarded was "a Cyrtodonta," and as he did not say that it comes under the head of any species described by his predecessor in office, perhaps we may infer that it may prove to be new. It is a singular fact that the less promising shingle at Winona last summer yielded the greater number of rare fossils. With no indications, few collectors would care to lose time in breaking up unpromising material; yet it was from such, as I stated, that the hammer revealed inside a well preserved value of the Ohio "Orthodesma curvata." This was forwarded to the British Museum. Another specimen, somewhat inferior as regards preservation, was transmitted previously to the Dominion Geological Survey Office, Ottawa, through the parcel post. The writer thinks if a proper representation were made to our Postmaster-General (who is already displayed far more liberality than any of his predecessors, as the writer knows well from the admission freely into Canada of ancient pottery, etc.), he might be induced to alter the rules regarding small parcels through the post. At present we can send to "the Director of the Dominion Geological Survey, Ottawa," free, small packages of fossils for "the National Museum" not weighing over 8 ounces. Many specimens are injured or completely destroyed by endeavoring to make them light enough to transmit. As a general rule, the ones obtainable in our local Chert beds are brittle and difficult to extract, and many rare organic remains are lost altogether that might not have required any reduction as regards weight if "the Postmaster-General" could see his way to permit the officers of the postal department to receive packages of 16 oz. instead of 8 oz., which are merely contributions to "the National Museum." The suggestion is respectfully offered solely in its interest.

During the past summer the writer managed to secure a rare Ohio fossil, which has not been discovered heretofore in Ontario probably. Unfortunately, in endeavoring to reduce the weight of the matrix to 8 oz. it was so much injured that it was useless to send it to Dr. Whiteaves, Ottawa. This was merely one of several cases known to me where the National Museum lost specimens which we may find some difficulty in replacing.

Few unknown fossils turned up during the past summer along the lake shore. Some, however, are of "the interesting finds." A fine example of the Hudson River (Bala) Lamelli-branch, Modiolopsis Modiolaris. Hale displays a portion of the outer shell, in a fossilized state, the lines of growth are well marked grooves. Internal casts of single and double valves are quite common in the Drift here, but this peculiarity may be recorded.* It may have attracted the attention of Palæantologists elsewhere, but the thin shell was unnoticed hitherto among scores collected by the writer and other members of the Geological Section here. True, faint concentric lines of growth are found on casts of Modiolopsis Concentrica occasionally. Perhaps all the Lamelli-branches of this group were provided with very thin shells. In the Palæontology of Ontario, by Professor H. T. Nicholson, under the head, Chapter II. Fossils of "The Hudson River Formation," you will find a figure of "Modiolopsis Curta" (Hall) in which fine concentric lines are represented. These do not appear in the Hudson River casts (Drift) here. Perhaps the matrix in which they are embedded, limestone was not favorable for their preservation. The Cyrtodontas (3) were discovered in some of the most unpromising slabs one could select.

Our fellow-worker, Mr. Bartlett, has been successful in obtaining from the Cambro-Silurian Drift some interesting specimens not found by myself or others here hitherto, which we may add to the list already published, namely the handsome gasteropod, "Cyclonema Vilex," Conrad, U. S. A. (also occurs in Anticosta), and a Brachiopod, which appears to be "Glossina Trentonensis—Con." The fragments of a minute Orthoceras, resembling a long narrow tube, I have not seen figured; a new species probably.

*Note—These lines I find were figured by Sir W. Logan already.

The late Palæontologist of the Dominion Geological Survey (E. Billings) pointed out in a paper published in "The Canadian Naturalist in 1860," that in the Silurian rocks here, and in the neighboring countries, there are many species or varieties of that group of the genus, viz., "Strophomena," of which "S. Alternata" may be regarded as the typical form. All are closely related, he adds. The specimen here submitted for the inspection of the Section appears to me to be nearly allied to "Strophomena Neglecta." It differs, however, in being rounded at the cardinal angles or extreme ends of the hinge. Millar, referring to Strop. Alternata, states "specimens secured within 200 feet of low water mark at Cincinnati are large, thin, frail and somewhat flat, but in their markings resemble the more profound ones of the Trenton group of New York and Ottawa, Canada. Many found from 350 to 450 feet above low water mark are peculiarly thick, firm, and heavy. Above that to the top of the group specimens are generally proportionately longer on the hinge line, more distinctly eared, and much larger." Few save Palæontologists, trained to close observation, would see the differences recorded by the Cincinnati Professor in this instance; fewer still can have any conception of the prevailing ignorance here regarding Natural History in this immediate neighborhood. At the recent meeting of "the British Association for the Advancement of Science," held at Belfast, one of the speakers asserted that Great Britain was at least two generations behind Germany in scientific matters. Heaven only knows how many the ambitious city of Hamilton has yet to overtake. Dr. Clarke (the Chief Palæontologist of the New York State Geological Survey) recently paid us a visit in order to clear up an unsettled point regarding the Barton Niagaras. On visiting the Museum he seemed surprised to learn that very little interest was taken in our collection by the learned professions generally. Among our members we can point to *a solitary parson.* We receive no grant from the city. It is presumed, because our aldermen are incapable of recognizing what every civilized country admits, viz., that a museum is absolutely worthless unless used as a means of imparting scientific knowledge. *The Curiosity Shop* lately established at Dundurn by the City Fathers will hardly fill the bill, but the public, I am informed, may obtain there some interesting wrinkles regarding the natural history of this district. The catalogue of this Museum (eagerly expected) may yet immortalize the Ambitious City.

When the late Sir W. Dawson figured on the chain of life a petrified butterfly from the United States Eocene, he could not have known the Silurian rocks of Canada contained "Moths" in a similar state of preservation. To designate a crustacean thus may be pardonable, when we recollect that a high dignitary of the Church of England not many years since expressed the opinion that the Mollusca (shell fish) and creatures called Trilobites were much alike, and both appear to have fed on stony matters. While we can point to-day to many Geologists in "holy orders," not the less true are the following words of the famous English philosopher, Herbert Spencer, in his article on "Education": "What we call civilization could "never have arisen but for what we call SCIENCE, and yet this "science, which in place of the most degrading conception of "things, has given us some insight into the grandeurs of crea-"tion, is written against by our theologians and frowned upon "from our pulpits." While the churches here display ill-concealed hostility to what they are pleased to refer to "as false scientific teaching" occasionally, need we be surprised to find laymen in the city papers urging the Canadian legislators to employ men to explore for coal (anthracite and bituminous) in the Silurian rocks of Ontario. It seems doubtful whether a writer knows the articles referred to are simply "mineralized vegetable matter," the product of old forests, swamps, etc.; that such did not exist when our limestones, etc., were deposited; that subsequently rocks known as "the Devonian formation," with an estimated thickness of 15,235 feet were laid down in which *no coal* has ever been found; that the true coal-bearing beds, "the carboniferom," follow in succession. Its maximum thickness can hardly be less than 24,100 feet, including "the Permian group" of Murchison, which is now looked upon as the capping of the series. There is an exposure of the lower coal measures in Nova Scotia (nearly 8,000 feet). These beds were deposited in "the ancient Palæozoic sea." They only contain sea plants, Fucoids. Any mining engineer can recognize the absurdity of expecting success in the direction indicated. The writer pointed out to the Section several years ago, in a paper published in "the Journal of our Proceedings," the result of boring for coal below the Silurian Graptolites of Ireland. Yet in this city we find a correspondent urging "the government or Geological Survey" to do precisely the same thing. We may feel assured that neither are so insane as to act on such a suggestion.

The coal-bearing rocks at Crow's Nest, Green Hills (the property of the Pacific Railway) are of "Cretaceous Age." In the summary report of the Geological Survey Department for 1901, Professor McEvoy stated there are no less than 22 seams of coal, with the enormous aggregate thickness of 216 feet, of which at least 100 feet may be considered as workable coal. The director (Dr. Bell) states it is of excellent quality. Professor Leach, of "the survey," mentions it is being converted into coke. 850 tons a day are produced from the ovens.

I was unfortunately absent at Winona when Dr. Parks, Toronto University, called. He stated he discovered some new forms of Cladoporæ of the Chert from Hamilton.

NOTES ON SPECIMENS FROM SEASON'S COLLECTION.

Read before the Geological Section of the Hamilton Scientific Association, December 26, 1902.

"The Webber Quarry," at least that portion handed over to the corporation, produced of late some few well preserved Graptolites, and several others so weathered as to render them too imperfect to determine. If we include the ones from that portion the proprietor retained, and blue building beds quarried by both, about six or eight new to this continent were discovered probably. The writer has not seen any found in the European Upper Silurians by Barrande, etc., figured or described.

A new Hamilton Sponge, "Aulocopina Walkeri" (Head) has been added. Two other Sponges, N. S., probably were obtained (not discovered). A very fine slab from the Clinton iron band, with many specimens of Lingula Clintoni (Conrad) was placed in the Museum. The Clinton Coral, Cyathophyllum Articulatum, referred to by Prof. Lambe, has not been found so low as these beds hitherto.

"Platyceras Angulatum" may be added to Niagara Shales, Grimsby. The Discina (Trenton Drift, Winona) seems a new species, as is the Lingula from the same place perhaps. The Drift fossils found by Mr. Bartlett, "Cyclonema Bivex," "Glossina Trentonensis," etc., may also be added to our list of Hamilton Drift fossils.

GEOLOGICAL NOTES.

The world itself has no limit for us. Humboldt and Herchel will carry us far away to the mysterious Nebulæ far bepond "the Sun" and even the Stars; time has no more bounds than space; history stretches out behind us; and geology will carry us back for millions of years before the creation of man, even to the origin of the material universe itself.—*From Pleasures of Life, by Lord Lubbock.*

The series of rocks so designated are of peculiar interest to the geologists of Europe and the American continent. How far do they extend is a question frequently asked, but it does not admit of a satisfactory reply, since they come under the head of "Concealed Measures" in both directions along the escarpment, east and west. It was not known that the beds extended in the first direction even to Stony Creek, until quite recently. I suspected such was the case, from finding Chert fragments in the ravine there. The overlying soil, timber, etc., prevented examination then. Mr. Schuler, a member of our section, having mentioned his intention of proceeding to the Creek lately on a collecting expedition, was requested, if possible, to clear up any doubt on the subject. On his return he displayed sufficient evidence in the shape of Sponges and Lichens, with other organisms, to show the Chert extended, so far at least as the place indicated. It may be found to thin out a little beyond, notwithstanding the immense numbers of graptolites discovered in these beds. The writer fears we have not acquired much knowledge respecting the young Hydrozoa. Unfortunately they are not calculated at an early stage to arrest attention, and even when more advanced they are occasionally neglected, as I noticed frequently, and considered hardly worth the trouble of removal. Young collectors, especially, are inclined to commit this grave mistake. They may not look particularly attractive in the cabinet, but that is a matter of minor importance. Fragments disdlaying cellules, radicles, etc., are also sometimes thrown aside, being supposed to be worthless. Now, such are the very things most eagerly sought after to determine the classification of the various families. The writer finds much difficulty at times in distinguishing "Acanthograptus" from "Inocaulis." When the former has been compressed the characteristic Spines disappear altogether in some instances.

The "Inocaulis bella" (Hall), figured in the geology of Ohio, appears to me to come under the head of Professor Spencer's Genera. However, since he has not claimed it as such, nothing more need be said on this point. The cellules of "Inocaulis" are found displayed on the surface of the Frounds, not at the side of the branch. The writer has no recollection of having seen a case where the cellules were exposed in any "Acanthograptus," although anxiously sought for by himself and others. Possibly the Spines themselves may represent the parts indicated, but nothing is actually known respecting "the cell apertures" of the Genera to any of the members of the Section.

THE CITY QUARRIES.

The Webber quarry (a portion of which is worked by the corporation) until quite recently presented very few specimens. some of the Graptolites obtained, chiefly from the Chert, were in fair preservation when found a little below the upper or glaciated layer, but the greater portion seen of late were so weathered or decayed as to render them perfectly useless. In some cases the outlines were discernable at first, but on washing the stone they lost branches or disappeared altogether. This is the more provoking, since the writer expressed his belief that they would put in an appearance at or about the point reached in quarrying on the surface of the layers there. The cause of their condition was ascertained to be the irregular distribution of the protecting "Erie clay." In places, on stripping the overlying soil, it was found to be absent, which permitted rain, snow or frost to penetrate and rot away the Chert beds beneath. The few well preserved Graptolites owe their preservation to patches of clay above them, probably.

On approaching the end of the quarry close to the road fence, many of the upper beds were found encrusted with a skin-like covering of carbonate of lime, which would effectually conceal specimens beneath. The material is very adhesive, rarely scales off, or is removed partly, perhaps, by the powder used in blasting. A small portion of the Graptolite is occasionally revealed in this way, which otherwise must have been unnoticed. The absence of Brachiopods was a remarkable feature in the Chert beds of the Webber Quarry; it cannot be readily accounted for. The Discinidæ, etc., so numerous in the adjacent ones, being only found ot the brow of the escarpment (a few turned up), but not another specimen of the large Lingula described and figured by Dr. Spencer (Lingula ingens) was discovered. It only put in its appearance when the quarry was first opened some years ago. I was looking closely for a better one to replace the specimen in the Museum case, but in that expectation I was disappointed. It is rare in the Chert, and the few secured probably formed a family group. All came from the same horizon and were close together.

Since Dr. J. Clark (Chief Palæontologist of New York State) visited our Museum I succeeded in securing for him an "Aricula" he wished to examine, perhaps with one already named by his predecessor (Jas. Hall), as well as I can recollect. I mentioned it represented the only Lamellibranch that did not appear to be dwarfed in the Hamilton, Ontario, local chert beds. I record this fact, since it has been noticed as very remarkable by the late President of the Geological Section (Mr. A. E. Walker), as well as the writer. Indeed, everything else in these upper layers has a stunted appearance, except the Graptolites and Lingulidæ. It must not be supposed that all the underlying layers in the Chert are unprotected by the Erie clay, otherwise the writer would have but very few specimens to submit for the Section's examination. You may notice, even in the restricted extent of the Webber Quarry, as you approach the road fence, certain patches of this material sufficiently thick to preserve from weathering the glaciated polish and Striæ underneath. It was from one of these patches in question that I lately secured an exceedingly fine and nearly perfect Inocaulis, and another in good preservation. The specimens of this family figured or described by Hall and Spencer are mere fragments chiefly. This group of the Hydrozoa seems to have reached its culmination in our local macadamizing beds. Many species probably remain undescribed yet. When the late Dr. Jas. Hall was selected to investigate and describe the Lower Silurian Graptolites in possession of the Canadian Geological Survey, he remarked: "In most of the species described the lower extremity is imperfect and its termination unknown." Since then considerable light has been thrown on the subject by the upper Silurian quarries here, but we have much to learn yet regarding the parts referred to in the monograph. We trust the Geological Section of the Hamilton Scientific Association may be the means of clearing up some doubtful points regarding these Zoophytes yet. We contributed a little already in this direction. The Hamilton Scientific Association has been congratulated even by far Australians for its contributions to our knowledge of these ancient Sertularians, and the very accurate illustrations of our Treasurer, Mr. Scriven, did much to attract attention to some of the most perfectly preserved ones that have even been found in the upper Silurian rocks.

The writer has not seen any of the Graptolites discovered by Barrande in Europe figured. He thinks the professor is not far astray when he claims this family reached its culmination when the Wenlock beds were deposited. Many specimens must have been secured to enable him to arrive at this conclusion. Independently I expressed a similar opinion in Ontario, and I feel inclined to think further that no quarries in the Old Country can compare with ours here in producing a class of fossil as numerous. The early Palæozoics of the Old World have been so tilted, crushed and altered that it appears difficult to understand how it can possibly compete in organic remains with the Limestones, shales, etc., that hold undisturbed the plane of the original sedimentary deposit.

During my stay at Winona I paid two visits to Grimsby.

On the first occasion I got from the Niagara Shale a poorly preserved specimen of a Crinoid, Rhodocrinus, and the more common one, Stephanocrinus angulatus, in fair preservation. The time of the second visit was occupied chiefly in searching for the residence of a friend of the late Dr. J. Pettit (Mr. Edgar Farewell), who kindly presented me with a small box of Crinoids, some of which you will find in the case containing the Barton and Niagara fossils. The Crinoid, Rhodocrinus, of the Niagara Grimsby Shales was recognized on comparing it with a far better preserved one I recollected to have seen which was obtained from the shales overlying the abandoned quarries there. Mr. Schuler also got a specimen which was even inferior to mine as regards preservation.

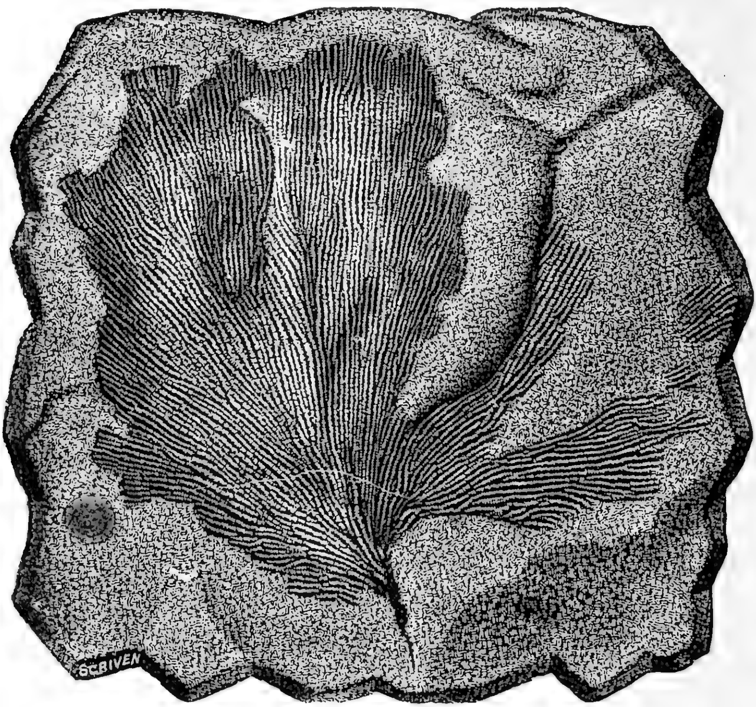
THE CLINTON (MAY HILL) BEDS.

The beds, I fear in future, are little likely to afford us many specimens unless the new reservoir, advocated by the daily city press, is started by the new corporation. At present the only place open to us for examination is the perpendicular cliff in rear of the small city reservoir at the Jolley Cut road. The places where fossils were obtainable a few years ago at the foot of the escarpment have been completely overrun by the sweet clover and other weeds. When late in autumn I went in search of a number of layers of the iron band which had been quarried years ago, bnt found too difficult to remove, I had much trouble in reaching the point where the massive beds were left on the summit of the slope, having to beat down a pathway through a forest of tall weeds as dense as they were high. This particular part of the iron band was found formerly to hold Rhinopora frondosa and R. Verrucosa (Hall), in good preservation, together with Posidonia Alata and impressions of marsh plants, probably. The latter are often found erect, as if the muddy sediment had embedded them gradually when alive. I failed in getting what I wanted, but succeeded in securing one good plant, now in the British Museum. It may not convey a true impression of its nature, however, because not an erect one, unfortunately. A fine slab containing numerous examples of the Brachiopod, Lingula Clintoni (Conrad) turned up at the small reservoir. It will be found in a side case in the Museum. The writer was better pleased to find on a different bed of the upper red band, fallen from above, Lingula Acutirosra (Hall). Schuchert states the only one found was lost or mislaid after Hall's description. As we have one already in the Clinton case, we can spare the last obtained to replace the missing one from the New York Survey Museum.

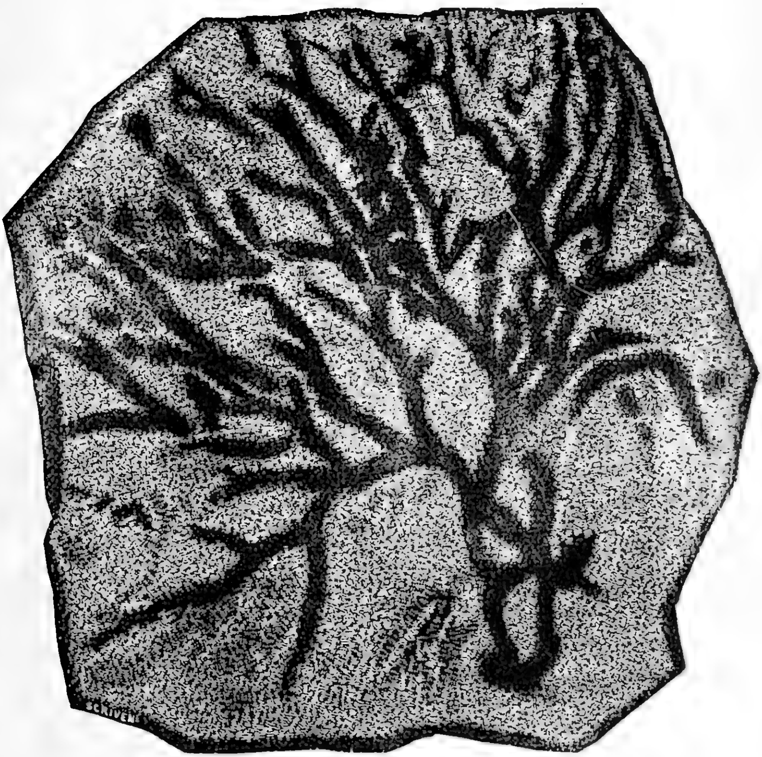
The Association Palæontologist of the Dominion Survey, Professor Lambe, F. G. S., states in his contributions to Canadian Palæontology, Vol. IV., part II., that a composite coral received from the Clinton rocks of Hamilton in 1880 is thought to be Cyathophyllum Articulatum. (What.) This may be added to the Clinton fossils. The Section may recollect on my return from Anticosti, the writer called attention to an ancient beach and large boulder, now laid bare, but which was submerged when the inhabitants first settled at English Bay, that such indicated a rapid recent elevation. In the summary report for the calendar year 1901, the Very Reverend Professor Laflamme, of Laval University, one of the leading field geologists of this continent, confirms the correctness of my statement that the island was undergoing a rapid elevation. The fishermen supposed the sea was retiring—a natural conclusion, but quite erroneous. The Principal of Laval mentions that when the marl from the shallow lakes was applied to the peaty soil it produced some wonderful crops of vegetables, etc. The writer was the first to suggest this there, but the credit of the discovery was due to a poor Mayo peasant, who reclaimed a bog there and subsequently found the rent increased by the landlord, as usual.

NO. 5—CALLOGRAPTUS SP.

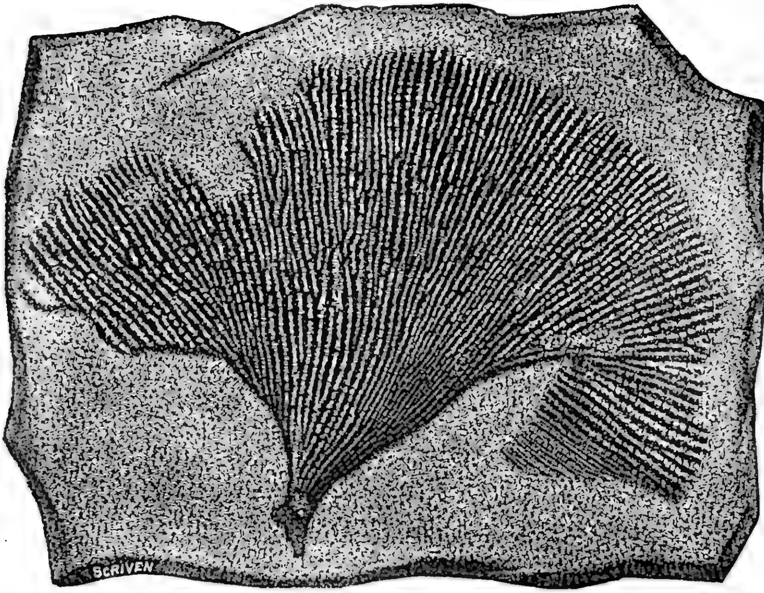
While not widely differing in shape from others of "the genera," found in our Niagara series here, it possessed an apparent flexibility not noticed in others of "the group." The actual position in "the chert" unfortunately was undetermined, but it was a layer between the upper glaciated band and one about six feet from the top of the quarry not so far back as the ones adjacent previously examined.



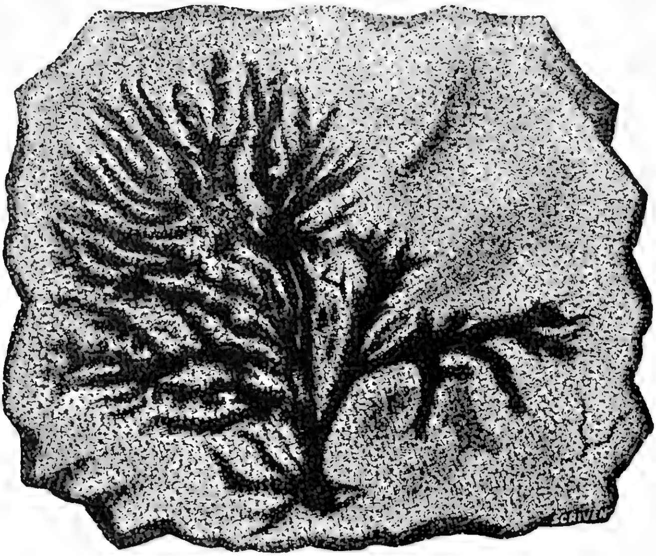
CALLOGRAPTUS NO. 5.



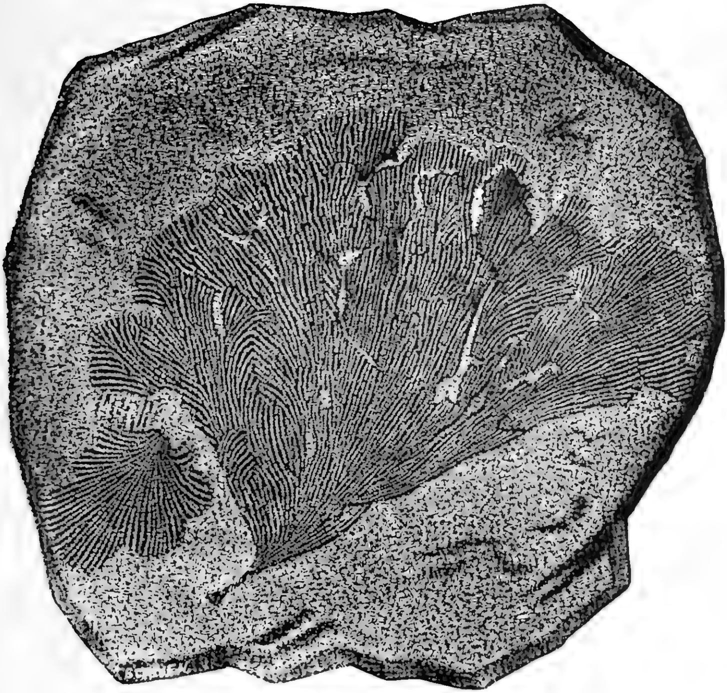
MOCAULIS.



DICTYOMEMA.



ACANTHGRAPTUS.



CALLYPTIGRAPTUS.

OPENING MUSEUMS ON SUNDAY.

BY COL. C. C. GRANT.

Read before the Geological Section of the Hamilton Scientific Association, February 27, 1903.

Although the writer feels the old puritanical element is too powerful at present in the Province to permit the opening of museums on Sunday to the public, I may be permitted to call attention to the following remarks of the late Director of the Dominion Geological Survey (Dr. Selwin), which have been extracted from "The Summary Report for 1892," and which probably are unknown to many residing in the locality: "In my Summary Report for 1885 I called attention to the question of opening the Museum on Sunday afternoons, and I then gave some very remarkable statistics of attendance, the result of this course having been adopted by 'The Australian Museum' in Sydney, showing that on the 52 Sunday afternoons only, the daily attendance was largely in excess of that of the 313 week days, the average being 986 on Sundays and 275 on week days. Such a fact needs no comment, and I venture again to express a hope, in the interest of education and knowledge, that the time is not remote when a similar experiment will be tried in Ottawa. There will doubtless be strong objections urged against such action, based chiefly, if not entirely, on the very erroneous, but unfortunately very prevalent idea, that the museum is a place of amusement, whereas it is essentially a place of instruction, as is the church and Sunday school; and the principal difference between the two, concisely stated, is that in the museum the work, and in the church and school the word of the Creator is expounded. This admitted, there seems no obvious, or intelligible reason why the one establishment should be closed and the other opened on the Sabbath. Since the foregoing was written I have sought opinions on the subject, and I have been much gratified to find such a large number of persons (including clergymen of various denominations) who regard the opening of museums on Sunday afternoons favorably, and think that to do so could not prove otherwise than advantageous to the community, and especially to that very large class of persons whose daily occupations leave them no time in which they can avail themselves of the valuable information and instruction which the museum is designed to afford."

Since the foregoing was published the writer received the following paragraph from a leading London (England) daily, dated December 26th: The movement for promoting the Sunday opening of national museums, art galleries, libraries and gardens appears to be making sure and steady progress. What is known as "Museum Sunday," the object of which is to aid in the attainment of this end, has just been observed in London.

It appears that last year nineteen sermons were preached in advocacy of the society's object. This year the number increased to forty-three, of which sixteen were delivered in London, six in churches, and the remainder in Nonconformist places of worship. The result is, so far, that on this second anniversary, the Flaxman Gallery, the institute of painters in oil colors, Picadilly and the Grafton galleries, were opened to the members of the society. The Duke of Westminster also opened Grosvenor House, Lord Brassey The Lady Brassey Museum, while no fewer than 80 museums, art galleries and libraries were thrown open to the public in the metropolis and large provincial towns. The promoters look forward to a much larger development of the movement. The Scottish Educational Department has also thrown open the Edinburgh Museum for three hours on Sunday, despite a protest, which received very little support from leading preachers or intelligent laymen. A revolt against the traditional observance of what is now all but universally known, not as the Sabbath, but as Sunday, is spreading. It takes the form, not of words, but of acts, a writer states in a paragraph now before me, and the most significant fact of all is the steady decline of church attendance on the part even of those who are reckoned not among those admittedly churchless. A revolt against the traditional observance of what is now all but universally known, not as the Sabbath but as Sunday, is spreading, remarks a Toronto daily. Dr. Howle, Minister United Free Church, Glasgow, puts down the numbers of non-church going population as 420,000, while only 19 per cent. attended service in Dundee. In many of the rural districts the rebellion is even more open and defiant. This reaction was long foreseen. It is a mere repetition (in a milder form) of what occurred on the accession of the worst of the Stuarts, Charles II. After the fanatical bigotry of the puritanical commonwealth, the offshoot of the old theological teaching is unbelief, pure and simple, asserts a recent writer; while the Rev. J. Minot Savage, in a paper entitled "The Agencies which are working a revolution in Theology," states the real infidelity to-day is to be found with those who stand with back to the sunrise, and see no reality except in the shadows of the night, which is passing away. God is the power that is wheeling the earth into a new day. Such hertical ideas may not meet with the approval of churches estabilshed either in mediæval times or even subsequently. Refute them if you can. Abuse is no argument, and only is a mere acknowledgment of an impossibility of any satisfactory reply. And what advantage can be gained by reverend gentlemen adopting or following the example of the street Arab. Sunday observance was without direct spiritual authority, and is simply an ordinance of the primitive church, remarks a Bishop of the Anglican Church. The statement has been fully confirmed since, and others have also admitted there was no law in the Bible for keeping Sunday, and where no law there can be no transgression. The first day of the week, the solar holiday of Paganism, dedicated to sun worship in Egypt, Babylon, Syria, etc., was selected originally by the early Christian church for the same reason as the birthday of Churst was fixed on as the 25th December. It was found difficult to induce the Pagan Romans to abandon the dates of the ancient festivals, so they were appropriated for Christian purposes. A fact new to many, and a curious one noted, remarks a writer, is that until the eleventh century Saturday was observed as Sabbath and not the Lord's day, and until the early years of the seventeenth century Sunday was a day of light work and amusement, christenings, weddings, athletics, sports and boisterous mirth. This was in Scotland, remember, whose modern degeneracy one of our city pastors recently deplored, while asserting that here in Ontario (Canada) we had a higher moral conception of the Christian life than any they possess there. It is not the Scotland of John Knox. Certainly not. One can perceive considerable improvement since then. The churches there can no longer enjoy the pleasure of roasting or boiling old people as witches. Is the reverend gentleman aware that torture exsited there even in the time of King William III, or does he possess even the slightest acquaintance with what Wright, for instance, a Protestant historian, an avowed opponent of the Queen of the Scots, admits that one or more of the clergy were implicated in the conspiracy of the brutal murder of the unfortunate poor deformed minstrel, known to us now by the name of Rizzio? We all know how bitterly the late Dr. Norman McLeod was assailed by his more narrow-minded brethren for stating he could see no harm to religion in a person taking exercise or a walk on Sunday, and he could not condemn young members of his congregation from enjoying a dance either. The land of the heather never stood so high in public estimation as in our own day. Look to her statesmen, soldiers and scientists, her Murchison, Lyall, Geikie, for nstance, and last, but not least, Professor H. Drummond. Now if the Anglican Bishop is right in stating that Sunday observance was without direct scriptural authority, and simply an ordinance of the primitive church, the writer feels inclined to believe reverend gentleman may be reckoned as belonging to the following class, referred to in the New Testament: "But in vain do they worship Me, teaching for doctrines the commandments of men." I know in England many of the English clergy have not the slightest objection to join their parishionres in games after Divine service. There is much ignorance prevailing here and elsewhere regarding the Jewish Sabbath. The day of rest from labor existed in Pagan nations long before the time of Moses. That is admitted by Hebrews themselves. The over-zealous Puritans of Ontario should remember the result of the abortive attempt they made here to prevent the city cars from running on Sunday. It is evident that the narrow views they entertained were not shared generally by their respective congregations i. one may judge from the well-filled carriages on Sundays subsequently. During the agitation got up by a few of the clergy here, one of the city editors requested the Rabbi Wohlberg to furnish the public with a statement of Sabbath observance from a Hebrew standpoint. The Reverend Dr. informs us that Sabbath observance did not originate with the Jews, and that God's ancient people were not Puritanic Sabbatarians: "It is a sad testimonial to our mental emancipation that the rightfulness or wrongfulness of running a street car on the Sabbath should be raised at the threshold of the twentieth century. I doubt whether it could have been raised twenty centuries ago in the city of Jerusalem without arousing laughter and ridicule. Sabbath restrictions such as pester our lives had not yet been heard of. A day eagerly looked forward to, and sorrowfully parted with, rejoicing the spirit with healthful exercise and joyful sport. The Jew knows of no other real restriction on the day of rest, beyond the prohibition of doing the servile work of the other six days. Custom and law even enjoin it upon him to rejoice on the seventh day. The Jew of to-day attends theatres and concerts on the Sabbath, visits museums and libraries, sends his children to the dancing schools and parks. The Rabbi reminds us of Luther's words: If anywhere the Sabbath is made holy for the mere day's sake, then I order you to work, to dance and to ride on it. Twingil said it is lawful on the Lord's day, after divine service, for any man to pursue his labors, and Beza (Calvin's successor) wrote: No cessation of work on the Lord's day is required of Christians.

It is time that we have done with intolerance, and permit every one to spend the Sunday as he pleases as long as he does not interfere with those who wish to keep it puritanically."

The importance of this learned doctor's letter, which appeared in the Spectator April 17, 1895, must be my excuse for directing attention at such length to merely a few of the principal paragraphs.

It is high time that this mischievous and ineffective legislative Sunday nuisance should be abated, recently remarks the Law Journal of England.

Many of the specimens in the museum cases were found by the quarrymen employed by the corporation. These cannot afford to relinquish their day's pay for the purpose of viewing our collection. If the Council of the Association thinks fit to afford them an opportunity of examining the contents on Sunday afternoons I feel assured some members of the Geological Section would volunteer attendance to explain matters to visitors. ,

The hours selected for opening need not interfere with churches or Sunday schools.

St. Chrisostom (who lived about the middle of the 4th century, I think), we are told, dismissed his congregation with the advice "to resume their ordinary occupations," while St. Jerome declared "This is a day of joy, not of fasting." An Episcopal divine (Rev. Mr. Holmes), in advocating Sunday baseball in New York recently remarks: "As a clergyman, I reiterate my former statement that there is no desecration of the Sabbath in allowing amateur baseball to be played. Every day is the Lord's day, so why lay aside one day for sanctimonious denial of a legitimate enjoyment? How can they get it if not on Sunday? By taking a day off their wages are docked, and of course they cannot afford this."

Is it true that Calvin himself saw no harm in a game of bowls on Sunday. The Premier of Great Britain has no objection to a game of golf on Sunday.

NOTES.

At a recent meeting of the Royal Geological Society in England Dr. Ami, F. G. S., Dominion Survey, corresponding member of the Hamilton Scientific Association, was awarded the Bisley Medal for his contributions to science.

IN DEFENCE OF LATE ASSERTIONS.

BY COL. C. C. GRANT.

Read before the Geological Section of the Hamilton Scientific Association, January 30, 1903.

Divines may say what they themselves believe,
Strong proof they have, but not demonstrative;
For were all sure, then all minds would agree,
And faith itself be lost in certainty.—R. CARLISLE.
For modes of faith let graceless zealots fight,
His can't be wrong whose life is in the right.—POPE.

The writer understands Geologists have been recently preached at, and a certain congregation warned against the false scientific teaching of such men as Huxley, Darwin, etc. Nothing is more calculated to bring religion under the ban of intelligence and the church into disrepute as ill-advised attacks on men who were looked up to and held in reverence by every civilized country on earth. Well was it said in substance by President McCosh, of Princeton University, remarks A. D. White (United States Minister to Germany), that no more sure way of making unbelievers could be devised than preaching that the doctrines arrived at by the great scientific thinkers of this period are opposed to religion. One would not have expected to find in an Anglican church an imitator of the departed sensational preacher, who was indignantly denounced by the daily press for executing a war dance, in the Indian fashion, on the grave of the venerated scientist, Darwin.

Perhaps many Canadians are not aware of the fact that His Gracious Majesty, when Prince of Wales, honored these great Englishmen by publicly unveiling their statues at the Museum of Natural History, London. In life they cared little for the abuse and vilification of the ignorant cleric or layman. The Morning Chronicle, one of the leading newspapers published in England, pays the following tribute to their memory, in placing before its readers an account of the Prince unveiling one of the statues at South Kensington:

"The name of Darwin is the greatest in the world of science since Newton, not by reason of exceptional genius, but because of the revolution, moral, intellectual and religious with which his name must be for ever associated. Yet much that was done under Darwin's name was effected by the unrivalled ability of Professor Huxley, who, whether expounding his own views or those of another, had no equal for the amazing lucidity of his demonstration, combined with a literary style, as incisive as it was strenuous." Few men entered the lists against him but lived to repent their rashness. How many are there in Toronto to-day who have read Darwin's doctrine of Evolution, asks a writer in the Mail and Empire, probably not two per cent. Your correspondent is a type of a class groping blindly through the world under the mind-warping influences of old theological doctrines. Why need we feel surprised to learn that the editor of an Ontario daily, it is said, spends his few spare hours in manufacturing a flattened world to mark off the exact position of the four corners of the earth. Blind faith, after all, is but a poor substitute for reason.

In one of the first papers the writer read to the Geological Section of the Hamilton Scientific Association (it was not published in the proceedings), he pointed out that the story of the deluge, recorded in the authorized version of the Hebrew Bible was evidently borrowed from the Chaldean myth of "The Deluge." Since then some at least of the churches have seen the utter impossibility of constructing a vessel at such an early period capable of transporting the animals stated for such a period, together with the required provisions. The utter absurdity of the Moas of New Zealand (20 species, according to Dr. Lucas, Grimsby) finding their way there from where the ark rested on Ararat (it is said one of these gigantic birds must have been 16 feet high), must strike any one not altogether devoid of reason. "Who believes in the universal deluge now?" asked Huxley. The most narrow-minded of sectarian creeds are willing enough to compromise the matter by admitting only domestic animals have been taken in, and possibly the flood was confined to that portion of the globe occupied by Palæocosmic men.

Is not this like throwing the cargo overboard to save a sinking ship. The writer has never questioned the belief Christian churches entertain that theology is progressive. He knows not one which can be found willing, authoritatively, to dispute this. Take, for instance, the oldest of all, in England before the Reformation. However, we may differ here from the great cardinal (Wiseman) in religious matters, we must admit that science was deeply indebed to him, when, according to the well known Professor St. G. Mivart, he cautioned his church against meddling in scientific matters, reminding it of the regretted result in the case of the famous astronomer. In a charge recently delivered bv a Presbyterian clergyman in this city the same wisdom was displayed when he remarked to a minister inducted to Knox church. A pastor should first and last and all the time preach the gospel of Jesus Christ and leave questions of science and philosophy alone.

One objection men urge against the church is its own lack of faith, says a Baptist minister, the Rev. S. G. Nelson, Brooklyn, N. Y. Sensationalism, he adds, more than all other causes, is responsible for the weakened hold of the church upon the respect of men of sense. Unreasoning acceptance of what Hebrew, Christian scholars and Jewish Rabbis alike repudiated (the early chapters of Genesis), no doubt is answerable also for the marked falling off in attendance on Sunday services. It is always the criticism of the day that is a dishonor to God. When Jerome began his revision of the text of the Latin version no words were too strong to condemn his presumption and arrogance, states Archdeacon Wilson, in the London Times, and when Erasmus published his Greek Testament and declared the Vulgate was not worthy of unquestioning belief (the first step in modern criticism), he was denounced as a blasphemer. "We stone our living prophets and build the sepulchres of the dead ones." Five years ago Professor H.

Drummond (of Lowell lecture fame), Glasgow University, died. In his lifetime this original scientific man was hounded down as one whose infidelity was such that it admitted of no dispute. How comes it, in the very city where he was so fiercely assailed for his heretical writings the public recently erected a bronze fountain in his honor, and that such a statesman as Lord Aberdeen and his noble English wife (whose name we Irishmen hold in reverence) could be found to eloquently express their admiration for the work of one who a few brief years previous was denounced as an agnostic and infidel. Yet in that public procession were to be seen numbers of the pious clergy who so bitterly denounced in life the dead scientist.

"One point became perfectly plain to me," remarks Huxley, "that Moses is not responsible for nine-tenths of the Pentateuch. Certainly not, for the legends which have been made the bugbears of science. Thirty years ago criticism of Moses was held by respectable people to be a deadly sin. Now it is a mere peccadillo if it stops short at the history of Abraham." More liberal views seem to have advanced in England of late, but the writer entertains grave doubts that such is the case in some Ontario towns. The influence of "a Talmage" is yet perceptible there. A few years ago I called the attention of the Geological Section to some remarkable discovery made by Archæologists, English, French, German and American, in the ruins of cities unearthed in the ancient Chaldea (or Babylon), as well as in Egypt, in proof that the Biblical chronology of Archbishop Usher, incorporated in the authorized version of the olden Hebrew sacred writings (which had been first translated by Pagan Greeks) was absolutely unreliable. Doubtless the same conclusion was reached by others also. Knowing the little interest taken in antiquarian matters bv narrow sectarian creeds, I ventured some years ago to point out that the leading Geologists in all countries agreed with Huxley that the Jewish legends he referred to (the deluge included) were simply Chaldean myths. For expressing concurrence in this view I was accused of warring against religion itself recently. I was chiefly indebted to the Rev. Professor Sayce, of Oxford, the famous Assyriologist, and other oriental scholars, for newspaper accounts of translation of the inscribed histories and tales (on stone and burnt clay tablets). In the library at Nippur the recently unearthed books of imperishable clay amount to 100,000. My first paper on "The Deluge" was not published in the proceedings, because probably the Council concluded our clerical members may feel offended at accepted beliefs being questioned at all. There are two distinct accounts of the Noachian flood in the Babylonian records. The translation of the first tablet convinced me it was not difficult to trace the origin of the early Bible tales to Chaldean myths. The writer subsequently ascertained this was also the belief of several bishops and leading clergymen in the church of England, as can be easily proved. Surely the Jewish Rabbis ought to be credited with knowing more about their national sacred writings that men whose statements cannot be reconciled with the laws accepted by science or even with historical facts. The Greek version of the Old Testament differs from the Hebrew, they say, inserting, omitting and altering, and even the Hebrew version itself (we are told) contains books which are rejected by Hebrew commentators. In a letter which I recently extracted from the Weekly London Times, written by one who signs himself "Another Presbyter," I find the following: "They (the liberal broad church clergy) apparently feel that the Church of England cannot hope to retain its hold on the intellect of the country if its clergy are expected to hold opinions which have long since been abandoned by the great mass of the educated laity." This section of the Anglican church, less in numbers than the other branches, known as "high" or "low churches" with such names as Deans Stanley and Farrar, Maurice, Charles Kingsley, the late Lord Tennyson, intellectually towers above both (its bitter assailants). We hold (the writer above states) that the general assent to the contents of the prayer book and articles cannot be held to imply an acceptance of every doctrine or every statement of historical facts contained therein in the sense which it was originally intended to bear.

1. The formalaries were drawn up a long time ago. Theological thought continually advances, and it has always advanced. It is only a very ignorant and illiterate clergyman who can even imagine himself to hold the whole doctrine of the Church of England as it was intended to be defined in 1571, or 1662.

2. In particular, the acceptance of the results of what is known as "the higher criticism" of the Old Testament by a large section of the High Church party, and some who would hardly disclaim the designation "evangelical," has entirely altered the position of the more advanced liberals. The Bishop of Worcester and the Bishop of Exeter, for instance, certainly do not unfeignedly believe all the canonical scriptures of the Old and New Testament since they admit them to contain numerous historical misstatements and contradictions.

Dr. Sanday ranks among the most conservative and orthodox of New Testament critics. Specially in favor with "English Church Union," in his article on Jesus Christ in Hastings' Dictionary of the Bible, he admits that some of the miracles probably did not occur, while others have been exaggerated.

The following is taken from an article by Dr. C. Briggs (Union Theological Seminary), published in the Presbyterian Review in 1887, quoted approvingly in "what is the Bible," by Dr. Ladd, of the Yale University, and Dr. Bacon in the "Genesis of Genesis." The critical analysis of the Hexateuch is the result of more than a century of profound study of the documents by the greatest critics of the age. Hilkeah's discovery of "The Book of the Law" occurred in the reign of the King Josiah, 620 B. C. Internal evidence in the book itself indicate that "the Priestly Code" was written during or shortly following "the exile," some older fragments being worked into it. The condition which the Jews found themselves in after exile, 597-537 B. C., made such a system of laws necessary. The system was unsuitable for an earlier period. The Section may see from the foregoing the writer had some reason, at least, for asserting the early Hebrew sacred writings contained not a few Chaldean myths. The legend of Lot's wife is said to be of

Arabian origin. You may find in one of the pamphlets of the late Sir W. Dawson (a copy of which probably the writer sent to some friend in Ireland), an attempted explanation of the conversion of Lot's wife into a pillar of sodium. My old correspondent and friend, knowing the utter impossibility of this miraculous change (now universally discredited), endeavored to prove a descent of volcanic ashes may have covered her and given her the appearance of a pillar of salt.

The writer was not aware that what Dr. Langtry calls "broad church liberal Christianity" had any representatives in Ontario until recently. The doctor indignantly protests against the appointment of Dr. Symmonds (a brother Anglican) to the headmastership of Port Hope Church School, on the grounds that he endorsed the position of nigher criticism, unbelief, viz., that the Bible ought to begin with Amos or Hosea, not with Genesis; that the Pentateuch was not written by Moses, but by an unknown compiler nine, or perhaps eleven hundred years later; that it is made up of myths, legends and fiction, and has no authority; that the real Old Testament history begins with Solomon; that Daniel is a recent forgery; that only five of the prophets is authentic, etc. In an extract now before me I find the Rev. H. W. Garth, rector of the Episcopal Church at Narragansett Pier, preached a sermon at a summer resort near Montreal August 28th, in which he stated the Bible is full of mistakes; that God gave infallibility to no person or book; that it was the literature simply of the Jewish people; that the stories of Adam and Eve, Jonah and the whale were myths and legends.

When was the use of reason in the interpretation of the Scriptures interdicted, interrupted or limited, asks Archdeacon Wilson? Is the spirit of God not now enlightening the church? What have the Rabbis to say regarding their sacred writings? Dr. Aaron, in Hamilton, declared the separate scrolls must have been at the mercy of scribe and commentator, its greatest enemies are those who believed it was all inspired.

Dr. Emil G. Hirsch, Chicago, declared his absolute disbelief in the first chapter of Genesis, and bade his congregation discard it as an article of faith. It simply is, he said, a relation by a Jewish writer of stories, told in Babylon during the captivity.

The above proves others share my views also. I can only say I am of the same opinion still, and I need offer no apology in the matter. Dr. Lyman Abbott told his congregation recently he did not believe a fish swallowed Jonah, the sun stood still, or that the natural law was violated when Moses wanted to cross the sea.

THE ORIGIN OF PETROLEUM.

BY COL. C. C. GRANT.

Read before the Geological Section of the Hamilton Scientific Association, March 27, 1903.

The alleged discovery of what is usually called "rock oil" in a portion of the city of Dublin, situated on what was formerly peat or bog, led to the enquiry: Could petroleum occur under the conditions mentioned?

While the writer entertains doubts regarding the discovery indicated, he does not for an instant question that vegetable matter, as well as animal, under peculiar circumstances may be responsible for the genesis of petroleum, etc.

The substance in question was obtained by subjecting coal (mineralized vegetable matter) to slow heat, distillation, by an English chemist, a year or so after the writer entered the army. Subsequently bituminous shale was treated in the same way, and the result was similar. The experiments mentioned led many to assert positively at this early stage that petroleum originated from the buried masses of sea plants which were subjected to heat and pressure in past geological ages. This may be true as regards some formations, but undoubtedly not all.

The writer attended a lecture given by an American gentleman in London, Ont., who was interested in the oil wells discovered near the city. He may have erroneously attributed its production to the accumulation of vast quantities of sea-weeds heaped together in bays or basins in the Devonian rocks. A Scotchman present remarked, "We have no such accumulation of vegetable matter in the present seas as could produce the petroleum of Enniskillen and Bothwell."

This gentleman had in view the shores bordering his native land, forgetting that for ages sea-weeds had been collected for kelp or manure. He may not have seen the Sargasso Sea, the tranquil portion of the Atlantic in the neighborhood of the Azores, some twenty times in extent of the British Isles, more or less covered densely with "Sargossum baseferum." In places it is so thick as to retard the progress of sailing vessels. Look again to the submarine forests of the Falkland Islands, which astonished Darwin. To the North Pacific Algæ found about the Kurile and Aleutian Islands, and we are told similar aggregations of sea-weeds to the Sargasso Sea are also met with in the Indian and Pacific oceans, in the comparatively tranquil spaces encircled by rotary currents. Petroleum does not appear to be confined to any particular formation or rock series, although on this continent it occurs in greater quantities in the Corniferous Devonians, looked upon as the age of fishes. Some geologists think these were responsible for its production. The remains of fishes may be numerous elsewhere. In Canada they are so rarely noticed that some years ago the writer ventured to express his belief that animals of the nature of jelly-fish, for instance, which were not at all likely to have left any records of their existence, and the coral (Polyp), which are found in incredible numbers in the limestone shales, etc., together with sea anemonies were probably accountable for the production. When formerly collecting fossils in West Canada I noticed the Favosites, etc., in the Drift, were frequently filled with petroleum. The reefs on the northwest of Anticosti (Cambro-Silurian) deposits held several corals whose cells contained an amber-colored rock oil. I find since I visited the island, the Very Rev. Professor Laflamme has also noticed its occurrence there, but thinks it probable that no crevices or cavities exist in the rocks to act as reservoirs for collecting the petroleum.

At Macdonald's cave the upper layers of the Hudson river rocks, where the tide receded, displayed an extraordinary number of Fucoid impressions resembling detached branches perhaps of a species resembling Hall's Buthotrephis, the characteristic conical root and the main stem of the latter were absent, no dark stain indicating the presence of petroleum was noticed in the underlying beds. Perhaps the majority of the larger bogs in the west of Ireland, examined by the writer, of Mayo and Munster, the southern province originally represented shallow lakes; the fresh water shell marl at the bottom of several examined is white like chalk, and when dry bears some near resemblance to the cretaceous substance. On this account I confess I entertain strong doubts of the alleged "oil strike" in Dublin, even while admitting that the chemist has succeeded in extracting a sort of parafine from peat. A recent writer in "Public Opinion," points out to the Jurassic period, Texas is indebted for the great gushers which come from Spindle Top, Montana, Wyoming, etc.; that the places indicated owe their oil to the land or marsh reptiles of this age, while in California the petroleum is drawn from tertiary deposits containing Mammalian remains. It may be so, but the original petroleum deposits may belong to other formations, rock fissures may convey the material from one series to another. Incredible numbers of these "Lords of Creation," accumulated under conditions at present utterly unexplainable, probably led my friend, Professor E. Chapman, Toronto University, an able chemist, acknowledged as such by scientific men in England and this continent, that he entertained a certain belief that the origin of petroleum was a matter for further investigation for the reasons he has already mentioned, viz., "the enormous quantity yielded both here, the United States, and elsewhere, renders the formation of this substance from sea-weeds or perishable animal remains in the highest degree improbable.

We all know before the flowing wells were discovered petroleum was extracted from the Utica Shale. In this case I can hardly see how the origin can possibly be doubted. There may be difficulty in understanding how the countless assemblage of the crushed flattened Trilobites had been brought about. The writer has not seen the Whitby slate *in situ* at Collingwood or Whitby, C. W., which was known to produce 20 gallons of mineral oil to the ton. From careful examination of many large slabs from these localities, and enquiries from others acquainted with the formation there, it appears impossible to believe that anything outside the buried crustacea, etc., could have furnished this animal matter.

The writer some years ago called the attention of this section of the Hamilton Scientific Association to what we called "the Mineral Quarry," which was opened by Mr. Carpenter on the Hamilton and Glanford road, but since abandoned. In addition to a great variety of colored Fluor crystals, Dolomites, etc., some of the beds held in pockets a considerable quantity of that rare mineral "elastic bitumen," and what Dr. Spencer, F. G. S., pronounced to be "mineral tar," or solidified petroleum. Occurring as it did in the Barton (Niagara) series, then imperfectly known, much time was devoted to investigation of these beds by the writer. It was clearly ascertained that the thickened petroleum in this instance occurred in layers, immediately beneath groups of flattened "Orthocerata." There were no fissures above or below, and the only conclusion possible was we had here absolute proof that animal remains undoubtedly produced the bituminous matter discovered in the abandoned Barton quarry. No plant impressions were obtainable there whatever.

DISCOVERY OF THE REMAINS OF TERTIARY MAN.

The recent discovery of human remains in undisturbed Pliocene deposits proves the existence of man, as such, in Europe, even so far back as Tertiary times. Two well known scientific men made the discovery, and the result has been since confirmed by Sergi from close personal observation. The bones, we are told, presented the same fossilized appearance as those of the extinct animals in the same deposit. They belonged to a man, woman and two children. The woman's skeleton was nearly complete, and the skull is of fair capacity, less rude and ape-like than the skulls of Spy and Neauderthal. M. Qatrefages sums up the evidence by saying that there exists no reason for any doubt as regards their discovery. The curved thigh bone and bend of the knee, characteristic of Quaternary Man, are absent (marks of inferiority).

The writer feels indebted to an interesting article in an Australian exchange, "The Science of Man," for the foregoing account, which conforms the claim of man's existence in Central France in Tertiary times.

At a meeting of the American Association for the Advancement of Science, held at Washington in 1891, Prof. E. D. Cope produced a crushed skull of the extinct American horse in Tertiary apparently undisturbed deposits. In the same bed, close beside it, lay the stone hammer, evidently fashioned by human hand, used for breaking the frontal bone of the animal. If the professor, famous for his knowledge of extinct animals, was not mistaken in this instance, he adds a further proof of man's existence in Tertiary times on this continent also.

REPORT OF THE PHOTOGRAPHIC SECTION.

Your Secretary begs leave to present the following report for the past year. In doing so, it is with a great deal of pleasure, for when we look back on the work of the year we find a year of good work and enthusiastic meetings. Although our meetings have been well attended, there is still room for improvement. During the past year we have added seventeen new names to our list of members, among them being some clever and enthusiastic workers, and the club will be much benefited by their presence.

On May 24th a well attended outing of the club was held at the Forks of the Credit, where some very fine views were obtained. This was the only outing we had last summer, and I think it would be of great benefit to the members and would also increase their interest in the club if we could arrange to have more outings together.

Very early in the season, acting on a suggestion of the President's, the members of the club were divided into four sections, A, B, C and D. The object of doing this was to make competition between the members of each section and to further the interest of the club by bringing out the new members. As you all know, the idea has turned out a grand success, and it has not only been the means of stimulating the members, both old and new, to work, but it has also been the means of adding several new names to our lists of members. Shortly after the sections were made up it was decided to ask each section to give an evening's entertainment to the other three sections. Sections B, C and D each gave good entertainments, and although Section A has not been heard from, yet we still expect to hear from them soon.

The club decided at the beginning of the season to enter the American Lantern Slide Interchange, and preparations were at once made to get together a good set of slides. On June 2nd we held a meeting for the purpose of judging eleven sets of slides entered in competition for a gold medal given by Past President Baker, also shortly before the close of the interchange set we held a very enthusiastic meeting, when the judging took place for prizes given by our President in a slide competition. As you know, from the result of the above two competitions the club was enabled to send to New York one of the largest and best set of slides it has ever sent.

The club's Annual Exhibition and Competition took place on March 27th and 28th, and was considered one of the most successful we have held. The new members were well represented, and the work shown was much superior both in composition and finish to that shown in previous exhibitions. Section C turned out to be the winning Section, and it is pleasing to note that Mr. A. G. Alexander, who is a member of that Seciton, and also one of the club's new members, was the winner of the first trophy and gold medal for the best collection of prints in the exhibition.

During the past year the club lost one of its oldest and most enthusiastic members. I refer to Mr. Samuel Briggs. On August 6th a meeting was held to bid him farewell, as he was then leaving for the Old Country. Mr. A. H. Baker, on behalf of the club, presented him with a fine group of the members taken at a recent club outing.

During the year several small improvements have been made to the dark room, but it is still not what it should be. The idea has been brought up about securing new club rooms, and I hope this will not be given up, for if there is anything we need to make the club a continued success it is new and comfortable meeting rooms.

In conclusion, I desire to thank all who have assisted in making our meetings a success, and ask from you for my successor in office the same hearty support that I have received.

Respectfully submitted.

JAMES MOODIE,
Secretary.

REPORT OF CURATOR.

Since the last annual meeting of the Association there have been a few additions to the Museum, which has been kept open every Saturday afternoon, as heretofore, and many of the cases rearranged. Large meetings of the various sections, which now number five, have been held in the room, thereby causing constant shifting of the glass cases, greatly to their disadvantage and injury. All are at present in tolerable order, and the Curator hopes they will not be so often shifted as they have been lately. The donations to the Museum have been few, but many of them are of great interest.

The chalk fossil, from England, are all in one case.

A fine tomahawk of one of the Indian Chiefs who fought at the Stony Creek battle, donated by Mrs. Pearson, who obtained it from the chief's grandson.

A very large petrified shark's tooth.

Two sets of tin candle moulds used by the early settlers in Canada.

An old flint lock pistol.

Specimen of a porcupine fish.

Various photos of curious promissary notes in circulation among the Morman stores in 1774.

Specimen of native copper from the north shore of Lake Huron.

Curious specimen of wood dove tailing, made of two different kinds of wood.

A fine piece of wood sawing by a machine saw.

A quantity of small sea shells from Jamaica.

Specimen of lace bark from Jamaica, very beautiful.

ALEX. GAVILLER,
Curator.

HAMILTON SCIENTIFIC ASSOCIATION.

Treasurer's Statement, 7th May, 1903.

RECEIPTS.

Balance from 1902	$168 06
Government Grant	400 00
Members Fees (regular)	44 00
" Photographic Section	34 00
" Astronomical Section	7 00
Horticultural Society and other rent	4 50
	$657 56

EXPENDITURE.

Rent of Museum	$138 00
Rent of Dark Room	18 00
Caretaker, $46.00; extra, $4.00	50 00
Gas Account	15 40
Printing Annual Reports	149 15
Printing and Engraving	58 00
Postage and Stationery	25 75
Lectures, including opening expenses	24 86
Grant to Photographic Section	32 50
Insurance	10 00
Sundry Accounts	15 55
	$537 21
Balance on hand	120 35
	$657 56

P. L. SCRIVEN,
Treasurer.

This is to certify that we have examined the vouchers and found them correct.

H. S. MOORE, } *Auditors.*
F. HANSEL, }

LIST OF EXCHANGES.

I—AMERICA.

(1) Canada.

Astronomical and Physical Society.......Toronto.
Canadian Institute ....Toronto.
Natural History Society of Toronto......Toronto.
Department of Agriculture...............Toronto.
Library of the University...............Toronto.
Public Library ....Toronto.
Geological Survey of Canada.............Ottawa.
Ottawa Field Naturalists' Club..........Ottawa.
Ottawa Literary and Scientific Society.....Ottawa.
Royal Society of Canada.................Ottawa.
Department of Agriculture...............Ottawa.
Entomological Society ....London.
Kentville Naturalists' Club.............Kentville, N. S.
Murchison Scientific Society............Belleville.
Natural History Society.................Montreal.
Library of McGill University............Montreal.
Nova Scotia Institute of Natural Science...Halifax.
Literary and Historical Society of Quebec.Quebec.
L'Institut Canadien de Quebec...........Quebec.
Natural History Society of New Brunswick.St. John.
Manitoba Historical and Scientific Society..Winnipeg.
Guelph Scientific Association...........Guelph.
Queen's University ....Kingston.
Niagara Historical Society..............Niagara.

(2) United States.

Kansas Academy of Science...............Topeka, Kan.
Kansas University Quarterly.............Lawrence, Kan.
American Academy of Arts and Sciences..Boston, Mass.

Psyche .... Cambridge, Mass.
Library of Oberlin College .... Oberlin, Ohio.
American Association for Advancement of Science .... Salem, Mass.
Museum of Comparative Zoology .... Cambridge, Mass.
American Dialect Society .... Cambridge, Mass.
United States Department of Agriculture .... Washington, D. C.
Biological Society of Washington .... Washington, D. C.
Philosophical Society of Washington .... Washington, D. C.
Smithsonian Institute .... Washington, D. C.
United States Geological Survey .... Washington, D. C.
American Society of Microscopists .... Buffalo, N. Y.
Buffalo Society of Natural Sciences .... Buffalo, N. Y.
California Academy of Sciences .... San Francisco, Cal.
California State Geological Society .... San Francisco, Cal.
Santa Barbara Society of Natural History .... San Francisco, Cal.
University of California .... Berkley, Cal.
Minnesota Academy of Natural Sciences .... Minneapolis, Minn.
Academy Natural Sciences .... Philadelphia, Pa.
Academy of Sciences .... St. Louis, Mo.
Missouri Botanical Gardens .... St. Louis, Mo.
American Chemical Society .... New York City.
New York Microscopical Society .... New York City.
The Linnean Society .... New York City.
American Astronomical Society .... New York City.
American Geographical Society .... New York City.
New York Academy of Science .... New York City.
Terry Botanical Club .... New York City.
Central Park Menagerie .... New York City.
American Museum of Natural History .... New York City.
Scientific Alliance .... New York City.
Cornell Natural History Society .... Ithaca, N. Y.
Johns Hopkins University .... Baltimore. Md.
Kansas City Scientist .... Kansas City, Mo.
Wisconsin Academy of Science, Arts and Letters .... Madison, Wis.
Society of Alaskan Natural History and Ethnology .... Sitka, Alaska.

University of Penn......................Philadelphia, Pa.
Franklin Institute ....Philadelphia, Pa.
Brooklyn Institute of Arts and Science....Brooklyn. N. Y.
War Department ....Washington.
Field Columbian Museum..............Chicago.
Academy of Sciences....................Chicago.
Agricultural College ....Lansing, Mich.
Colorado Scientific Society..............Denver, Col.
Museum of Natural History............Albany, N. Y.
State Geologist ....Albany, N. Y.
Rochester Academy of Sciences..........Indianapolis, Ind.
Indiana Academy of Sciences...........Indianapolis, Ind.
Davenport Academy of Natural Sciences...Davenport. Iowa.
Pasadena Academy of Sciences...........Pasadena, Cal.
U. S. Board of Geographic Names........Washington, D. C.
Lloyd Library ....Cincinnati, O.
Colorado College ....Colorado Springs.

(3) West Indies.

Institute of Jamaica.....................Kingston, Jamaica.

(4) South America.

The Royal Agricultural and Commercial
Society of British Guiana............Georgetown.

II—EUROPE.

(1) Great Britain and Ireland.

England.

British Naturalists' Club................Bristol.
Literary and Philosophic Society of Leeds.Leeds.
Conchological Society ....Leeds.
Royal Society ....London.
Royal Colonial Institute..................London.
Society of Science, Literature and Art.....London.
Geological Society ....London.
Machester Geological Society...........Manchester.
Mining Association and Institute of Cornwall ....Camborne.

Cardiff Photographic Society............Cardiff.
Owens College Conchological Society.....Manchester.

Scotland.

Glasgow Geographical Society...........Glasgow.
Philosophical Society ....Glasgow.

Ireland.

Royal Irish Academy...................Dublin.
Royal Geological Society of Ireland.......Dublin.
Naturalists' Field Club..................Belfast.

(2) Austria-Hungary.

Anthropologische Gesellschaft ....Vienna.
K. K. Geologische Reichsanstalt..........Vienna.
Trentschin Scientific Society.............Trentschin.

(3) Belgium.

Societe Geologique de Belgique..........Liege.

(4) Denmark.

Societe Royal des Antiquaries du Nord....Copenhagen.

(5) France.

Academie Nationale des Sciences, Belles Lettres et Arts.....................Bordeaux.
Academie Nationale des Sciences, Arts et Belles Lettres ....Caen.
Academie des Nationale Science, Art et Belles Lettres ....Dijou.
Societe Geologique du Nord.............Lillie.
Societe Geologique du France............Paris.

(6) Germany.

Naturwissenschaftlicher Verein ....Bremen.
Naturwissenschaftlicher Verein ....Carlsruhe.

(7) Russia.

Comite Geologique ....St. Petersburg.
Russich-Kaiserliche Mineralogische Gesellschaft .. ..St. Petersburg.

III.—ASIA.

(1) India.

Asiatic Societies of Bombay and Ceylon....
Asiatic Society of Bengal................Calcutta.
Geological Survey of India..............Calcutta.

(2) Straits Settlements.

The Straits Branch of the Royal Asiatic
Society .. ..Singapore.

(3) Japan.

Asiatic Society of Japan..................Tokyo.

IV.—AFRICA.

(1) Cape Colony.

South African Philosophical Society......Capetown.

V.—AUSTRALIA.

(1) Australia.

The Australian Museum................Sydney.
Royal Society of New South Wales.......Sydney.
Linnean Society of New South Wales.....Sydney.
Royal Anthropological Society of New
South Wales ....Sydney.
Australian Natural History Museum......Melbourne.
Public Library of Victoria...............Melbourne.
Royal Society of Queensland.............Brisbane.
Queensland Museum ....Brisbane.

(2) New Zealand.

New Zealand Institute..................Wellington.

(3) Tasmania.

Royal Society of Tasmania..............Hobartown.

THE LATE THOMAS MCILWRAITH.

OBITUARY.

We have again to record the passing away of one of our oldest and most valued members, in the person of THOMAS McILWRAITH, SEN., who died on the 31st of January last.

The late Mr. McIlwraith had a national reputation as a naturalist. From boyhood he possessed a strong love of nature in all its forms, and the insects, plants and birds were familiar to him at an early age. His chief interest, however, was in bird life, and he roamed the woods with great energy in pursuit of knowledge. There being no books to serve as guides to the identifying of the species in Ontario, he prepared a paper containing a list of the birds of which he had obtained a knowledge by careful observation. This paper was read before this Association about 1859, and it appeared in the Canadian Journal the following year. In this same year he was first vice-president of the Association, and from then till 1875 he acted as librarian and curator. On the re-organization of the Association in 1880 he was elected President, and from that time on, until failing health prevented, he took a lively interest in the welfare and progress of our Society, and often contributed to the pleasure and instruction of our members out of his vast stock of natural history, information gathered in the pursuit of his favorite study of Ornithology. He was looked upon as the best authority on the "Birds of Ontario," a work on which of 300 pages, containing a minute and correct account of 300 species of birds, their nests, eggs, etc., was published under the auspices of our Association.

The ornithologists of the United States were early attracted by Mr. McIlwraith's knowledge of bird life, and in 1883 he was invited to New York to take part in the formation of the American Ornithologists Union, he being one of the founders. He was appointed superintendent of the district of Ontario for the migration committee of the Union, and did considerable work in appointing observers at various points to note the arrival and departure of the migratory birds.

Mr. McIlwraith preserved and mounted many of his specimens, and he had one of the largest and best private collections in Canada.

Mr. McIlwraith was a native of Ayr, in Scotland, where he was born on Christmas day, 1824. He came to this city in 1853, so that he lived here nearly half a century. From that time until 1871 he was manager of the Gas Works, when he went into business, retiring about ten years ago.

He was of a kindly disposition, and had formed a large circle of friends, many of whom are members of this Association, who highly value his contributions to the objects, for which it exists, viz., to add something to the sum of scientific knowledge.

OFFICERS FOR 1903-1904.

President.

J. M. DICKSON.

1st. Vice-President.

REV. D. B. MARSH, Sc. D.

2nd. Vice-President.

W. A. ROBINSON.

Corresponding Secretary.

R. J. HILL.

Recording Secretary

G. L. JOHNSTON, B. A.

Treasurer.

P. L. SCRIVEN.

Curator.

J. SCHULER.

Council.

GEO. BLACK. JAMES GADSBY.

J. M. WILLIAMS.

R. CAMPBELL. R. A. PTOLEMY.

Auditors.

A. BAKER. J. F. BALLARD.