Journal and Proceedings

OF THE

Hamilton Scientific Association

Session 1903-1904

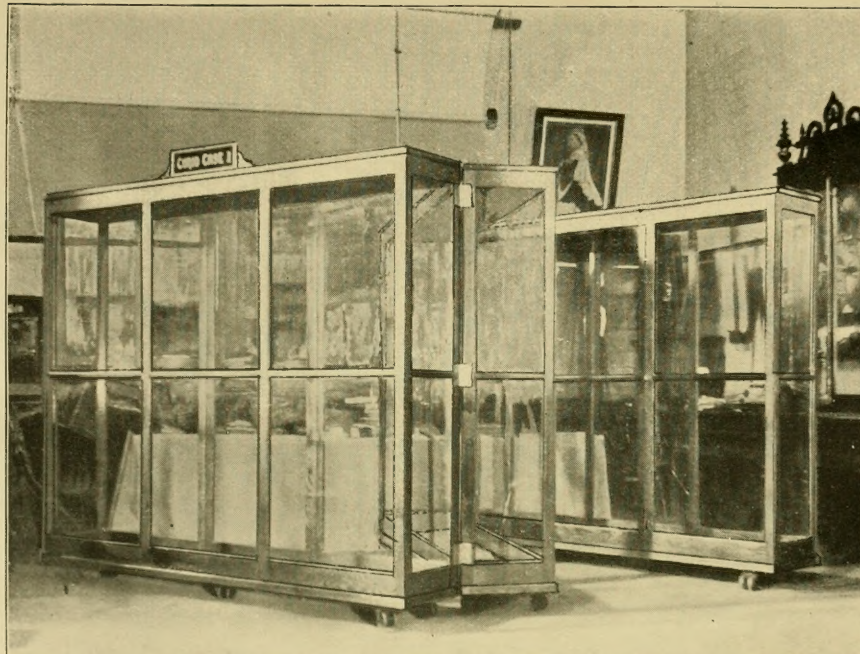
NUMBER XX.

CONTENTS.

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

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

1904.



NEW MUSEUM CASES, HAMILTON SCIENTIFIC ASSOCIATION.

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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............
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1898	T. W. Reynolds, M.D.....	A. E. Walker.............	J. M. Dickson ....
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1903	J. M. Dickson............	Rev. D. B. Marsh, Sc.D ...	W. A. Robinson ....

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R. J. Hill............	G. L. Johnston, B.A.	P. L. Scriven........	J. Schuler.

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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.

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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. Leggatt; 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.; Robert Campbell; W. A. Childs, M.A.; Wm. C. Herriman, M.D.; W. A. Robinson.

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

1900—Robert 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.

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

J. M. Williams; Geo. Black; Jas. Gadsby; A. H. Baker; R. A. Ptolemy

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF

The Hamilton Association

DURING THE

SESSION OF 1903-1904.

NOVEMBER 12th, 1903.

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

Two new members were elected. President delivered his annual address, which is published in this Journal; it breathes of nature, and is a literary gem, besides.

An exhibition of slides was given by Messrs. Gadsby and Baker. A well-attended and interesting meeting.

DECEMBER 10th, 1903.

Regular meeting held, with President in the chair. A lecture was to have been given by O J. Stevenson, M.A., of St Thomas, on "The Wild Birds of Ontario;" but, owing to blocking of trains, lecturer did not arrive in time. Meeting was postponed to following night, but, the weather being very inclement, the attendance was small. See Journal for paper.

JANUARY 14th, 1904.

Regular meeting held, with President in chair.

Three new members were elected.

Mr. F. B. Kenrick, M.A., Ph. D., lectured on "The Art of Glass-Blowing from the Earliest Times." For abstract of paper see Journal.

FEBRUARY 11th, 1904.

Regular meeting held, with President in chair.

Professor Pelham Edgar lectured on "Nationalism in Poetry, and Canadian Poets," for abstract of which see Journal.

MARCH 10th, 1904.

Regular meeting held, with President in chair.

Two new members were elected.

Mr. W. A. Parks, B. A., Ph. D., lectured on "Ontario's North Land," for abstract of which see Journal.

APRIL 14th, 1904.

Regular meeting held, with President in chair.

One new member was elected.

Mr. F. B Allen, M. A., Ph. D., lectured on "The Manufacture of Natural Products." For abstract of lecture, see Journal.

MAY 12th, 1904.

Annual meeting. President in chair.

Eighteen new members were elected.

Feeling reference was made by Mr. Alexander, and supported by Col. Grant, to the loss to the Association by death of Mr. Alexander Gaviller, for 20 years faithful curator of the Museum, and Mr. Jno. Alston Moffat, one of our honorary members, and letters of condolence were ordered to be sent to relatives of these deceased members.

Reports presented.

Officers elected as follows:

President,	GEO. L. JOHNSTON, B. A.
1st Vice-President,	REV. D. B. MARSH, SC. D.
2nd Vice-President,	R. A. PTOLEMY.
Corresponding Secretary,	R. J. HILL.
Recording Secretary,	J. F. BALLARD
Treasurer,	P. L. SCRIVEN.
Curator,	COL. C. C. GRANT.
Council,	WM. ACHESON, J. G. CLOKE, J. M. WILLIAMS, JAS. GADSBY AND ROBERT CAMPBELL.
Auditors,	E. H. DARLING and A. H. BAKER.

May 26th, 1904.

Adjourned Annual Meeting held, with President in chair.

Committee appointed to deal with Membership Fee reported "That the fee of the H. S. A. be $1 00 per annum, as at present, which fee, in case of members of Sections, is to be collected by the Treasurers of the Sections and to be paid over to the Treasurer of the Association. The Sections, as at present, may impose any additional fee for the purposes of their Section."

The report was received and adopted.

Report of Geological Section was presented by Mr. A. T. Neill. This report showed the continued activity of Col. Grant in the collection and distribution of fossils.

Dr. Marsh was appointed representative to Royal Society, with Prof. Fletcher as substitute. Meeting adjourned.

J. M. DICKSON,
President.

G. L. JOHNSTON,
Secretary.

REPORT OF COUNCIL.

Your Council take pleasure in submitting their report for the session 1903-1904.

During this session there have been held four meetings of Council and seven meetings of the General Association, at which the following Papers and Addresses were given :

November 12, 1903—"Inaugural Address"—President J. M. Dickson.

December 10, 1903—"The Birds of Ontario"—O. J. Stevenson, M.A.

January 14, 1904—"The Art of Glass-blowing from the Earliest Times"—F. B. Kenrick, M.A., Ph.D.

February 11, 1904—"Nationalism in Poetry and Canadian Poets"—Prof. Pelham Edgar.

March 10, 1904—"Ontario's North Land"—W. A. Parks, B A., Ph.D.

April 14, 1904—"The Manufacture of Natural Products"—F. B. Allen, M.A., Ph.D.

May 12, 1904—Presentation of Reports, Election of Officers and other business.

Your Council is pleased to record the continued activity and good work of the Camera, Astronomical and Geological Sections, and to hear of the resumption of active work during the present summer by the Biological Section.

The Museum has been kept open regularly on Saturday afternoons for visitors. New cases have been procured for the better displaying of specimens and for the economizing of floor space.

During the year the Association has been called upon to mourn the loss of its Curator, Mr. Alexander Gaviller, an old and able supporter of the Association. The position, however, is being ably filled by Col. Grant, who has special knowledge of the Museum and its requirements.

There have been added during the year twenty-six new members ; the meetings have been fairly well attended, and altogether the Association has had a successful year.

All of which is respectfully submitted.

J. M. DICKSON, *President.*

G. L. JOHNSTON, *Secretary.*

REPORT OF ASTRONOMICAL SECTION.

We report a very satisfactory session.

Meetings at which papers have been read, fourteen. These, with two exceptions, were by our own members, which we consider a matter of congratulation, evidencing the real educational results from the work of the Scientific Association. Our audiences have been very large, in many instances filling the Museum to overflowing.

We are confident that the cases which the Association have purchased will result in making the room which has been so much needed

We report a membership of 53.

Aberdeen observatory, through the courtesy of Dr. Marsh, has been visited by over a hundred visitors through the medium of the Astronomical Section, and in accord with the verdict of the many hundreds who have otherwise visited the observatory, have expressed themselves as favored indeed by the value of the knowledge given and the courtesy accorded to everyone by Dr. Marsh. It is worthy of comment the far-reaching influence that has resulted from Dr. Marsh coming amongst us, and the expansion of knowledge, Astronomical and otherwise, that has resulted, will not be easily measured, but is to be found in every quarter of our intellectual field.

We have been again much indebted to our Toronto confreres; they have, ever since our inception as a society, been ready and prompt to assist us by their excellent papers, loan of apparatus, and in very many ways exemplified the attitude of generous courtesy, which is the characteristic of the highly intellectual.

We mean no discrimination when we mention the liberal use we have had of the tube of Radium from Mr. J. R. Collins, and by which one of the first, if not the first radiograph lantern slide, was made in Canada, and shown, together with the tube so kindly loaned for the occasion, to the largest audience of our season, a courtesy which the audience appreciated, it being the first Radium shown in Hamilton.

We append the papers which have been read, and desire to express our views as a Society that the grant of the Ontario Government to Hamilton is being expended in a way which must certainly meet with the approval of the same.

We also wish to add our views to the general view held in this city, that the excellent valuable work of the Geological Section, under the hand of Col. C. C. Grant, deserves the recognition by the Dominion Government by a grant to enable the valuable collection of Col. Grant to be cased and catalogued, and we would request the Association to draw attention of the Dominion Government to the question of having the various collections catalogued and recorded by the Curator-General at Ottawa, so that a collaboration of Canada's resources may be initiated in every department, including Geological and Biological collections.

All of which is submitted to the Association.

J. M. WILLIAMS,
Secretary.

REPORT OF GEOLOGICAL SECTION

For the Year Ending May, 1904.

The Section, in submitting this report, has much pleasure in informing the members of the Hamilton Scientific Association that the usual interest has been maintained and much work has been done by the members of the Section during the year which has just closed.

Many specimens have been added to the already large collection of Silurian fossils in the Museum of the Association, by Col. C. C. Grant and others.

Col. C. C. Grant has made the discovery of several new varieties of Graptolites, which have been sent to different recognized authorities upon these obscure forms of life which existed in the ancient seas of the Silurian period, also some new Gastropods, which have been sent away for identification and classification. Although the season covered by the period from May to November for the collection of the fossil sponges was not as favorable as some previous ones, yet a considerable number of these unique fossils were obtained and distributed to different parts of the world. The Barton beds in the vicinity of Hamilton have become famous for the number and variety of specimens obtained from them, and they are frequently alluded to by writers of the life history of the fossilized sponges. The thanks of the Hamilton Scientific Association is due to Col. C. C. Grant for his indefatigable zeal in the pursuit of the collection of specimens and for sending them to so many Museums, thereby being instrumental in publishing to the world this fruitful field of the fossilized remains of the homes of the Amoeba.

Letters have been received from the Directors of different Museums expressing their thanks to the Council for specimens sent them by one of our members, Col. C. C. Grant: Dr. Ray Lancaster, of the British Museum; Prof. J. F. Whiteaves, of Ottawa; Prof.

Clark, State Geologist of the State of New York; Dr. Gourley, at Washington, and Prof. Schuchart, of the same place.

The number of specimens sent away may be approximately stated to be 200; some, as I have said, to be identified and classified, and some writers have asked for specimens in order that they might give them more thorough study, with a view of writing a monograph on the subject .

The Museum has been kept open on Saturday afternoons, and many students have taken advantage of the opportunity to study the specimens displayed in the Museum cases. This privilege should be esteemed and appreciated by every lover of nature studies.

The Section has not held as many meetings during the past year as formerly, owing to a chain of circumstances which prevented the members assembling as frequently as they wished to read and hear papers read.

Col. C. C. Grant read two papers on Geological subjects; following are the dates and titles of the papers read:

April 6—Geological Notes
" 26— " " continued.

Respectfully submitted.

A. T. NEILL,
Chairman.

REPORT OF PHOTOGRAPHIC SECTION.

The past year, though it appeared to be a rather quiet one with this Section, was, nevertheless, a year of much good work, and in many respects ahead of any previous one. The number of members who contributed slides to the Interchange set, and prints to the annual exhibition, was twice that of previous year, and the work all of a good quality, which shows that the members have been active. But our regular meetings have not been as well attended as they should have been. It would be well for our programme committee to try and arrange, during the coming year, for more demonstrations and discussions along the different branches of photography.

At the beginning of the season it was decided that the Camera Section should join the American Lantern-slide Interchange; and, in order to get as many slides as possible to select from, a slide competition was held in October for prizes given by the President, and it proved to be a most successful one. About twenty-five members contributed slides, and as a result we were enabled to select a hundred very good slides, which were sent on to New York. Of these about 45 were chosen as a set to go around the Interchange circuit with the Toronto and Vancouver sets.

At intervals throughout the year sets of slides from the American Interchange have been shown before fairly good audiences. There were many fine sets among them, and they were much enjoyed by the members and others who attended these exhibitions.

As some dissatisfaction with the American Interchange has been expressed of late, it was suggested some time ago that an effort should be made to form a Canadian Interchange. It would, perhaps, be well to keep this matter in view, and ascertain during the coming season if such an interchange could be formed.

It was very gratifying to the members of our Section to have five slides chosen from our last year's set to go in the European set; this was a very creditable showing.

A few interesting and instructive demonstrations were given during the year, some of which were: "Toning Developing-out Paper," by Mr. A. G. Alexander; "Development of Under- and Over-exposed Plates," by Mr. J. G. Gadsby; "Making of Lantern Slides," by Mr. Land and Mr. Gadsby. The Section is much indebted to Mr. Gadsby for devoting every night for a week during the lantern-slide season in his untiring efforts to teach many members how to make good slides.

There were some improvements made to the darkroom during the year—such as a new zinc developing-table, the erection of 12 new lockers, and the addition of several large developing-trays and graduates. But things are not yet as they should be. The enlarging and reducing apparatus is not satisfactory; a larger condensor is needed. It is to be hoped that our darkroom will receive a large share of attention during the coming year.

There was but one outing last year—that to Guelph on Victoria Day. Though no views of any note were obtained (the locality not being favorable), the members, of whom there was a good turnout, had an enjoyable time.

Our annual print exhibition, held this year on the 24th, 25th and 26th of March, was conceded to be equal, if not superior, to any previous competition held by the Section. There were about thirty exhibitors, and the pictures were of a high artistic merit. The successful exhibitors were:

A. G. Alexander, gold medal and first trophy;
D. A. Souter, second trophy and silver medal;
W. G. Grant, landscape—medal;
C. A. Herald, genre—medal;
J. G. Gadsby, flowers—medal;
Mrs. Robt. Campbell, enlargements—medal;
Miss Dixon, best collection by lady members—medal;
T. J. Davenport, Wentworth County amateurs—medal;
J. H. Land—Mr. Cunningham's prize for best print of tree.

The medals for marine interiors and portraiture were withheld by the judges; the work outside of that which had already been awarded prizes in other classes was not of sufficient merit to allow of a prize being given.

Twenty new names have been added to the membership roll during the year, among them being many enthusiastic workers.

In conclusion, as Secretary, I desire to thank all who have helped me in any way to perform the duties of office, and ask for my successor the same hearty support that I have received.

Respectfully submitted,

WALTER E. HILL,
Secretary.

CURATOR'S REPORT.

As acting Curator of the Museum, I regret to say only a few things have been added recently to the cases. Through the late Mr. Gaviller, Mrs. T. D. Walker kindly presented to the Museum three Australian Emu's eggs. A dealer lately stated the bird is fast becoming extinct, and such things are now difficult to obtain—of late years have risen considerably in value—so we may regard them as an important donation.

A farmer friend of mine who lives near the Hesse Spring, and who already brought us a few arrow and flint spearheads, presented the Museum with an excellent specimen of what is known as an Indian firestone.

Any one who has seen the collection of Indian relics at Toronto, or Mrs. Carey's at Dundurn, may readily perceive what a poor display of antiques we present to the public. The only thing we can say in its favor is that the few we possess at least are genuine, and not the fraudulent specimens we so frequently find in many Museums.

The fine collection of native birds, donated by Mr. and Mrs. Eastwood, were removed to one of the side cases near the entrance, where they can be seen to more advantage than when suspended from the rod at the end of the room. The present position is not all that may be desired, but it seems a slight improvement on their former place. The doors of the sides can be temporarily opened on Saturdays. The Council may notice some two or three specimens in several cases. When our funds permit, it may be thought necessary to separate the specimens and provide a few additional cases for a very interesting and valuable collection.

We may have some difficulty now, since the death o our old member, Mr. McIlwraith, in getting the birds correctly named, your Curator's knowledge of Ornithology (especially of bird-life on this continent), being very limited.

CHAS. COOTE GRANT.

INAUGURAL ADDRESS.

HAMILTON SCIENTIFIC ASSOCIATION, SESSION 1903-1904.

BY J. M. DICKSON, PRESIDENT.

Ladies and Gentlemen:

My appearance here to-night indicates that another year has passed, whether of profit or loss remains for your decision. We have profited by the addition of many valuable papers to our proceedings and have lost several of our active members.

Death, I regret, has removed from our ranks a figure once prominent in our meetings. I refer to the past President, Thomas McIlwraith, the noted Canadian ornithologist, who, full of years, departed this life in January. An earnest student, keen observer and careful writer, his works, of wider than continental repute, will perpetuate his memory.

We have also to regret the resignation of Mr. Alexander Gaviller, a gentleman who has held for many years the honorary office of Curator, a position which he has most zealously filled.

Mr. Schuler, the active assistant Curator, has likewise been compelled, by business pressure, to remove from our midst.

The Astronomical, Geological and Photographic Sections continue to carry on their good work and increase in strength.

Scientific investigation of the element Radium has attracted much attention. Its remarkable production of heat and light, great rarity and almost fabulous cost have claimed the interest of all readers, while its destructive action upon the tissues has created the hope that it may prove to be a valuable germicide Like many new discoveries its powers have probably been over-rated, and already a British scientist has concluded that it is not a true element, but a compound of helium and some other element or elements, the constant discharge being simply due to spontaneous decomposition.

Nature study has taken a prominent position during the past year, and almost illimitable is the field it offers for our exploration.

Many lessons of scientific and commercial value might be learned from the despised dwellers of the field and wood. For example, the common wasp is not a subject that commends itself to the close consideration of many, yet this creature has been engaged for incalcuable years in the manufacture of paper from wood pulp, an industry which has only recently commanded the attention of man.

Health, pleasure and profit await the student of nature who roams afield. To the lover of wild flowers, or botanist, "with what a glory comes and goes the year." Let us glance at some of her attractions March, the first month of the Roman calendar, may also be said to be the first month of the floral calendar. We perceive signs of activity everywhere in nature. The buds of deciduous trees and shrubs are full and prominent; the evergreens shake themselves in preparation for a general spring house-cleaning.

The earliest plant to be found in flower is unquestionably the Symplocarpus foetidus or Skunk Cabbage. You will find it ere the snow and ice have disappeared. Peeping, with roguish eye, from underneath the winter's mantle, you may see her if you chance to recognize her purple cowl. She does not wait to be fanned into consciousness by the soft spring breezes, nor revived by the warm rains of weeping skies. The first kiss of the sun upon her upturned lips is sufficient to set astir the blood within her veins. Indeed, to be concise, she is even now ready to begin her mysterious operations of growth. Already the Skunk Cabbage has woven her ornate hoods of red and purple, and these hoods, themselves wrapped securely in a layer or two of thick integument, protect within them the flowerets of the succeeding spring. Besides the fresh spathe are to be found also the black and decaying receptacles wherein is stored the prolific harvest of fruits matured during the past summer. If but ten per cent. of these fruits were to germinate and grow the humble bog city of the Araceae would soon require enlarged boundaries. This plant blooms alone—the fairer and more pleasing gems of

> "Merry April and sweet smiling May
> Come not till March has first prepared the way."

Soon the snow has gone and "stooping showers have sandalled the feet of May with flowers," and wider fields present themselves to the botanist.

In the vanguard comes the familiar Hepatica, a graceful and interesting flower, the more interesting because of mythological beliefs which attach to it. Scholars of the middle ages believed it to be the Leichen of the Greeks and invested it with the interest with which mythology surrounds the fate of that unfortunate damsel. Reared by her mother to a life of piety, and educated in medicine by her father, who was himself the god of physicians, and by whom she was given in marriage to a youth of good report, she died suddenly on her wedding eve and the gods turned her dead body into a flower, the Hepatica, because of her skill, before her death, in curing diseases of the liver, which the Latinized Greek word "Hepatica" implies.

Now the beautiful but fugacious Bloodroot *(Sanguinaria Canademse)*, unfolds her gleaming petals and her palmate leaves. The Windflower *(Anemone nemorosa)*, swings its solitary bell between a pair of compound leaves, and the pretty little pink and white fairy known as spring beauty carpets the ground.

The dainty Violet next attracts attention. It is a numerous and by no means inconspicuous household. Some species confine their flowering period to the spring, others bloom throughout the entire summer. Some adorn the low and moist ground, others prefer high and dry situations. The flowers are of yellow, white, and all the various shades of purple.

In passing we note the Erythronium or Adder's Tongue, with scape bearing a single yellow gem, rising from between two long, spotted, satiny leaves.

During May and June we have the most abundant wealth of bloom. Now we have the Uvularia or Bellwort, the beautiful Phlox divaricata, the Dicentra cuccularia and the feathery Tiarella cordifolia or Foam flower.

The Trilliums, abundant on every hillside, call to mind a host of happy children waving their white sunbonnets and dancing to the music of the breeze.

The wild Columbine with nodding balls of red and yellow is graceful and attractive.

A little later the glories of the genus Cypripedium burst upon us. This genus includes several species found in this locality, viz. :

C. Pubesens and C. Parviflora, the yellow ladies'-slippers ; C. Acaule, the beautiful rose purple moccasin flower, and C. Spectabile, the showiest of all terrestrial orchids.

Side by side with these grows the Ledum latifolium, a shrub of remarkable beauty, bearing tufts of snowy flowers and scarcely less attractive foliage, the upper surface of which is shining green and the under a sunlit color resembling buffed leather.

July ushers in an entirely different floral aspect. Now the gorgeous masses of Asclepias tuberosa set aflame the hillsides and sunny uplands ; in the cooler glades of the wood the fragile wood-lily, Lilium Philadelphicum, lifts her golden chalice to the dews of heaven, while her elegant and more stately sister, Lilium superbum, poises her flaming candelabrum.

August gives to the floral world the many varieties of sunflowers and cone-flowers, all worthy of our appreciation and study—the splendid cardinal Lobelia, that "red-coated sentry of the wood," in contrast with which we find, dressed in suit of blue, its stouter but less graceful neighbor, Lobelia Syphilitica. Farther on appear the snowy masses of Chelone glabra, turtle head.

Across the threshold of the year now comes September, with her crown of gentians, royal blue, a fitting color for a plant with name of kingly origin. Gentius, who reigned 167 years B. C., was the last King of Illyria. He provoked a war with the Romans, was defeated and taken in triumph to Rome. Suffering from malarial fever, he was treated with an infusion of this herb, hence the name, Gentiana.

Our local gentians are confined to two species, the beautiful fringed blue gentian, G. Crinita, and the closed blue gentian, G. Andrewosii ; a white form of this latter species grows plentifully in our locality.

We must not forget to mention the humble Monotropa uniflora, well known under the common names of corpse plant and Indian pipe. This is a very strange and interesting citizen of the vegetable kingdom. Dependent for support, and with no specialized organs of distribution, it has established itself to a degree scarcely equalled by any other species of flowering plants. Notwithstanding its wide distribution and existence under so many varied conditions of environment, it remains constant to type, merely becoming of shorter and stouter growth as it approaches the north, a prevalent geographical character of plants. It is a root parasite, and not, as has long been supposed, a saprophyte. This unique child of the floral race is a paradox to the human race. In youth its head is bowed to the earth, in age it stands erect. When at perfection, the entire plant is colorless, the stalk, leaves and petals are all waxy white. After maturity it takes on a pinkish coat, and finally blackens. All preserved specimens of this plant are black, which is characteristic of most, if not all, parasites. (The beech-drops and Hypopitis form an exception to this rule; they retain their tawny color, as in life).

At our recent Horticultural Exhibition, in one of the wild-flower collections, was a carefully selected specimen of the Indian Pipe, showing the mycelium of the fungus host permeating the root ball. It is not known whether it should be classed as an annual or as a perennial. Their is evidence to support both characters. Here is a convenient field for research, worthy the attention and study of some of our younger botanists.

As the season advances, still another view of the ever shifting panorama of nature is presented to the spectator. Summer, with her magnificent train, is past; the first month of Autumn has woven her threads of color in the many-hued garment of nature, dropped her empty shuttle and fled. Now blushing October, garlanded with a wealth of fruits and flowers, sweeps with queenly grace across the land. Her brow is decked with asters, purple, and rose and white; her arms are filled with sheaves of golden rods; her robe is pieced of painted forest leaves; her girdle is of trailing vines dyed crimson in the life blood of the year; her face is veiled with purple haze; her feet are sandalled with glistening frosts: for the flowers her song is the dirge of death, and when, with outstretched arms, she rises to take her farewell, we write the "finis" to this floral biography and close the volumes as her lessening pinions rise and fall in the distance.

> "And yet, there is not lost
> One of Earth's charms: upon her brow,
> After the flight of untold centuries,
> The freshness of her far beginning lies
> And yet shall lie."

Abstract from Minutes of Lecture by F. B. Kenrick, M.A., Ph.D., on "The Art of Glass-blowing from the Earliest Times."

The Queen of Sheba had her glass beads buried with her. Little change in the art for 5000 years. Bottles belonging to the time before Christ, and window-panes of the early Christian era, found in Rome. Two methods of blowing glass—from the furnace, and by the blow-pipe—were illustrated. Glass-blowing in early times an art, and glass-blowers ranked with the nobility, and given special exemptions and privileges in the Byzantian empire. Tiny pitchers, vases, etc., made in a special stereopticon machine, which threw every movement on the screen. Hearty vote of thanks tendered.

Abstract from Minutes of Lecture Delivered by Professor Pelham Edgar on "Nationalism in Poetry and Canadian Poets."

Do we possess a literature with a distinctive Canadian spirit? Have we nationalism in the poetry of different countries? All countries have to some extent, and some more than others, exhibited national characteristics in their poetry, yet all that is best in the poetry of any country is cosmopolitan, rather than national. Canada has contributed such men as Carmen and Roberts to the U. S. and Parker to England. Canada is a new country, vast in extent and resources. Splendid also in history, but lacking in legend and myth, upon which so much of the Poetry of older countries is based.

Chas. D. Roberts has gained more than a national reputation by his narrative verse. His classical poems are artistic, but imitative. He treated in a superior way native themes, such as Indian legends. His descriptive lyrics are characterized by limpid purity. Two sonnets were read—"Where the Cattle Come to Drink" and "Burnt Lands." Simple lyrics, such as "Bringing Home the Cows;" passionate lyrics, such as "In the Solitude of the City;" sea poems, such as "The Laughing Sally," showed the versatility of his genius.

Archibald Lampman was described as the greatest nature poet. Far removed from human interest, his poetry is stimulated by the bracing north air and broad expanse of varied scenery, making it abound with artistic power. His sonnets show more meditative depth and abound in the harmonies of versification.

Bliss Carman, astoundingly original, is master of an aerial caressing music. His perceptions are exquisitely beautiful; his nature imagery is not forced; his rollicking sea pieces not lacking in fun; and his mystic poetry dealt with in an exceptionally clear and simple way.

Reference was made to three poems which had appeared in the "Children's Corner" of the *Mail* and *Empire*, written by a young girl named Margery Picthall, and which showed remarkable intellectual and dramatic power. Their titles—"A Prayer," "Armorell" and "A Mother in Egypt." Conclusion—we should not seek to cultivate a distinctively national poetry. The epoch of world poetry is with us. Its scope should be universal rather than local. We should get into the main current of the world's ideas. Hearty vote of thanks tendered. Meeting adjourned.

Abstract from Minutes of Lecture by W. A. Parks, B.A., Ph.D., on "Ontario's North Land."

Out of the 220,000 square miles in Ontario, about 140,000 is practically unknown. To study the geological structure of this region we must go back to very ancient times, when there was a V-shaped axis of granite rocks surrounding Hudson Bay. This ridge of granite being exposed to disintegrating forces for countless ages, and also to the grinding forces of the immense ice fields of the glacial age, was gradually reduced to a watershed or divide of less than 2000 feet in height. The ascent of this divide is so very gradual that there is difficulty in ascertaining when the summit has been reached. It is frequently low and swampy, swamps being found on the ridge which give rise to rivers flowing in opposite directions. The whole country is a network of small lakes. Contrary to common rumor, the lecturer stated that there was little pine north of the Height of Land, but, instead, spruce, poplar and birch, with everywhere an impenetrable growth of underbrush, so dense that only with axe in hand can a path be made The nature of the water-courses are such that falls are numerous, and sufficient to provide water power for the whole world. The only practicable means of transportation through this northern country is the canoe, and the streams and lakes are so numerous that any part of the country can be traveresed by this means. Forest fires have destroyed large areas of timber. Near James Bay the country consists largely of muskegs —deposits of peat. This muskeg country may in time be drained and so made suitable for agriculture. There is on the uplands what is known as the Clay Belt, containing 16,000,000 acres of arable land. The mineral wealth of the country consists of gold, nickel, copper and iron. Canada has a monoply of nickel, on this continent at least. An interesting and extended account of Moose Factory was given. The Hudson Bay Company has had a post there for 200 years.

The lecture was illustrated by maps and photographs, and was most interesting. A hearty vote of thanks was tendered. Meeting adjourned.

Abstract from Minutes of Lecture by Mr. F. B. Allen, M. A., Ph.D., on "The Manufacture of Natural Products."

As an illustration of the changes taking place everywhere, ice, water and steam were referred to; also the fact that in combustion or decay there is no loss in matter, merely a change in form—the first being an example of physical change, the second of chemical. Some changes, however, are hard to classify, such as the electrolysis of water. An element was defined as a product obtained by following out a line of reactions which give us something else than the material with which we began, until we arrive at a point where no further reactions are possible. There are at present 80 known elements. Many of these are found in the native state, such as iron, copper and carbon. Many of them are also manufactured. We manufacture iron from compounds of iron with oxygen—hematites being the most common. Graphite, a form of carbon, is manufactured for lubricating purposes from coal. One of the most interesting manufactures is the diamond. Paris is the headquarters for this industry. The theory being that the diamond is a piece of carbon which has been subjected to enormous pressure, particles of coal were thrown into molten metal, which, on being allowed to cool, produces a diamond equal to those got from Kimberley. They are, however, extremely small. Also in Paris, by means of the electric furnace, many of the minerals have been made. One of these—the ruby—is a compound of aluminum and oxygen, without a trace of iron to give it color.

Passing away from the minerals, the lecturer dealt with a much more interesting class of substances. He distinguished between organic and inorganic substances. The latter can be made in the laboratory, but the former required the life element. The organic compounds are essentially compounds of the element carbon; the other common elements in them are hydrogen and oxygen, more rarely nitrogen and sulphur, and occasionally phosphorus. By means of formulae, a shorthand description was given of the way in which the elements were related in such substances as glucose, glycerine, cane-sugar, benzine, toluene, anthracene, napthaline; the last three being coal-tar products.

The manufacture of analine dyes was next treated of. In Germany, after many years of experimenting, it had been found possible and commercially profitable to manufacture indigo. A five million dollar factory has been erected for this purpose, so that the manufactured product is likely soon to displace the natural product of India. The indigo used annually in the world is worth $25,000,000. Germany exports $20,000,000 of analine dyes made from coal-tar products imported from Great Britain. The hope was expressed that the mother country, as well as Canada and the United States, will soon manufacture their own coal-tar products.

In conclusion, the lecturer made an appeal for State support for the scientific chemist alongside of the technical or practical chemist. In England technical schools were being taken up, but pure science was being neglected. The State should encourage both classes. After a hearty vote of thanks the meeting adjourned.

NOTES ON PAST COLLECTING SEASON.

Read before the Geological Section of the Hamilton Scientific Association, April 6th, 1904.

BY COL. C. C. GRANT.

The early part of the collecting season of the Geological Section proved, as was anticipated, an almost complete failure as far as Chert Sponges, Bryozoons, etc , were concerned. This was owing to the nature of the crops, clover, etc., which prevented examination of the fossiliferous fields which presented so many fossils to our members formerly. It was expected that a newly ploughed field on the brow of the escarpment, near the reservoir, might offer some compensation for the disappointment experienced nearer the city, but such was not the case, its appearance proved highly deceptive. Tons of broken chert lay on its surface, but merely a few poor sponge sections were obtainable there—no Bryozoons or other organic remains. The material was derived from some of the barren chert layers probably. Potato fields, between the escarpment and corporation drain, often contain Niagara Sponges and sections, but last season was so wet that a farmer friend remarked there are more weeds than spuds to be found there. On a recent visit I was pleased to find the old reliable hunting ground, adjoining the drain, which formerly displayed the majority of the flint-flake fossils obtainable here—Cornulites, Bryozoons, etc.—had been ploughed up after many years once more. The locality in question is particularly rich in Cladoporæ; several species of Professor Jas. Hall's "Lichenalia Fenestillidæ" have been found there. When first examined, many years ago, some fine specimens of "Avicula Undata" and "Avicula Emacerata" were discovered there. The ornamental markings and well defined wavy lines of the former were in perfect preservation. Neither had that dwarfed appearance which flint-flake specimens so frequently present. No Lamellibranchs have turned up there since, although crops favorable to collecting have been raised there in several seasons. Our local Niagara Chert Corals, or in shales, are presumably restricted, yet they clearly indicate a time when Corals lived and flourished under conditions absolutely impossible under modern conditions.

Since the above notes on Field Geology were taken, I find some additional fields have been recently ploughed near the city from which many sponges were formally obtained, as well as glaciated flint-flake specimens.

When staying at Winona during the past summer I received a letter from Dr. Whiteaves, Palæontologist to the Dominion Geological survey, in which he mentioned that the Smithsonian Institute intended to publish a Monograph on the Niagara Bryozoons, and asked if I could obtain any for the publication. The shale at Grimsby formerly contained a good many fairly preserved specimens, but I think few can be had now. The writer remembers forwarding some fine specimens to the Redpath Museum, in Sir W. Dawson's time, and also to Dublin. Very few are obtainable there now. The ones secured on two or three visits to Grimsby were sent on to Ottawa, together with specimens from the local glaciated Chert beds of Hamilton. The latter, as you know, may be considered to present some varieties of Dr. Jas. Hall's "Lichenalia." I think the prospects for collecting now far brighter than they have been for many years, at least as far as Sponges and glaciated Chert specimens go, but I fear we must experience much disappointment with regard to the Graptolites. The new City Quarry has no protecting bed of Erie clay, and the Chert there is greatly decayed and improves very slightly when worked inwards from the face of the escarpment on the Stoneman road. This is not favorable to the preservation of such organisms.

The Indian corn has been cut down near the city, but the stalks, etc., have not been removed yet, and the clay clods (protected by the crop), require rain to break them up and frost to bring specimens to the surface. Still, despite all these disadvantages, I secured on the first visit I paid lately to one well known locality some good Sections, as also three or four Sponges. Unfortunately the latter are not very well preserved, and a bad attack of inflammation of the eyes prevented the writer from further researches for more than four weeks before the snow put in its first appearance.

Extract relating to Barton Niagara beds from another source.

GUELPH FAUNA (Clarke & Rudeman).

SOUTHERN ONTARIO—SECTION AT HAMILTON.

"The composition of the Niagara escarpment, which is finely continued along Lake Ontario (Hamilton Bay), just south of the City of Hamilton, has been carefully studied by Col. C. C. Grant, of that place, who has published various data in regard to it. Dr. J. W. Spencer also some years ago studied this region stratigraphically, and described some of the fossils therefrom. From these sources we gather that the section here is the following, beginning at the top: The Barton bed (Spencer), summit formation mostly dark dolomite with interbedded shale and soft hydraulic layers, the latter considerably employed in the manufacture of cement, 87 feet; Magnesian Silicious beds filled with irregular nodules of light or white chert, 20 feet maximum; Blue Dolomite, 5 feet 6 in.; Rochester Shale, 17 feet, 6 in. For our immediate use we need not carry the section further down, though the outcrop of the deposits extends well into the Medina, as on the Niagara river. To return to No. 1: these heterogeneous strata, consisting of shales, soft water-limes and hard dolomites (Barton beds) contain distinct faunas. In the hydraulic layers are "Atrypa reticularis," "Enteno-lasma Caliculus," while the dark dolomites bear a distinct association. With the aid of Colonel Grant, and by the study of his collection and that of the Hamilton Scientific Association, we are able to cite these as characteristic species: "Orthorites Subplanus," "Leptæna Rhomboidalis," "Orthoceras Bartonense" (Spencer), a "Dawsonoceras," identical with "Dawson Annulatum." More important, however. are the following, each of which has been seen by Col. Grant in but a single specimen: "Pleurotomaria perlata," "Cœlidium Macrospira," "Trochoceras," like "T. Waldronense," of the Waldron. The first two of these are of distinctively Guelph character, and "P. perlata" has not been found outside that fauna. Col. Grant finds that the upper layer of these Barton beds, whenever stripped of soil, is everywhere deeply scored by glacial shearing, and believes that some part of the dolomites has been carried away.

Hence we get in these Barton beds a clue to, or suggestion of, the true Guelph fauna, which we may well believe was more fully developed in the later deposits removed by glacial erosion."

WINONA—LAKE SHORE.

On arrival at the Winona camp in May last, the writer found the water in the lake unusually high for that time of the year; he also discovered the ridge of sand at the east end along the shore was gradually extending westward. This would prove an excellent barrier to the waves and a great protection to the high banks there if permanently fixed. On enquiry I ascertained after I left Winona the residents had the worst storm that was known there for forty years, and that this sand-bar had been carried off into the lake and the particular portion referred to had disappeared altogether—not a vestiage of it was left. A large number of Cambro Silurian fossils rewarded research, bnt I fear not many can be claimed as new species.

The Lingula submitted for inspection of the Section was found in a slab containing a "Trenton fossil." A small portion was concealed by the matrix, but it was more completely developed by one of our members (Mr. Schuler), who now resides at Rochester, U. S. A. In a work published by the late Palæontologist of the Canadian Geological Survey (E. Billings), in 1865, containing description and figures of new or little known species of organic remains from the Silurian rocks, he figures a very fine "Lamellibranch Cyrtodonta (Cypricardites) Hindi," the only one known to him. The writer succeeded in obtaining another this last summer at Winona (Lake Shore), in good preservation, now in the British Museum A few other members of this family group are submitted, which probably have been already described; however, the writer thinks it unsafe and strongly objects to names attached to fossils without comparison with the originals—figures are often misleading on certain points.

The Section can see from the extract taken from the Geological Magazine, London, July 1903, that Prof. T. R. Jones, F.R.S., F.C. S., credits the Glacial Drift of Hamilton, Ont., with producing some new minute "Crustaceans," which he describes and figures in this well known scientific publication.

Since the paper was written a few fine slabs have been forwarded, which the Professor, no doubt, will be pleased to receive. The writer holds over others for future transmission, but many more were left behind ; not removed from Winona camp yet.

On Victoria Day some members of the Geological Section and friends from Dundas proceeded on an excursion to Grimsby. One of the party, Mr. Schuler, was provided with a hand-rake, furnished with long close teeth, which was suggested as an improvement on a claw-like implement. I used these on the loose shale formerly ; it proved very useful for the purpose of raking in the Niagara shale Crinoids. He displayed no less than six specimens of "Caryocrinus ornatus," and two heads of "Rhodocrinus," independent of Bryozoons, etc , when he produced his collection for our inspection. The most perfect specimen of a Crinoid, however, found on this occasion, was one secured by a young fellow from Dundas. Mr. Freeborne of the same place was successful in obtaining from the upper Clinton there a well defined plant of this upper Silurian age, and to which I may call your special attention. Under the name "Fucoides Harlani," Conrad described (and figured probably) a sea plant from the Medina sandstones in the annual report, New York State Survey, 1838. This name was changed subsequently to "Arthrophycus Harlani" by the late Dr. James Hall, who mentioned it as occurring at this horizon. I have not seen the plant from the New York Medina beds, but Mr. Schuler informs me the ones he observed in the Rochester Museum resembled the large "Arthrophycus Harlani" found in the massive upper Clinton sandstone bed at Grimsby. A mistaken idea was entertained, even by members of this section, that the layers in which the Fucoid occurs at place above mentioned represented Medina—not the Clinton series—and that the latter was altogether absent there. It was difficult to imagine that our Hamilton Iron-band, with its soft red shales, should be there represented by the mottled sandstone used in building houses in that neighborhood. Closer observation has since convinced many that the writer was not mistaken in correcting a very erroneous idea. The plants discovered at Grimsby require further investigation. They are found in three or more distinct layers, varying considerably in size ; all are in good preservation there, and it hardly seems possible to look upon the smaller ones as young representatives of the family group. I think palæontologists generally would feel inclined to view them as different species, although others may classify under the head of "Varieties."

On Victoria Day Mr. Schuler called my attention to the projecting under-surface of one of the thick, massive blocks of sandstone, displaying a magnificent specimen of the large "Arthrophycus" in situ. It is in a difficult position to reach, and a dangerous one in addition, as loose layers are lying above it. Even when released I fear it may be found impossible to make it sufficiently portable to carry it to the stone road or railway station. The smaller specimens of the "Arthrophycus" are found on thin sandstone slabs, and are exceedingly numerous in particular parts of the abandoned quarries. It is not unusual to find six or seven in places after heavy rain or when the snow has disappeared. Mr. Schuler, a member of the Geological Section, extracted even more than this number from their position in situ this last summer.

Having left my hammer behind at Winona, the writer, on Victoria Day, was compelled to restrict his fossil-hunting to the Niagara Shale Bryozoons, in which he was not particularly successful. This is the more to be regretted, for the reason referred to in a letter received from Dr. Whiteaves, the Chief Palæontologist of our Dominion Geological Survey. The boxes sent through the Canadian parcel post to Ottawa contained Bryozoons (also from our local chert beds), a few of which may be hitherto undescribed.

GEOLOGICAL NOTES.

The wonderful discovery of the Dutch Surgeon, Dubois, of the skull of the great ape in the river bed of Java, remarks Professor Herman Klaatsch, of Heidelberg University, goes far to prove that the ancestors of the contemporary types of apes bore a far closer resemblance to man than do their degenerate successors. The Gibbon's arms, for example, have lengthened in answer to his needs as an inveterate climber of trees. A still more remarkable discovery has been recently made in Borneo—a race of men (dwarfs) with webbed feet. How is this for the pollywogs?

In digging recently under the foundations of the *Daily Chronicle* office, in Fleet street, London, England, a well-preserved skeleton of the extinct woolly rhinoceros was found. It has been sent to the South Kensington Museum.

Dr. Scharff, in a paper read recently before the Royal Irish Academy, maintained that the Atlantes of Plato was a reality and not a myth, and that in ancient times it joined Morocco to Portugal, and extended to St. Helena Island. Greek and Roman historians state that the submergence of Atlantes occurred 9,600 years B. C.

IN DEFENCE OF LATE ASSERTIONS—Concluded.

Read before the Geological Section of the Hamilton Scientific Association, April 22nd, 1904.

BY COL. C. C. GRANT.

The writer was not greatly surprised to learn recently that some of the members of the Association thought such things as the creation, the deluge, etc., were matters outside geological investigation. To men of inherited religious prejudice it may appear so, but few geologists will be found to agree with them. The beginning of life upon the earth is an important point for their consideration. To submit, as was suggested, scientific matters to the public for decision, would not be entertained for an instant. The Hamilton Association has a Journal with a wide circulation among scientific societies in all civilized countries, and that publication is the proper place for scientific papers. In Ontario one seldom meets a person possessing even a faint acquaintance with geological matters (Scotchmen excepted). As a general rule you will find them intelligent and well acquainted with Hugh Millar's works; they are justly proud of their famous countryman.

The writer remarks that even astronomers cannot always escape the censure of piously-inclined individuals.

In a lecture delivered in New York on the 3rd April, 1875, by R. A. Proctor, on "The Past and Future of our Earth," which you will find in selections of *The Canadian Monthly* of January, 1875, or *The Contemporary Review*, I may be permitted to extract a few passages:

"It has been in vain thus far that men have attempted to lift the veil which conceals the beginning of life upon the earth. In any case, we need not feel hampered by religious scruples in considering the possibility of 'spontaneous generation.' It would be straining at a gnat and swallowing a camel if we found a difficulty of that sort here after admitting, as we are compelled by clearest evidence to admit, the evolution of the earth itself, and of the system to which the earth belongs, by purely *natural processes.* The student of science should view these matters apart from their supposed association with religious questions—apart, in particular, from interpretations which have been placed upon 'the Bible records.' Repeatedly it has been shown that ideas respecting creation, which had come to be regarded as sacred because they were ancient, were altogether erroneous. It may well be so in this matter—the creation of life.

My readers may remark, whenever practicable, I make it a point to furnish my authorities for every statement recorded. In doing so I can hardly be accused of omitting the names of men of various christian denominations. This in itself may, no doubt, be looked upon as unbelief in the doctrines of your respective churches; the question is *theirs*—not *mine.*

I may be permitted to call attention to a work lately published in England by six Oxford tutors, entitled "Transitional Theology." The reverend gentlemen, I understand, are among the best known professors, who prepare the students of the university for ordination in the Established Church. In the work in question occurs the following: We are agreed that as christians and churchmen, no less than lovers of truth, we have cause to be thankful for the new light which science and criticism have within the last half century thrown upon religious problems. They are agreed that scientific and critical methods ought to be applied to such questions, and that authority should not be invoked to crush or stifle enquiry. A very considerable restatement, and even reconstruction, of parts of our religious teaching is inevitable.

A writer in the London *Times* states: Drs. Parkdale and Juge are well-known to the thoughtful and religious public, the one as an acute and powerful philosopher, the other as an accomplished and erudite divine. Their colleagues are widely known outside Oxford, and hold high academic positions of importance. Compare the foregoing with the language attributed to Ontario clerics towards higher criticism and science; language which clearly indicates their own ignorance. The Rev. Dr. Milligan, Toronto, thinks truth stands to gain by such enquires, and expects the church to honor the men some rash preachers are now vilifying.

Professor Delitzsch, a well-known German historian and Assyriologist, on his return from the recent excavations in Chaldea, delivered two lectures in presence of the Kaiser and Court, entitled "Babel and Bible." In the address he exhorted his audience not to cling to antiquated dogmas which lacked any scientific basis, expressing his belief that theology was progressive; other remarks I may refer to subsequently. The Kaiser himself published a reply in which he rebukes the Professor, alleging the excellent lecturer in his zeal rather forgot the principle that it is really very important to make a careful distinction between what is appropriate to the place, the public, etc., and what is not. It is to me self-evident that the Old Testament contains a number of passages which are of the nature of purely human history and are not God's revealed word. This will certainly undergo considerable alterations under the influence of research and inscription.

His Majesty's attempt to explain how the Mosaic Laws (claimed to be delivered on Mount Sinai) should be symbolically regarded—when they are clearly shown to have existed during the reign of Hammurabi, King of Chaldea, more than 2000 years B. C.—seems slightly illogical.

We now come to the reply by Professor Harnak. The writer in the *London Times* claims he is one of the foremost scholars and men of letters of his day and an authority on Biblical criticism—enjoying the personal friendship of his sovereign. The professor begins by reminding his readers that the Babylonian origin of many of the myths and legends of the Old Testament has long been recognized. He adds that in the general opinion of scholars the fact is recognized as fatal to the popular conception of the inspiration of the Old Testament. He complains that church and school, in alliance with one another, have suppressed the knowledge of these facts by banishing them from their domain. He thinks theology cannot slur over these questions, and while he agrees with the Emperor that religion requires to be expressed in forms, he thinks Professor Delitzsch has achieved his main object when it is acknowledged that the traditional forms in which the Old Testament has been authoritively handed down are urgently in need of *alteration*.

I have already encroached on the patience of my hearers by placing before them quotations from German professors, etc., at considerable length. Indeed, other matters in the letters and lecture have little to do with the subject of my paper, and a critic in the *Times* appears to be as much surprised as the writer at the lateness of what was known to many outside Germany for years. It seems to be as far behind in antiquarian research as our own Ontario clery themselves.

I wonder if many of them ever remarked the following, taken from the London *Times*: We must say, remarks a critic in the London *Times*, we are extremely puzzled to know what all this outburst of wrath on the part of the Evangelical party is about. Dr. Delitzsch, in his two famous discourses, has said nothing more than may be found in a dozen English works, which are supremely orthodox, besides such works as Professor Duff's "Hebrew Ethics." Many critics of the modern school will wonder on reading this work, not at what the Dr. *has said*, but rather at what he has *not said*. The controversy has certainly done good in drawing some valuable notes from the author—that on the Sabbath being very important. *The Sabbath was essentially a priestly function in Babylonia, and as such found its way into the Hebrew code.* It is never found in any civil document. The writer adds that the real cause is an attempt on the part of the orthodox school in Germany to keep the general public in the dark as to the real bearing of Assyriological research; and now that the hidden knowledge has passed beyond the portals of the university the consternation is great.

A work, entitled "The First of Empires—Babylon of the Bible in the light of recent research," by W. St. Chad Boscawen—a history of the ancient empire from the earliest times to the consolidation of the empire in 2000 B. C., has lately been published in England (The American Edition by Harper Brothers, New York). The work itself the writer has not seen yet, but he is in possession of many extracts. It is a most fascinating volume, remarks a critic—illustrative of the extraordinary results of scientific historical research. We are carried off at one gigantic step for close on six thousand years, and the remarkable feature is that one feels convinced he is reading authentic history. The author insists (rightly in the opinion of the critic) that some of the most cherished beliefs of the

Christian must be traced directly to the Babylonian in preference to the Hebrew—so called. As we peruse the evidence here brought forward we are certainly less inclined to accord to the Jew the exclusive claim to his having laid the foundation of our religion. Beneath the mounds of Eski Harran (unexplored) there must be the remains of the famous temple, adds the author. Perhaps there still lies perdu, amid the debris of that ancient fane, the record of Abraham and his fellow colonists from "Ur of the Chaldees." We have here a clue to the early history of the Chosen People. For example, writes the Kaiser, the act of the giving of the law on Mount Sinai can only symbolically be regarded as inspired by God, inasmuch as Moses was obliged to resort to the revival of laws which perhaps had long been known. Possibly they originated in the codex of Hammurabi. The writer doubts if His Majesty's explanation would be considered satisfactory by any of his German subjects who dare to think for themselves. Few may be found to dispute his assertion. This form (*i. e.*, the Old Testament) will certainly undergo considerable alteration under the influence of research and of inscription. The writer does not know what grounds the Kaiser had for stating the Chaldean king Hammurabi was the friend of Abraham. I have carefully examined the extracts in my possession, and can find nothing regarding the departure of a portion of the Chaldean people quitting the country.

We learn from one of the leading English daily papers the recent Babylonian discoveries have created an extraordinary sensation in church circles in France. One of the best known and eloquent theologians there (the Abbe Loisy) published a work a short time since entitled "L'Evangela et L'Eglise." Those who are in a position to know declare that two-thirds of the younger clergy are on the side of the Abbe. It is also known that some of the French—the most able and learned bishops—are strongly in favor of freedom for historical research and investigation into the origin of the Bible and Christianity. Our Vienna correspondent, writes the Abbe, recently published a second work entitled "Antour d' un Petite Liver." He denies the Mosaic authorship of the Pentateuch, criticizes the value of the first chapter of Genesis, attributes an Assyrian origin to the accounts of the Flood and the Fall, declares the books of Daniel and Ezra to be apocryphal, and denies that St.

John was the author of the Gospel attributed to him, or that it is the work of any witness. The eminent position and great authority of the Abbe as a biblical critic have caused this book to be received in Rome and elsewhere with considerable excitement

The reader may notice how extensively I have borrowed from others. This was purposely done in order to meet the objection that I have been putting forth views not in accordance with papers published by others, better known in scientific circles—in a land of "shams" and "cant." We can hardly avoid censure, but who cares for such when actuated by the certainty that what is true will be established, and what may be erroneous must certainly be rejected.

Extensively as he has already appropriated the views of others, the writer cannot refrain from calling attention to a leading article in the London (England) *Times* of the 15th April, with the heading "Things New and Old." This paper is credited with engaging only the very best writers, antiquarians and scientists, on such a subject. The following is an extract which I borrow from it: "Archæological research is not, perhaps, always welcomed by those whose accepted conclusions it reverses. If it confirms some old traditions, it discredits others; and when such traditions are consecrated in venerated religious literature, doubts thrown upon them are apt for a time, but only for a time, to be regarded as a slur upon religion itself. The code of Khammurabi adds one more to a series of discoveries which have proved to every open mind that the ideas, religious and secular, of the early Hebrews enshrined for us in the Old Testament, were not all original, but were largely influenced by an older Babylonian civilization. The Biblical accounts of 'The 'Creation and 'The Deluge' are shown to be variants of traditions common to the Hebrews, with or perhaps borrowed from other nations of antiquity. The chronology of Archbishop Usher, still preserved in the authorized version of the Bible, has been utterly discredited by modern discoveries. The days of the Mosaic account of the Creation need no longer be understood literally, nor is 'The Fall of Man' an early attempt to explain the insoluble problem of the origin of evil—now received with the pious horror of even half a century ago." Inherited religious prejudice must be dense indeed which demands additional proof in defense of the writer's late assertion.

One would expect to find our spiritual guides to take a little more interest in modern researches amid the ruins of Egypt and Chaldea, both so closely connected with the history of the Hebrew people. They may find it more profitable than the classical tales regarding

> "Thim Haythen Goddesses
> Who wore no boddices,
> And cut such capers
> Round the walls of Troy,"

whose morals certainly were not beyond reproach.

As some of the city clergymen may not have noticed in the Public Library a London *Weekly Times* of last month (March), I take the liberty of calling their attention to a sermon preached at St. Paul's Cathedral by the Archbishop of Canterbury on Bible Sunday, and of which the following is an extract: "The guardians and champions of orthodox belief, as based on Holy Scripture, have times without number, on the authority of their own interpretation of the Bible, denounced as presumptuous or even blasphemous error, the discoveries and aims of science. True science and true religion are twin sisters, each studying her own sacred book of God. Nothing but disaster can arise from the petulant scorn of the one, or from the timidity or the tyrannies of the other. Let there be light. And so with the scientific knowledge which has been so strangely supposed to be contradictory to the scriptures, rightly understood so, too, with every reverent investigation into the history of the sacred volume itself. Let there be light."

The essence of the scientific spirit is first—that it is free and disinterested; second—that it knows nothing of tradition or authority, but lays down laws for itself, and refuses to be bound by any others. Scientific education starts in simple communion with nature. The process is at once opposed to and subversive of the old order of things. Between a system based on authority and one founded on freedom of thought and opinion there can never be united action.—*Sir Henry Roscoe, F. R. S.*

NOTES ON SPECIMENS FIGURED.

The figures given in our proceedings represent the following organic remains.

No. 1.—A species of Monticulipora, a family very numerous in the drift (lake shore), formerly known as Chætetes in Ontario Palæontology (Nicholson).

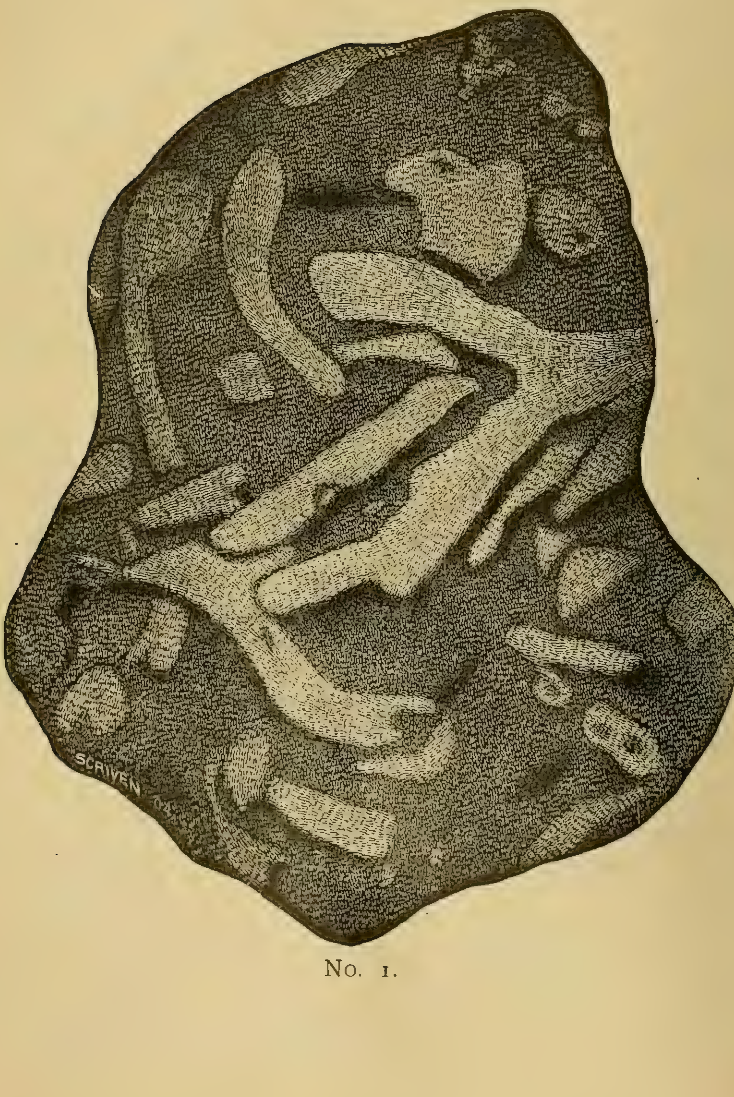
No. 2.—A pretty little Dendrograptus from the chert, city quarry, Jolley cut.

No. 3.—This cup-shaped (now flattened) circular graptolite does not present the connecting bars of a Dictyonema—the branches bifurcate; the writer thinks it may be the type of a new genera, holding three or more distinct species in the Niagara limestones or shales.

No. 4 seems a different species, and was obtained by Mr. Nichol in the new city quarry.

A graptolite in the chert beds here can hardly be distinguished from Oldhamia radiata of the Irish Cambrian rocks.

Although No. 4 has something of the appearance in the figure of a Dictyonema, it possesses no true bars, merely the bituminous matter spreading from one branch to another.



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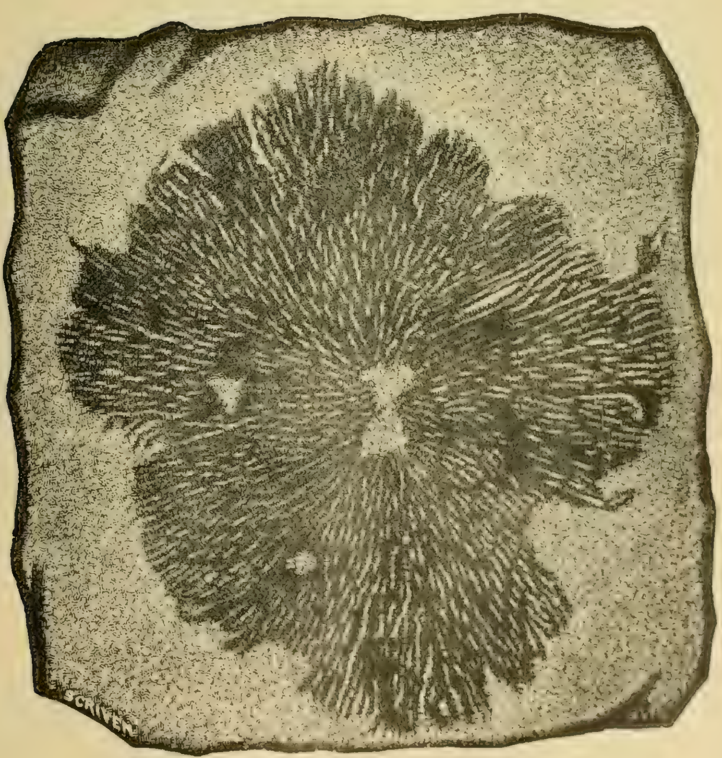

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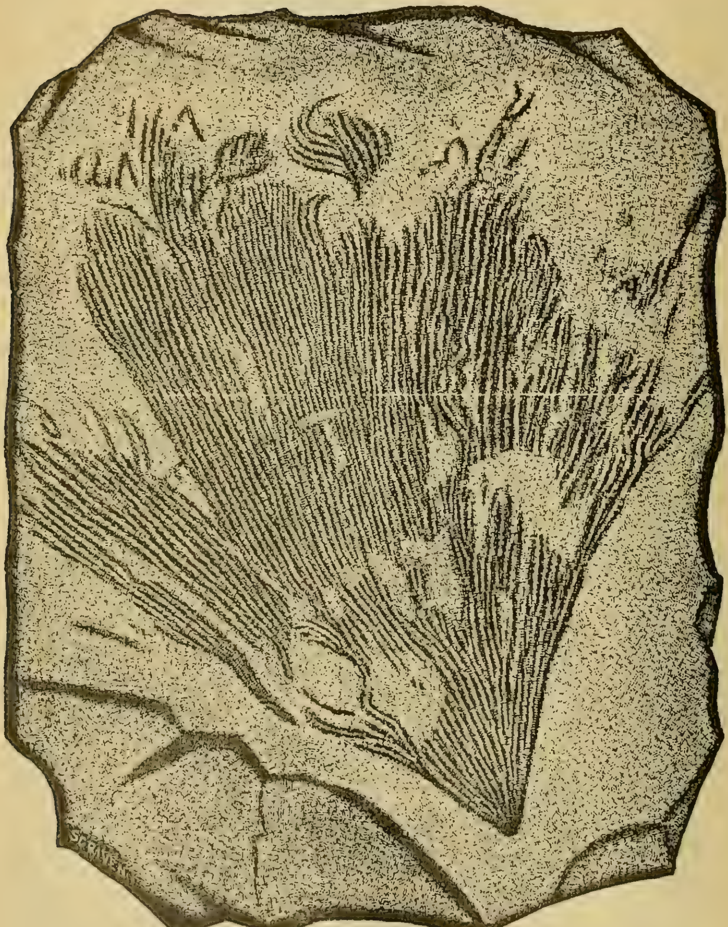

No. 4.

ASTRONOMY FOR BEGINNERS.

Read before the Astronomical Section of the Hamilton Scientific Association, November 6th, 1903.

BY J. M. WILLIAMS.

Every seat in the museum of the Hamilton Scientific Association was occupied last night when J. M. Williams gave his address on Astronomy for Beginners. Printed slips were passed among the audience with the words earth, sun, moon, stars, planets, day, night, seasons, morning and evening stars, eclipses, transits, longitude, latitude, declination and ascension printed on them. The address was delivered under these headings, and the speaker succeeded in explaining the meaning of each very clearly. He had a large light on the table to represent the sun. A globe stood for the world. Attached to the globe was a smaller body, the moon. The planets of the solar system were represented by mounted balls. The fixed stars were indicated by candles burning in different parts of the room, while the north star and the dipper were shown by small metal balls suspended above the speaker. On the globe of light that stood for the sun Mr. Williams had drawn a sun spot, and by turning the globe he gave the audience a very good idea of the appearance of one of the great holes in the flames of the sun.

At the conclusion of the lecture Rev. F. E. Howitt moved, and Stuart Strathy seconded, a vote of thanks to Mr. Williams, which was tendered with very hearty applause

The meeting was a very interesting one, and the large audience was more than delighted with the instruction it had received.

THE ASTRONOMY OF MILTON'S "PARADISE LOST."

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

BY JOHN A. PATERSON, K. C., M. A.

Three poets in three distant ages born,
Greece, Italy and England did adorn ;
The first in loftiness of mind surpassed
The next in majesty, in both the last ;
The force of Nature could no further go,
To make the third she joined the former two.

And thus blind John Milton, shut in "from sight of vernal bloom or summer rose, or flocks or herds or human face divine," sung of "things unattempted yet in prose or rhyme," and made the ages eloquent with that song that swept at large through the compass of the whole universe, and through all heaven beyond it, and surveyed all periods of time from before the creation to the consummation of all things. We are not, however, to speak to-night of him as a poet, well called "that mighty Arc of Song—the Divine Milton," but rather of his astronomical knowledge, when he knew of the starry heavens, and what purposes he worked out by that knowledge in the exercise of his powers of imagination and description Young in his "Night Thoughts," says "the undevout astronomer is mad," and we might venture to express the correlate of that thought that the devout man who knows not something of astronomy is also mad, in that he fails to cultivate as he should the faculties that God gave him whereby his worship would be advanced. Is it too strong a statement to make that an average scientist knows a greater and more puissant God than an average Christian ?

Milton was one of the most—if not the most—deeply read men of his day. His mind was saturated with the "classics," learned in French, Italian and Hebrew ; and in science, in philosophy and in general learning he was regarded as the foremost scholar of the University of Cambridge. His travels in Italy, where he met the distinguished literati of the day, gave breadth and polish to his robust intellect. When Milton wrote this great poem the basis of astronomical knowledge was shifting. The Almagest of Ptolemy, which taught the geocentric theory, had been the text book of science, "falsely so-called," for more than fourteen centuries. The older Greek astronomers had conceived the heliocentric motions of the planets, but the ingenuous Ptolemy had flattered the egotism of man by brushing aside this theory and explaining the motions of the planets and sun and moon by a cumbrous mechanism of cycles and epicycles round the central earth, and as all that corresponded so well with the old legends and myths, and had thus become interwoven with the literature and the religion of these centuries, the Ptolemaic system sat enthroned.

Students of prehistoric man trace the advancing history of our race by the records of the kitchen middens—the refuse of the food of primeval man, perhaps our arboreal ancestors—as they lie in strata now uncovered. And so we may to-day read the intellectual and scientific history of our race when we lay bare the strata of old doctrines and exploded theories, the debris of ages, the "middens" of old libraries.

Milton in his early years visited Galileo, the great Italian philosopher. Two years before Milton saw him he had become totally blind, and thus the inventor of the telescope, the discoverer of Jupiter's satellites, which showed a Copernican system in miniature in the sky, was compelled to relinquish his favorite pursuit. His friend Castelli writes: "The noblest eye is darkened which nature ever made, an eye so privileged and gifted with such rare qualities that it may with truth be said to have seen more than all of those eyes that are gone and to have opened the eyes of all who are to come." Galileo endured his affliction with rare fortitude, and thus writes: "Alas, your dear friend and servant Galileo has become totally blind, so that this heaven, this earth, this universe, which with wonderful observations I had enlarged a hundred and a thousand times beyond the belief of bygone ages, henceforward for me is shrank into the narrow space which I myself fill in it. So it pleases God; it shall then please me also."

We know not the details of that interview between the astronomer and the poet, who afterwards immortalized his name in heroic verse, and who in his own old age also suffered as the astronomer did, and to which he alludes so pathetically in these lines :

"Thee I revisit safe,
And feel thy sovran vital lamp ; but thou
Revisit'st not these eyes that roll in vain
To find thy piercing ray, and find no dawn,
So thick a drop serene hath quenched their orbs
Or dim suffusion veiled.

"Nor sometimes forget
Those other two equalled with me in fate,
So were I equalled with them in renown.
Blind Thamyris and blind Maeonides,
And Tiresias and Phineus, prophets old,
Then feed on thoughts, that voluntary move
Harmonious numbers ; as the wakeful bird
Sings darkling, and, in shadiest covert hid,
Tunes her nocturnal note."

Milton has not given us any account of this remarkable visit, yet it was one which made a lasting impression on his mind, and was never afterwards forgotten by him. That was a remarkable meeting of two remarkable men—a great Italian of the same land as Virgil, who wrote the greatest Latin epic, and the Cambridge scholar, who was yet to write the greatest English epic. Ulysses, that wild rover over land and sea, said: "I am a part of all that I have met;" and so with Milton. This meeting with Galileo touched his nature. There is a veritable communion of Saints on this earth outside the Apostles' creed—a communion of men devoted to truth, and holy because so devoted. They were Apostles of truth, these men. One revealed to us the physical heavens, and solved for us the riddle of the universe ; the other lifted us in contemplation to the great Creator's throne, and we heard the symphonies of Creation and learned that though "death came into the world and all are woe," yet one greater man was foreshadowed "to regain the blissful seat." "Great men," says Carlyle, "are the inspired speaking and acting Texts of that divine Book of Revelations, whereof a chapter is completed from epoch to epoch, and by some named History." Galileo was indeed an inspired Text, read to mankind from the manuscripts of God. Milton was, too, an inspired Text that sang to mankind such rhymes of the universe that all stood enthralled by their melody.

When Milton met Galileo Copernicus had been dead nearly a hundred years, and yet the Ptolemaic theory, by which it was believed that the earth was the immovable centre of the universe, and round it all the heavenly bodies circled in a daily revolution, still retained its ascendency over the minds of men of learning and science. The Copernican theory, by which the sun is assigned the central position in our system, with the earth and planets revolving in orbits round him, obtained the support of a few persons of advanced views and high scientific attainments.

Milton had read science at Cambridge and afterwards, along the lines of current belief, so far as a true soul could assimilate error. His studies in Dante, which he absorbed, had also fastened on him the Ptolemaic cosmology. According to the Ptolemaic system, the earth—the immovable centre of the universe—was surrounded by ten crystalline spheres or heavens, arranged in concentric circles, the larger enclosing the smaller ones, and within these was situated the cosmos or mundane universe, usually described as the heavens and the earth. To each of the first seven spheres there was attached a heavenly body, which was carried round the earth by the revolution of the crystalline. This was called the firmament, as it gave steadiness to the inner spheres. Ptolemy made this last his boundary. But after he of Alexandria had settled the cosmos and pronounced the plan of the great world builder unrolled, some discrepancies and difficulties arose. The precession of the equinoxes, discovered by Hipparchus in the second century B. C., had to be dealt with, as this phenomenon very ungraciously disturbed the harmony, and insisted upon being explained, and so later astronomers put, so to speak, another story on the building. An extra sphere or two was always at hand, and so they added as an evidence of good faith, and to stop all awkward objections, a ninth sphere, which they called the "Chrystalline," and thus accounted for the precession of the equinoxes. Thereafter, in order to demonstrate the inexhaustibility of their resources, a tenth sphere was added, which they called "Primum Mobile," or first moved, which brought about the alternation of day and night by carrying all the other spheres round the earth once in every twenty-four hours.

Thus was evolved the Alphonsine system, as having been adopted and taught by the famous king and astronomer, Alphonso X. of Castile (A. D. 1252-1284). Beyond this last sphere there was believed to exist a boundless chaotic region of immeasurable extent, called the Empyrean, or Heaven of Heavens, where the deity was enthroned, the place of eternal mysteries, which was to the mind unfathomable and to the imagination inconceivable. Thus the cosmogony remained until Copernicus, Kepler and Galileo shook the structure with swift and mighty blows, and Newton, with the sledge-hammer force of his great principle of universal gravitation, laid it low, and the Heliocentric theory took its niche in the temple of eternal truth.

When Milton returned to England from the continent he lived in London, and undertook the education of his two nehpews, John and Edward Phillips, and other sons of his intimate acquaintances. Amongst other subjects of a polite education, he took astronomy from a text book, " De Sphœra Mundi," which was an epitome of Ptolemy's Almagest. This book was written in the 13th century, and was so popular that it went through forty editions. When Milton taught his pupils the principles of astronomy from it that text book was four hundred years old. Do you know of any school or university which has on its curriculum of science books four hundred years old, or indeed even forty years old, saving, perhaps, Newton's Principia? But Newton's Principia is sacred ; it is the Bible of mathematical truth. This was, however, in the darkness of the middle ages, when the lamp of knowledge burned dimly.

We shall find that Milton's knowledge of astronomy was comprehensive and accurate. He was familiar with its technicalities, and ready with all the arguments in support of the old and the new theory, from both scientific and theological points of view. He had a mind which, notwithstanding all his early and later manhood training in the Alphonsine theory, was not darkened by tradition, but was open to the sunbeams of truth. If he had lived in later days he would have made an intelligent and reverend higher critic, both scientifically and theologically. "Custom," says the Chelsea philosopher, "makes dotards of us all," but it made no dotard of John Milton. Most men are too anxious to get Truth on their own side, rather than to get themselves on the side of Truth. It is pitiful and unprofitable for a man to try and force the rigid body of Truth to accommodate herself to the narrow circle of his views ; but it is a far different thing for a man to get his beliefs within the sphere of Truth herself, and then to let them expand.

Astronomy enters largely into the composition of "Paradise Lost"; indeed, it is difficult to understand how such a poem could have been written without a knowledge of the heavens and celestial orbs and the theory of the universe. In Book VIII. he introduces a scientific discussion between Raphael the angel and Adam, upon the respective merits of these different theories. The configuration of celestial and terrestrial orbs and the great circles by which they are circumscribed he also knew. The causes which bring about the changes of the seasons—the obliquity of the ecliptic—Zodiacal constellations through which the sun travels and the periods of the year when he occupies them, are embraced in Milton's knowledge of the science of astronomy. The motions of the earth, including the precession of the equinoxes, the number and distinctive appearance of the planets, their direct and retrograde courses, and their satellites, are also described by him. Milton, too, was familiar with the constellations and their relative positions, the principal stars, star groups and clusters and the galaxy, and in the elaboration of his poem all these bear their part.

Milton adopted the Ptolemaic theory as the groundwork of his cosmogony, not so much from conviction, but because it provided a more convenient working plan for localizing these regions of space wherein the chief incidents of his poem enter, viz. : Heaven or the Empyrean, Chaos, Hell and the Mundane Universe. All space above the universe newly created and beyond the Primum Mobile was known as Heaven or the Empyrean, a region of light, glory and joy—the dwelling place of the Deity, who, though omnipresent here, was visibly revealed to myriads of angels, veiling their faces with their wings and hymning Him throughout eternity. Underneath there existed a vast illimitable region called Chaos, occupied by embryo elements of matter that with incessant turmoil struggled in battle array—

"The womb of Nature, and perhaps her grave."

The lower portion of this region was divided off, and embraced the locality known as Hell, the place of torment, where the rebellious angels were driven and shut in after their expulsion from Heaven—

> "As far removed from God and light of Heaven
> As from the centre thrice to the utmost pole."

The new universe, which included the earth and all the orbs of the firmament known as the starry heavens, was created out of Chaos, and hung as if suspended by a golden chain from the Empyrean above, and although its magnitude and dimensions were inconceivable, yet according to the Ptolemaic theory it was enclosed by the tenth sphere, or Primum Mobile.

In his description of the creation, the earth is formed first, then the sun, followed by the moon, and afterwards the stars, all of which are described as being in motion round the earth. In this he closely follows the traditional understanding of the Mosaic cosmogony. Allusion is made to this ancient system in several prominent passages, and in the following lines there is a distinct reference to the various revolving spheres:

> "They pass the planets seven, and pass the fixed,
> And that crystalline sphere whose balance weighs
> The trepidation talked, and that first moved."—*Book III.*, *481*.

The seven planetary spheres are mentioned, then the eighth sphere—that of the fixed stars—then the ninth or crystalline, which was believed to cause a shaking or "trepidation," to account for certain irregularities in the motion of the stars, and lastly the tenth sphere, or Primum Mobile, called the "first moved" because it set the other spheres in motion.

It is much to be doubted if Milton's clear mind, with that poetic insight that discerns truth, ever accepted the Ptolemaic theory, although adopted as a poetic convenience. As if he were watchful of his reputation and to keep himself right with posterity, we find that he first makes an incidental allusion to the theory of Copernican in Book IV., 590-8, and further on in the 8th Book he introduces a discussion between Adam and Raphael, and we may with good reason take it that Adam's reasoning represented Milton's own view. By a bold poetic liberty he endows Adam, the first of men (according to the traditional belief) with a prophetic insight which stretched through many future centuries in propounding as he did the Copernican cosmogony. At this time the law of gravitation was unknown. It had not yet leaped Minerva-like, fully armed, from the brain of the Jupiter of Natural Philosophy—Isaac Newton. Although the elliptical orbits of the planets had been discovered by Kepler, the nature of the motive force which guided and retained them in their path still remained a mystery. It was believed that the planets were whirled round the sun as if by the action of magnetic fibres, a mutual attractive influence having been supposed to exist between them and the orb, similar to that of the opposite poles of magnets. Milton alludes to this theory in the following lines:

> "They as they move
> Their starry dance in numbers that compute
> Days, months and years towards his all-cheering lamp,
> Turn swift their various motions or are turned
> By his magnetic beam."

Milton may have builded better than he knew—may have written more wisely than he dreamed. The sun's "magnetic beam," in the light of our new astronomy, has a meaning past Milton's ken.

Galileo imagined he discovered with his telescope on the face of the moon continents and seas, and that therefore the moon might be the abode of intelligent life, and so Milton presents this possibility. Since then the moon has been more closely studied, and we have now the theory of the moon being a ruined world—a burned out cinder, a derelict in space—acting as the sun's deputy tide-raiser, and filling the office of a large reflector for the solar lamp, lighting up the dark earth, and for lovers to swear by and then forswear themselves, and by which almanac mechanics prophesy the wind and rain. One would almost believe that in Newton's day the study of lunar possibilities was in the same condition as is now the study of Martian possibilities. Pecival Lowell is supposed to have as conclusively settled to-day the habitability of Mars as Galileo settled the habitability of Luna 300 years ago. Some "mute inglorious Milton" of to-day may loosen his pen and write an epic on Mars, based on the investigations of Flagstaff Observatory, and some cold, soulless being in future years may criticise the science of that epic, as I am now daring to criticise Milton's line that speaks of "rain producing fruits on the moon's softened soil." It is possible that we need not wait long for a critic, for has not Dr. A. R. Wallace already spoken in unsympathetic language of the doctrine of planetary habitation. But let me forbear. Milton must not be trifled with.

Milton was no doubt a Copernican. He in the Third Book describes the sun as occupying a supreme position in the system, having the planets with their satellites,

> "That from his lordly eye keep distance due," (*line 578*)

circling in majestic orbits round him, acknowledging his controlling powers, and being held by a strong arm, that Newton afterwards proved was not only strong, but gravitating.

The angel, in bringing to a conclusion his conversation with Adam, deems it unadvisable to vouchsafe him a decisive reply to his enquiry regarding the motions of celestial bodies, and in lines 159-167, Book VIII., gives a beautifully poetical summary of this elevated and philosophical discussion, which ends with these words:

> "Solicit not thy thoughts with matters hid,
> Leave them to God above; Him serve and fear."

Raphael was doubtless a good angel, but he was a bad philosopher. We have read that "Fools rush in, where angels fear to tread." We are thankful that a chosen band of Adam's descendants in later years, and their name have been legion, have declined to take Raphael's advice, but had greater courage, and that they have "solicited their thoughts with matters hid," and that by their laborious investigations they have made for the world a galaxy of truth, and held vigorously to the principle that the search for truth is the noblest occupation of man, and its publication is a duty, and so "Wise men walked where Raphael feared to tread" "*Felix qui petit cognoscere causas omnium rerum.*"

And in our own humble way, whether we are only plain members of the Astronomical Society of Toronto, or of the Hamilton Scientific Association, or whether we have become exalted to that dazzling eminence of Fellows of the Royal Astronomical Society of Canada, let us pursue investigation and reflection. It is not what we are called that counts, it is what we know and what we do with what we know. "Great truly is the actual," as Carlyle puts it.

The lecturer then pointed out the passages where Milton referred to the so-called science of astrology, his allusions to the course of the seasons, the obliquity of the ecliptic, the Pleiades, the stars as being suns and centres of planetary systems, the phases of Venus, the comets, etc.

The pages of his poem rival the arch of the firmament in glory —gems of literary beauty here, myriads of glowing sapphires there.

It is a strange coincidence, as a stray piece of contemporary history, that while in the year 1665, Milton, driven out of London by the plague, was in a country house revising and rewriting his "Paradise Lost," Newton, driven out also by the plague, was in the same year, 1665, thinking out the theory of gravitation, aroused to enquiry by a well-known trivial occurrence in his garden, and was testing his theory of calculating the distance the moon fell to the earth in one second of time. Thus, at the same time and in the same country, we have the poet philosopher Milton dealing with the great problems of creation and eternity, and revealing to his fellow-men, by the spell of his immortal song, the counsels of God from before the beginning, and also the mathematical philosopher Newton dealing also with the great problems of the universe and revealing also to his fellowmen in that work of God-given genius, the "Principia," those eternal, unchangeable and universal methods of God's government in nature, based as they are on adamantine truth, and read by him in the shining scriptures of the sky.

Before closing something must be said of Milton's theory of creation. His was the Divine Fiat theory—"Let there be," and all things instantaneously were. It was the spectacular method—the traditional theory taken as the author understood it from—

> "That Shepherd who first taught the chosen seed
> In the beginning how the heavens and earth
> Rose out of Chaos,"

and it possessed all those elements of majesty that entered into this greatest of all poems, and which most sublimely interpreted a transcendentally sublime theme. Milton died 100 years before Kant or LaPlace had suggested the nebular theory of creation, and although evolution had been slowly working out her results, no Darwin yet had sought to interpret her movements and no Christian philosopher had arisen to point out the good gifts that the truly wise men of modern time were to lay at the feet of our Christ.

Tennyson wrote under the sunlight of a later and clearer science—

> "This world was once a fluid haze of light,
> Till toward the centre set the starry tides,
> And eddied into suns, that wheeling cast
> The planets."

The Muse of Poetry and Urania, her sister, clasped hands, and have in all ages sung to the world the sweet rhymes of Mother Nature. But Milton's muse did not as beautifully and as fully interpret the teachings of Urania as Tennyson's muse in the "Princess." When the Divine Fiat theory is propounded mankind says, "What effort." When the Creation theory of growing from more to more under a Divine Architect is explained then mankind says, "What power and also what wisdom." Ruskin writes: "Is not the evidence of ease on the very front of all the greatest works in existence? Do they not say plainly to us not 'there has been a great effort here,' but 'there has been a great power here'?"

In conclusion let me say that changes in human ideas and the rapid advance of science have to a large extent thrown the poem into conflict with present day knowledge of the physical universe. Had Milton's astronomy been more modern and had he clothed its truer principles with that glorious imagery that flowed from him in such harmonious numbers, would the poem have been more pleasing because more scientific and equally poetic? It is, I think, reasonably clear that if Milton had adopted the evolutionary theory of creation we could have had no "Paradise Lost." It would have lost its dramatic power and its dynamic fervor. Satan was to launch into space and decry a completely created world, and to visit and tempt and ruin a completely created man. He could not have been depicted as watching through eons of time a slowly revolving habitable globe and wait for milleniums to visit a prehistoric vertebrate growing to completeness and acquiring knowledge and reason and conscience, and then to destroy him mortally.

The first three chapters of Genesis constitute an oriental poem in prose, teaching deep spiritual truths, and not, when properly understood, unscientific, and Milton has made of all that an occidental poem in blank verse. The world is all the richer and better for this, but no evolutionary theory could have brought forth such an epic. We know now that this universe of ours is not built up like so many concentric shells; that there is no limit or Primum Mobile. We have burst through all that, and we have found no chaos beyond fenced off on this side by a definite limit. We find what we believe to be chaos within our universe—vast pulps or welters of unformed matter lying disintegrated—the raw material of new universes; but they are not dead like Milton's chaos, and irresponsive to the thrill and throb of movement, and therefore of life, but being governed and moved by those laws that pierce the remotest limits of space, are being fashioned by the hand of the Divine Architect according to his eternal plans.

Milton's divisions of space are poetic only, but yet they have their own philosophy and teach their own lessons. Is not after all our universe a mere drop hung from the Empyrean—heaven above it and close touching it, and impenetrable gloom all round it, and Hell far beneath it? If heaven does not closely touch us, then indeed we are banished and Paradise is Lost, never to be Regained. Let life be such that we shall have—

> "Earth crammed with heaven,
> And every common bush aflame with God."

ELECTRICITY AND MAGNETISM.

Read before the Astronomical Section of the Hamilton Scientific Association, December 4, 1903.

BY DR. CHARLES I. KELLY.

Mr. President and Members of the Hamilton Astronomical Society.

LADIES AND GENTLEMEN :

I thank you for the honor you confer upon me this evening, and I trust I may say something which may be of interest to you. Our subject is Electricity and Magnetism. It would seem most opportune just as this, our electrical city, is celebrating the reality of the utilization of electrical power for commercial and industrial purposes, that we should devote our time this evening in considering this mysterious force. I propose to divide my discourse into three parts—

a. Historical Part,
b. Elementary Part,
c. Terrestrial and Solar Part.

To yield the thunder bolt was the marked attributes of the chief gods of old; the lightning flash was the surest proof of the presence of divinity. Indra, the Jupiter of the Hindoos, was the god of thunder. The Etruscan tinia always yielded the electrical storm. Jupiter Tonans waved his thunder bolt over trembling Rome, and in every form of ancient superstition a belief in the divine origin of the most startling of the heavenly appearances lay at the basis of the national faith. When it thundered, the grave Romans dissolved their public meetings and the wise Greeks listened with unfeinged awe. The gods spoke from the heavens in the rattle of the passing storm, or wrote their age upon the earth in the ruin of the lightning stroke. Some such sentiments of mysterious awe pressed upon the mind of Thales, when twenty-five centuries ago he probably discovered Electricity. A sage of Greece, the philosopher's keen eye watched the minute phenomena of nature. His mind was eager for every kind of knowledge. Phœnician voyagers who were in the habit, in the dim age, of sailing out of the Straits of Hercules, and perhaps of coasting along the desolate shores of Europe until they reached the Baltic, brought back from the savage seas of Prussia a substance greatly prized by the ancients for its fair color and transparency. It was amber or elektron (the Greek for amber). To the Phœnicians it was an article for commerce, but to Thales it possessed a mysterious value. He discovered that elektron, when rubbed, had the property of attracting to itself various light articles, as if endowed with volition. This discovery was the first step in the great science of Electricity. But the philosopher did no more than record his observation and attempt to account for it by ascribing to amber a soul. He supposed some hidden principal of life lay in the yellow jewel from the northern seas. The discovery was never forgotten, and the peculiar property of elektron was noticed and commented upon by various ancient philosophers, but no one for a moment supposed that there was any connection between the animated elektron and the wild electricity of the thunder storm ; that the same power was active in both, and that the secret of amber was that of the thunder bolt of Jove ; that the precious elektron was to create and to give a name to the most wonderful of modern discoveries.

Yet Electricity in all its varied phenomena never suffered the puzzled ancients to rest. It flashed along the spears of their long array of soldiers and tipped every helmet with the plume of fire. It filled even the immovable Cæsar with a strange alarm. It leaped down from the clouds and splintered the temples and statues of Rome. It was seen playing around the ramparts of fortified towns, crowning their sentinels with strange effulgence. Often the Roman and Greek sailor far from land on the stormy Mediterranean saw pale, spectral lights dancing along the ropes of their vessels or clinging in fitful outlines to the mast, and called them Cæsar and Pollux. In ancient Etruria countless students were instructed in the act of reading the will of the gods by lightning. The heavens were divided into various compartments. If the lightning flash appeared in one it was a favorable omen, if in another it was fatal. The accomplished augurs stood upon lofty towers watching for a sudden gleam or a sudden peal of thunder, and knew at once by their divine art what undertaking would be successful when their warriors, clad in brass, should go forth to battle. The religion of ancient Etruria was almost a worship of electricity. Centuries passed away, but the observations of Thales was never lost, and at length, at the opening of the 17th century, an Englishman named Gilbert made his name famous by a series of discoveries, yet they were so meagre as to make little advancement. Otis Guericke, a Prussian, invented the first machine by which electricity could be readily produced. He placed a globe of sulphur on an axis to be turned by the hand of the operator, while with the other he applied a cloth to the sulphur to produce the necessary friction. It was a rude, imperfect machine, but it made a great revelation in the science. Electricity, which had hithertofore been known only in its feeble forms, was now given out in sharp sparks, and displayed a thousand curious properties. Sometimes it attracted objects—sometimes repelled them. It seemed at times to exert a kind of volition. The weather affected it sensibly, dampness dissolved its strength ; it was capable, too, of influencing bodies at a considerable distance. Yet the 17th century glided away with its fierce religious wars and its wonderful voyages and discoveries, while little progress was made in the knowledge of electricity ; but in the next century electricity sprang at once into startling importance. Hawkesbee invented the glass electrical machine, and in 1730 Stephen Gray made a course of experiments that unfolded the leading principles of the science. Dufaye suspended himself with a silken cord, thus insulating himself, and was then charged with electricity. He presented his hand to his companion, half doubting the truth of his speculations, when a brilliant spark shot from one philosopher to the other, and filled both with an equal surprise. Not long after Prof. Musschenbroek discovered the layden jar. He had been endeavoring to enclose electricity in a safe receptacle from which it could not escape, except with his permission, and at length he succeeded in imprisoning the genii in a glass vessel partly filled with water. Suddenly he formed a connection between the two surfaces of the jar. The imprisoned electricity sprang through his body and shook him with a wild convulsion. Novelty added its terror ; his imagination was filled with an indefinite alarm. He shrank from the glass bottle as if it was tenanted by an evil spirit. Yet the shock of the layden vial soon became the favorite of court. It was exhibited before Louis XV. at Versailles, and a chain of 200 people, having joined hands, received at once the mysterious blow. But to Franklin of Philadelphia electricity owed the most wonderful of all its achievements in the 18th century. He showed how iron points attracted electricity, and at length he declared that lightning and thunder were produced by the same agent that was enclosed in the mysterious layden jar, and he urged the English philosophers to draw down the electricity of the skies by placing iron points upon towers or poles, and thus test the accuracy of his theories. His suggestions were received by the Royal Society of London with shouts of laughter, and they refused to print his papers in their Transactions. His theories remained untested by experiment, and the philosopher prepared with doubt and dismay to attempt their verification. He felt that his fame must rest upon the success. If he could draw down the lightning from the skies by presenting his iron point to the thunder cloud, he must attain a renown that would live forever. If he failed he would seem to merit the scorn which European philosophers were prepared to pour upon him. His inventive mind suggested a simple expedient. He formed a common kite from a silk handkerchief stretched upon two cross sticks; upon the upper part was placed the iron point. The string was of hemp, terminating in a short silken cord, and at the end hung an iron key. Such was the simple apparatus with which the philosopher set forth from his home on a cloudy June day to draw the lightning from the clouds. He raised his kite. A cloud passed by, but no trace of electricity appeared; the heart of the philosopher sank with dismay. But suddenly the falling rain made the cord a good conductor, and Franklin saw that his fibres began to be stirred by some unusual impulse. He applied his hands to the key, and at once drew sparks from the skies. Thus the 18th century elevated electricity into a science. Franklin often sighed at its uselessness, but he would have been amply repaid if he could have forseen how powerful an agent his favorite science was destined to become.

GALVANISM.

The next great step in electrical progress was discovered by Prof. Galvani in 1790, by a very accidental circumstance. Madame Galvani was slightly ill, and a diet of frogs' broth had been recommended to her. Several of the animals chanced to be on the table near an electric machine. When sparks were drawn from the machine it was noticed that the frogs' legs became distorted and assumed the appearance of life. Galvania sprang to the conclusion that he had discovered the origin of life, but Volta, Professor of Natural Philosophy at Coma, soon showed that two different metals would produce the same action, and in 1800 Volta announced to the world his invention of the Voltaic pile. It was composed of alternate layers of zinc and copper, separated from each other by discs of wet cloth. Two currents of electricity, one positive and the other negative, were found to flow from respective poles of the pile; thus from the merest accident was discovered the foundation of our magnetic telegraph and telephone.

What is electricity? The latest and most plausible theory regarding this mysterious force is that it is a mode of motion or other manifestation of a very exceptional form of matter called the ether. The properties of this ether are: 1—It permeates all bodies and pervades all known space even to the most distant stars; 2—it is affected by the matter of bodies in which it is (it appears to be concentrated in it to an extent depending upon the density of the matter); 3—it is continuous, not granular; 4—its density is to that of water as is unity to unity followed by twenty naughts, while its rigidity is one billionith that of steel.

This ether, then, is electricity in a latent or passive state, but in order to convert it into energy it is necessary to destroy its equilibrium and kinetic energy, and power is generated when it seeks to restore that lost equilibrium much the same as water when water raised above its level can be made to do work by the pressure it exerts. If we take a rubber tube open at both ends and immerse it in a lake, the tube will be filled with water, but we can do no work with it because the water does not flow; but put a force pump at one end of the tube and cause a flow and the work that can be done will be in proportion to the pressure exerted by the pump. A copper wire is strung along the street on poles, and although the wire is immersed, as it were, in ether, and is a good conductor of the same, we have no current or flow because the electric level is not disturbed; but put a force pump (a dynamo) at one end of the line and we can do work in proportion to the work exerted by the dynamo.

VOLTS, AMPERES, OHMS.

The volt, ampere and ohm are the first three measurements in electricity, and it is necessary for us to have a proper conception of them before we can hope to proceed intelligently. Voltage is pressure or push power, or velocity, and is not electricity, but the force which impels. Amperege is electricity or current, and is not to be confounded with voltage, for although each is a component part of electric energy and are interchangeable, they serve an entirely different purpose. Voltage is that which tends to move current over a conductor, while amperege is electricity, and is that which is moved. We often read in our dailies about a person losing his life by having ten thousand volts pass through his body. This is simply not intelligent, and means nothing, for in static work we often use two hundred and fifty thousand to one half a million volts; what we would say is that the person was eloctrocuted by having three or ten amperes, as the case may be, driven through his body by ten or twenty thousand volts.

The water in a river would represent the amperege, the swiftness with which it flows the voltage. We may have a very large river flowing slowly, or a small stream flowing swiftly, and just so we have electric currents of high amperege and low voltage, or of high voltage and low amperege. The ohm is the unit of resistance, and resistance in the electrical sense does not differ in meaning than that used with the other forces, and simply means that which opposes the passage of electricity through a circuit. An ohm is the resistance offered by a piece of copper wire 250 feet long and 1 20″ thick. Metals have different powers of resistance. Silver offers the least resistance, copper is next; platinum has five times the resisting properties of copper. It requires 50,000 volts to send a spark of electricity through an inch of space. For convenience we may divide electricity into four divisions—1, Galvanism: 2, Farradism: 3, Franklinism; 4, Roentgenism. Though we have divisions do not think we have different kinds, but it is the ether so modified by mechanical apparatus that different results are obtained.

GALVANISM.

The galvanic current, sometimes called the direct dynamic or continuous current, is for Therapeutic purposes generally produced by chemical decomposition, or is merely the conversion of chemical energy into electrical energy. The simplest of galvanic cell consists of a plate of carbon and a plate of zinc immersed in an exciting fluid, that is, some fluid containing an acid or some similar substance that will act upon one or both of these immersed elements. If the carbon and zinc were equally acted upon there would be no current, but the zinc is easily acted upon by the acidulated water; chemical decomposition takes place, the potential of the zinc is raised, and a current of positive electricity starts at the zinc pole and flows towards and out of the carbon pole through any conducting medium that may join the elements together.

The word Magnetism is named from the town Magnesia in Lydia, where an iron ore was found possessing remarkable attractive powers for iron. It is now applied to all the phenomena having a selective attraction for iron. We have three kinds of magnet: 1—The loadstone or natural magnet; 2—The piece of hardened steel which, when once magnetised, retains its magnetism and is called the permanent magnet; 3—The electric magnet, of which I shall speak of later. By the invention of the mariner's compass the following scientific discoveries of capital importance are demonstrated: 1—That the loadstone can transmit to iron with which it comes in contact a permanent property like its own; 2—That a magnetized needle will, if suspended, freely assume a fixed position relative to the geographical meridian, a certain part of the needle turning always to the north and the part opposite to the south (the opposite parts are called the poles); 3—That like poles repel and unlike poles attract; 4—If a magnetized needle be broken into many pieces each piece is a miniature magnet with a north and south pole; 5—That every magnet has a space or field over which it acts, shown by the influence the magnet exerts upon the compass needle some distance from it; 6—That the geographical north pole and magnetic north pole are not identical, therefore the magnetic needle does not point due north and south, but a little to the east and west, according to the locality (this is called the declination or variation of the needle); 7—That when a magnetized needle is balanced on a horizontal axis so that it can turn a vertical plane, it is found to set itself at an angle depending upon the locality with a north seeking pole pointing downwards if north of the equator, and the south pole downwards south of the equator (this is called the inclination or dip of the needle); 8—That every purely magnetic action on the magnet has its source in some other magnetic body, and therefore we are naturally led to the conclusion that the reason why at every point of the earth's surface the magnetized needle assumes a definite position is that the earth itself is a huge magnet.

FARRADISM AND THE ELECTRO MAGNET.

The electrical faker largely prefers this field of electricity, because this current manifests itself by a buzzing noise more or less intense, and gives a current of considerable sensation, both of which tend to impress the patient, but in reality the quality of electricity received into the patient's system is very small. The Farradic battery in medicine is simply the mechanical apparatus driven by electricity constructed to produce contraction of the muscles and in this way is good in massage treatment, just as the motor is a mechanical apparatus driven by electricity constructed to produce power and motion. In the mercantile world it has its great use, as upon Farradism or the electric magnet depends the magnetic telegraph and X-ray. An electro magnet is usually a very soft iron cord surrounded by a coil of insulated wire, in which magnetism is induced by a flow of electricity through the coil of wire. The value of the electric magnet depends upon the fact of its being enabled to rapidly acquire its magnetism on the passage of the magnetizing current, and as readily to lose its magnetism on the cessation of such currents.

X-RAY.

It will surprise many of this intelligent gathering who are here this evening to learn that X-rays are invisible. No living being has ever seen an X-ray or ever will, unless in time to come through the great process of evolution the obliging cells of which the retina of our eyes are composed still further specialize themselves into a new organ for their recognition. The Spectrum shows that composite light is made up of many rays, among which are heat rays, chemical rays and actinic rays of active properties, but without luminous effect upon the eye, and X-rays belong to this class. Farrady, Giesler, Crooks and many other distinguished scientists had experimented upon the passage of electric currents of high tensure through glass tubes from which a portion of the atmosphere had been exhausted, and thereby discovered many strange and wonderful phenomena. Wilhelm Conrad Roentgen, Professor of Physics in the University of Wursburg, discovered in 1895 that not only could the shadows of inert objects be depicted, but the tissues of the living human being could be examined and photographed. He placed his hand between the tube and a photograph plate, and beheld to his amazement the likeness of his bony structure. What are X-rays? They are Cathoid or negative rays, or in simple language a modification of the electric light rays.

LIGHTNING AND INDUCE CURRENTS.

Franklin showed that the thunder bolt of Jove and the lightning stroke were the same, and by his kite drew the electricity from the clouds. With awe and fear we watch the great phenomena of nature as the vivid flashes play through the stormy heavens, yet how easy it seems to imitate. I have shown you the electric discharge between the two poles of the Static, which has the appearance of miniature lightning, and in fact is identical.

In this we have two accumulators or layden jars, one charged with positive electricity, the other with negative. Revolutions of the glass plates induce more and more electricity into the jars till the resistance within is greater than the resistance offered between the two terminals, and the opposite elements rush together, producing the light and noise we heard. In the atmosphere the clouds are layden jars or accumulators. They become polarized, that is, one is charged with positive electricity and the other with negative electricity. The clouds gather moisture as they float over ocean and lake. Water is a good conductor of electricity, and when the atmosphere and clouds have absorbed sufficient moisture to make a suitable passage for the electricity, the opposite elements rush together, causing the lightning flash and roar of thunder, producing condensation of the moisture, which falls in the form of a shower. This lightning flash which is seen is not electricity, but a column of intensely heated air, which becomes luminous due to the intense resistance offered to the passage of the electric fluid through the air.

We have grasped the important truth that the earth is a great magnet, but unlike ordinary magnets its magnetic system has four poles or foci of magnetic force, two situated in the northern hemisphere and two in the southern hemisphere. Of the two northern poles the stronger is situated in the upper region of North America, near Hudson Bay ; the weaker is situated above Siberia. Explanation : With the dipping needle, if we start at the equator and travel northward towards the focus of magnetic force, we find that the dip or inclination is increased until we reach a point where it points vertically downward. This corresponds with the focus of declination or variation. Thus we have a point in the north of America which has the following properties : 1—The various lines of declination converged to it ; 2—The needle points vertically downward ; 3—The horizontal force vanishes and the needle will point in any direction. Likewise we have another focus with same properties in Siberia and corresponding foci in the southern hemisphere, but with reversed poles. The reason for these two foci is hard of explanation. There is a supposition that the world was composed of two separate masses, but through the magnetic moulding influences of ages they became united. In support of this hypothesis note may be taken of the remarkable relation the orbits of the Leonids bear to the orbit of the comet Leo. It would seem difficult to find any cause that should bring into such a strangely shaped group bodies that have had originally orbits distributed at random. Hence we are apparently forced to the conclusion that these meteorites have something common in their past history, in fact they would seem to have been once part of a single body, and these common elements are essentially those of the parent mass. By some process they have become separated from the comet—thrown out of control of the attractive power, and so left to travel each in its own orbit. It is found the declination, the inclination or dip, and the intensity of magnetic force vary not only in different places, but also in the same place from year to year, from month to month, and even from hour to hour. There are also changes which proceed gradually for years. They are called secular. All changes are now recorded in tracings at our observatories by specially adapted instruments, and if we study these tracings we will find the sun produces its effect upon the declination of the magnetic needle, causing it to reach the easterly extreme of range about eight in the morning, and the westerly about two in the afternoon, and that this diurnal fluctuation is greatest in mid-summer and least in mid-winter—that is, it is greatest when the sun is north of the equator and least when south. Frequently disturbances occur which cause a temporary irregular effect on all the needle over a considerable area. These are termed magnetic storms, and are often connected with manifestation of electrical phenomena, such as aurora borealis, violent thunder storms, and still more generally with those solar outbursts known as sun spots. To give some idea of the extent of the magnetic disturbances during the aurora we may mention that on May 13th, 1869, the declination at the Royal Observatory, Greenwich, varied one degree, twenty-five minutes, while the vertical force experienced four successive maximæ. During April of the same year the declination at Stonehurst varied two degrees, twenty-three minutes and fourteen seconds in nine minutes. The electric force produced at such times in telegraphic wires, though transient, are often very powerful. Professor Lomis mentions cases where wires had been ignited, producing brilliant flashes, and combustible material kindles by the discharges. On August 13th and September 1st, 1858, the electric waves noiselessly worked the telegraphic needles and violently rang the alarm bells in the city of Paris. In addition to the resemblance between the aurora phenomena and those of electrical discharges in rarified tubes which I have shown you, we have seen that the aurora display is accompanied by marked disturbance in the direction and force of terrestial magnetism, and taken in conjunction with the strong earth currents which are at such times produced and with manifest polarization or setting at right angles of the arches and rays with regard to the magnetic meridian, may be considered as conclusive that the aurora is some sort of electric discharge. Professor Lomis states in an excellent article in the *American Journal of Science* that he has registered the extent of sun spots for six days preceding and following each of the great magnetic disturbances at Greenwich, and has compared these values with that for the very day of the disturbance. In this manner he has treated all the days of the great magnetic disturbance at Greenwich for a period of twenty-three years. The cases of disturbance thus treated amounted to 135, and from the results he draws the following conclusions: 1—Great disturbances of the earth's magnetism are accompanied by unusual disturbances of the sun's surface on the very day of the magnetic storm; 2—The great disturbance of the sun's surface which accompanies a great terrestrial storm is generally heralded by a smaller disturbance three or four days previous, succeeded by a comparative calm, which immediately proceeds the magnetic storm. There is one instance on record of a sudden solar change which was practically simultaneous with a magnetic disturbance on earth. We cannot suppose that a small black spot on the sun exerts any direct influence on the earth's magnetism or electricity, but we must rather conclude that the black spot is a result of a disturbance at the sun, which is accompanied by an emanation of some influence from the sun, which is almost instantly felt upon the earth in an unusual disturbance of the earth's magnetism shown by the tracings of the needle. The appearance favors the idea that there is a direct flow of electricity from the sun. It has been demonstrated that the declination and inclination of the needle are affected by the time of day by the aurora borealis by the position of the sun north or south of the equator at the time when sun spots appear. To produce a change in the declination it is necessary that the needle should receive some magnetic influence from without, and only through a magnetic influence can it be affected ; therefore I argue that the cause of light, the aurora borealis and the sun spots must be electrical, and that there is a most intimate connection existing between the solar magnetism and terrestrial magnetism—in fact they are the same—and for every effect produced in the sun's magnetism there is an analogous effect in the terrestrial magnetism ; for example : the electric light system, if there is a break or any irregularity at the power-house, though situated many miles away as at Hamilton, at Decew Falls, there is a corresponding effect produced in the most distant light, but the connection between sun and earth is not by wires, but wireless. I would, from the electrical standpoint, prefer to regard the sun as a mass surrounded by atmospheric cushion, and that solar laws are practically identical with terrestrial laws, and therefore I claim that the sun is not hot and its rays are not hot, and do not directly heat the earth, but that the sun furnishes the electrical power and that the earth heats itself. The sun's rays come to the earth as electricity, which is convertable into light, heat and all vital force. This light, heat and vital force is generated in the dense atmosphere of the earth at its surface, where it is needed for animal and vegetable life. The rays are shot by the laws of electrical repulsion from the sun, and drawn by the laws of electrical attraction, to the earth, where, coming in contact with the earth's opposite electric polarity and the resistance of the atmosphere, these electric sun currents burst into new form, light and heat down near the surface. This it does in exactly the same manner that two wires oppositely electrified and brought together with a resistance between produce the arc and incandescent light. A good example of this is furnished in our electric light system, and especially at Hamilton. Decew Falls is situated some miles out of the city; the electric power house is there, but the light is produced at the city. The necessity for an atmosphere for producing heat is remarkably shown by the frozen condition of the moon, which is void of atmosphere. This remark does not coincide with Professor Pickering, of Harvard, who claims that there is a lunar atmosphere. It requires 50,000 volts to send a spark of electricity through an inch of air, so great is its resistance, and it is known that meteors fiying in space are invisible until they come into contact with the earth atmosphere, when they burst into life and become a heated mass so intense that many are shattered to pieces and fall as a shower of stones. And I claim the same conditions prevail at the sun as on earth. From the etherial of space, or more correctly from planets which throw out electricity into space, rays of electricity are shot by the laws of repulsion and drawn by the sun's great magnetic force coming into contact with the sun's opposite polarity, and the increasing resistance of the sun's atmosphere produces what astronomers call the chromosphere, and then burst into magnificent splendor—the photosphere. The analogous condition I have shown you in these beautiful tubes. The earth and sun has used wireless telegraphy since creation began. Heat cannot come to the earth through the intense cold of the upper atmosphere of the earth, which increases with its altitude. How is it possible to have snow-capped mountains near the sun when the valley is filled with verdure if heat comes from the sun? Nor can heat come through the ninety-three miles of frigid ether, 460 degrees colder than ice; no heat could penetrate such cold. All heat must come in the form of electricity, which is converted into heat. The sun's corona, that beautiful light which we view as the sun's rays, is like our aurora borealis, which are electrical, which is the earth's surplus of electricity thrown off to the north and south, which is earth's attempt to form corona like the sun, but the earth lacking in electricity must content itself with its gorgeous streamers as they reach out on their return voyage to the sun. The sun is one million three hundred thousand times larger than the earth, therefore if we multiply our beautiful aurora borealis by one million three hundred thousand the splendor would equal that of the sun. I have said from the ethereal realm of space the sun receives its great electric life-giving energy and power. It only gives as it receives, and by the convertability of electric energy into light and heat by friction and contact with opposite polarity we can readily understand that it is not essential to consume millions of God's beautiful spheres or suns to afford us light and heat.

There is no waste or loss of light, heat or vital energy in the sun or in the universe; what is lost in one place is regained in another. Not one atom of matter or ampere of electricity has been destroyed or manufactured since the universe began. The sun sends its rays by wireless telegraphy to earth, and Marconi in sending electricity without wires simply imitates nature. Their transmitters and receivers are attuned to each other like the sun and the earth, which send their electric energy from one to the other in perfect harmony and accord. The earth has two hundred miles of atmosphere surrounding it. The sun is one hundred and eight times the diameter of the earth, and by the law of analogy and proportion should have an atmospheric cushion of twenty thousand miles surrounding it, and in this atmospheric belt is developed all the sun's light, heat and vital force needed for his existence. There is an unanswerable fact that proves the sun's corona is cold like our aurora, and that is the unquestioned fact that comets have passed through it three thousand miles without being affected in the slightest. These comets were excessively cold, and the corona must have been cold or there would have been a disastrous explosion. If I take two horseshoe magnets and place their positive and negative poles together they will cling until some stronger force overcomes their mutual attraction. If I reverse them and place their like poles together they will not cling but will repulse each other. In chemistry molecules of opposite polarity unite, and this is called chemical affinity. Molecules of like polarity will not unite, and this is called chemical repulsion.

Magnets attract only when their poles are reversed, and suns and worlds do the same. Why does the sun revolve on its axis? Why do planets revolve on their axis? if it is not to produce induced magnetic currents converting them into magnets. Therefore I claim that the universe of suns and worlds is held in position by the magnetic influence one exerts on the other and the great magnetic influence the sun exerts upon all the solar system. My theory is that the sun is the great central magnet and dynamo of the solar system which supplies all the electricity necessary for heat, light and vital force for the planet, and that the planet supplies the component part of electrical energy which is requisite for the life and existence of the sun, and I believe that the outer envelope or corona of the sun is electricity given off, which becomes beautiful, rich and luminous, corresponding to earth aurora borealis, with all the varied hues of a million rainbows with mighty arches of flaming light and sapphire domes, and streaming banners of varying colors of orange and gold and purple, waving and flaring out into space thousands and millions of miles as the electric currents speed on their life-giving mission to the earth and planets.

POLARIZED LIGHT.

Read before the Astronomical Section of the Hamilton Scientific Association, December 18th, 1903.

BY PROF. C. A. CHANT, M. A., PH. D.

The great essential fact which has been demonstrated in investigations into the nature of light is that the light-effect is due to definite periodic actions. Now, the simplest physical hypothesis we can suggest to account for the transmission of a periodic action is that it is due to a wave-motion. Hence we have the wave-theory of light, the substantial correctness of which no one properly informed now questions.

The great method used to test for an undulatory motion is to apply the phenomenon of interference. If two wave-motions are travelling through the same space, or over the same surface of liquid, the motion of the substance at any particular point in the space will be the sum of the two motions from the two sources, and it is possible for these two to be in opposite senses and so destroy each other's effect; or the motions may be in the same sense, in which case the substance at the point will be moved through a double distance. When one motion is destroyed by another they are said to *interfere*, and this interference will occur when the waves are "out of step," or the distances of the point under consideration from the two sources of the motion (which are supposed to be identical in behavior) differ by 1, 3, 5 or any odd number of half-wave lengths. The waves will be "in step" and the action be intensified when this difference of path is 2, 4, 6 or any even number of half-wave lengths, *i. e.*, any number of whole waves.

We know that sound is due to wave-motion, and in this case the motion of the particles of the medium (usually the air) transmitting the sound are back and forth in the direction of propagation. For many years after the distinct promulgation by Huygens of the wave-theory of light it was thought that the ether, the medium transmitting the light, was gaseous in nature, and that the motions of its particles were longitudinal, or the same as in sound.

Now Huygens had observed that the two beams of light into which a single incident beam traversing Iceland spar is broken had peculiar properties, which Newton described as "two-sides." In 1810 Malus, when examining the light of the sun reflected from the windows of the Luxenbourg Palace in Paris, observed that the reflected light had properties similar to those possessed by lights which has traversed Iceland spar. It was he who applied the term "polarised" to describe the effect. About the same time it was discovered that light which had passed through tourmaline in the proper direction was also polarised. Thus the problem of determining the precise nature of polarised light became a live question. It was solved by Fresnel and Arago, who made many beautiful experiments on the interference of polarised light. The conclusion reached by them was that the vibrations in light cannot be longitudinal as in sound, but must be transversal, *i. e.*, in a direction perpendicular to the direction of propagation; and further, that in polarised light this transverse motion must be limited to a certain direction. Thus, if the axle of a carriage represent the direction in which the light is moving, then the particles of the ether may vibrate along any spoke if the light is common, but if it is polarised they are restricted to be along some particular spoke—for instance, in the vertical or horizontal plane. Thus polarised light is of a more simple, regular, restricted nature than common light. This latter has a certain go-as-you-please freedom about it; the former is tied down to definite limitations. Hence when we use polarised light in an investigation we use a tool much simpler in nuture, and which will show more easily interpreted effects.

Polarised light can be utilised in many important investigations and to show some transcendently beautiful phenomena. In working with it the common light is first polarised, usually by a Nicol prism—which is made from a crystal of Iceland spar and is named after its inventor—and then after passing through or being reflected from whatever we are investigating, it passes through a second Nicol. The first one is called the polariser, the second one the analyser, and the combination of the two with any suitable lenses is called a polariscope. Of course, in place of the Nicols we may use any other polariser or analyser, *e. g.*, a slice of tourmaline or a glass plate inclined at the proper angle.

Let, now, light enter the polariser from a powerful source (arc lamp). It emerges polarized. Then let it pass through the analyser and be received in the eye or on a screen. We can turn the analyser so that no light can get through, and the screen is dark. It must be remembered that the analyser and polariser, when examined in common light, are perfectly transparent, and yet when placed one after the other can completely shut out the light. If the analyser is turned either way, the light gets through and illuminates the screen. When arranged so that no light gets through, polariser and analyser are said to be *crossed;* when turned, that maximum light gets through, they are said to be *parallel.*

Suppose, now, polariser and analyser are crossed ; the screen is dark. On inserting between polariser and analyser a piece of mica or any other thin crystalline plate, very beautiful colors are seen on the screen. These are due to interference. When the white light, polarised by the polariser, enters the crystalline plate, it is broken up by the crystal into two portions, each polarised, one with vibrations in a certain direction, the other with vibrations at right angles to these, these two directions being determined by certain lines in the crystal. Now, one portion travels faster than the other, and so when they emerge on the other side of the plate the latter lags behind. At once comes the suggestion that the two portions should interfere. But they are polarized in planes perpendicular to each other, and as motions at right angles can never destroy each other, they cannot. And so we make them pass through the analyser which brings them together again and makes interference possible. But the various components of white light—red, yellow, blue, etc.—do not travel in the crystal with the same speed, and so while the waves proper to one color interfere and cause that color to disappear, other colors will not go out, and we get on the screen what is obtained by subtracting certain components from the white light. Again, if the crystalline plate is not of uniform thickness, there will be seen a color proper to each thickness. Hence by making a pattern by using sheets of mica of varying thickness, we can show any figures we desire on the screen in gorgeous colors.

By rotating the analyser through 90° the colors become complementary to the former ones. Every sheet of doubly-refracting crystal shows these effects, but mica is the easiest to work with.

An amateur can easily construct a polariscope, and the production of these gorgeous colors is extremely interesting. Again, common glass when put in the polariscope does not exhibit colors, but when strained in a press shows them beautifully. No test for annealed glass is comparable with the polariscope. The very inner arrangement of the molecules seems to be thus revealed. If a sample of rock be ground to about the thickness of ordinary writing paper it will show in the polariscope most beautiful colors, and, what is more important, will show to the petrologist the precise composition of the specimen. Another application of polarised light is in the analysis of sugar and sugar solutions. The levying of duty is proportional to the strength of the sample, and the polariscope is in daily use in the custom house to determine this. There are many other applications of polarised light of commanding importance in science and industry, and in many cases extremely beautiful as well.

In addition to the Society's projecting lamp, a powerful lantern polariscope, with its numerous accessories, belonging to the University of Toronto, was used to exhibit the various effects described, and in the management of the apparatus the lecturer was most efficiently assisted by Mr. W. P. Near, B. A., who accompanied him from Toronto.

THE EXTENT OF THE UNIVERSE.

Delivered before the Astronomical Section of the Hamilton Scientific Association, January 19th, 1904.

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

That stately ceiling fretted with gold and bedecked with living points of light, supported by no pillars, having no abutments or foundations; that azure canopy embroidered with stars, and sufficiently spacious to form a covering for unnumbered suns and their planetary companions, has from all time been the study of him who is made like unto his God

From time unknown man has sought to learn the great book open before his gaze. To know something of these mighty orbs that roll along the space of the sky and trace the Creator's steps in yonder starry plains has been the desire of thoughtful man from time immemorable. We have seen the touches of God's pencil glowing in the colors of spring. We have seen a sample of His beneficence as exhibited in the stores of nature. We have seen a ray of His brightness beaming in the blaze of a meridian sun; but what an infinite field for the display of His perfections and power is to be seen in the unmeasurable wilds of ether.

Man stands to-day with the knowledge of centuries at his feet, proud in his armour of the most recent scientific equipment, coupled with faith; yet as he looks at that majestic dome he is able only to catch but a glimpse of the Almighty's glory, and spell but a syllable of His eternal name.

On a clear, moonless night, if you look upwards to the stars a countless number of shining points will meet your gaze in every direction your eye is turned, and if you are a thoughtful observer you will pause and try to take in the wonderful sight. As you gaze up to that gilded roof with those celestial luminaries glittering through the gloom, methinks I hear you say: "Stars, as you twinkle you beckon me; stars, your wonderful splendor inspires me. Yes, ye majestic monitors, I understand your meaning, and will strive also to obey Him who said: 'Let your light so shine among men.'"

Without the aid of the telescope an observer on a clear, moonless night can see about 4,000 stars, but by the aid of the telescope miliont of suns, whose variety and beauty will be revealed.

From early times scientific men have tried to gain some clear and definite ideas of the extent of the starry Heavens, in fact this subject although immensely difficult has been the one great theme of astronomers of every clime and age, and as knowledge has increased throughout the world, both general and specific, the study of the stars has not dimished but has rather quickened its pace, so much so that within the last half century old methods have been changed, new ones have been introduced and multiplied, and all branches of astronomy are bounding with vigorous life.

The question before us to-night is: Is this star-lighted canopy an endless thing, or has it limits? Is the stellar universe boundless? Is it infinite, or has it somewhere definite limits? This is a great question. I have, however, not ventured a paper on it without, to some extent at least, having counted the cost. The first question that came to my mind when contemplating this subject was, to what section of the field of knowledge must I look for material to answer this question? Something suggested the philosophical field, but I soon discovered that philosophy would not solve the problem. Philosophy, as you perhaps all know, deals with pure reason, analogy and the general fitness of things in the order of nature. The great philosopher Kant proved most admirably the universe to be limited and just as admirably he proved it to be unlimited or infinite. Hamilton, whilst to a certain extent assisting Kant out of his dilemma, fell into a pit hole himself, pointing out by philosophy the impossibility of the finite mind conceiving of space being infinite and the impossibility of the finite mind conceiving of space being bounded. If I leave not the philosophical field to answer this question I fear I will make no progress to-night. Failing in the philosophical field for material to answer this question I set myself immediately to explore in the field of astronomical science, this being to me apparently my only hope.

While the science of astronomy does not as yet give us all we would like to know, yet the astronomer is not discouraged but is hopeful, and says: "Give me clear skies, good instruments and time enough and I will give you full information regarding all that comes within the range of the telescope, spectroscope and camera plate, and perhaps sound, sensible speculation of what is beyond, if a beyond there is."

Differing from philosophy, astronomical science has facts for its data. These facts are determined from observation. From these facts combined the astronomer gets working theories, from working theories he gets data, and by the combination of these he discovers nature's laws, which to him are facts. Thus in this way the astronomer learns the laws that govern those worlds and suns, and thus in time he will be able to trace nature's operations back to Alpha, and look forward to Omega, if there be an Omega, at the same time to pry into those secrets which reach beyond Hamilton's philosophy, and discover facts relevant to the size of the universe which the finite mind cannot grasp, and which in my mind he need not grasp. Mortal mind can conceive of the distance of two objects separated from each other, the distance say of a mile or five miles, or even five hundred miles, but what mortal mind can conceive of the distance of the sun and A Centauri separated from each other 202 biliions of miles, or 61 Cygnus three times that distance, 606 billions of miles, or from Sirius 120 trillion, and yet these are some of the nearest fixed stars. Man cannot conceive of it, but this deficiency in man does not interfere with the facts that be.

I will now seek to present to you some of the arguments which, if they do not enable us to come to some conclusion and enable us to have some idea of the extent of the universe, they will supply us with food for reflection and thought.

That bright belt of glittering star dust known as the Milky Way is probably the groundwork of the universe, but I make this remark without reference to Dr. Wallace or his teaching. I may say, however, for the benefit of those who may not know much about Dr. Wallace's particular holdings, that his most fatal fallacy is that our system is so related in its situation to the Milky Way that our sun is the only one of the myriads of suns that can have life-bearing planets. And, moreover, he states that the earth is the only life-bearing planet that our sun has, and this is because it is so peculiarly related in size, position, atmospheric conditions, etc., to the sun, that this earth is the only celestial body that can possibly have life. It was stated about ten days ago by one of our Hamilton ministers that the teaching of Dr. Wallace was quite correct, and that he agreed with it; but that the teachings of the venerable old doctor was misunderstood. It behoves me, as President of the Hamilton Astronomical Society, to correct this. I do it kindly, but firmly. I may say that those most likely to understand an astronomical work written by Dr. Wallace or any other on the subject would be the astronomers, and I think his article previous to his book was so well understood by astronomers and so properly criticized by them that Dr. Wallace has modified considerable of his teachings in the book so recently published. Moreover, a number present here to night have the distinguished honor of belonging to the Society whose criticisms sent direct to Dr. Wallace was instrumental in modifying some of his extreme views. I refer here to the Royal Astronomical Society of Canada, whose worthy President, Prof· Chant, of Toronto University, was with us only a few nights ago and gave us that admirable paper on "Polarized Light."

That galaxy of stars being the fundamental plan of the universe divides the great structure into two parts, and to the up-to-date astronomer suggests the sphericity of the universe. Close to the Milky Way and on either side of it the stars are so numerous that it is impossible to count them even with the aid of the telescope or camera plate. In a space the size the full moon appears to the naked eye there are hundreds of stars. In many places the stars are so numerous they are termed star clouds.

By over 3,000 actual star counts in all parts of the sky Herschal found that they were evenly distributed on each side of the Milky Way;

That there are over thirty times as many stars in the Milky Way as there are distributed in space on either side of it;

That from either side of the Milky Way from a close proximity to it, the stars gradually decrease in number down to 90 degrees.

But the recent introduction of the spectroscope has much encouraged the astronomer; and whilst he has not mastered this instrument fully, yet it has given him a great step forward towards the goal which he hopes sooner or later to reach in determining this great question—the size of the universe. By carefully examining stars as to the color, it is found that certain colors prevail in certain localities, that is, the blue stars prevail in and about the Milky Way, whilst those approaching the poles are prevailingly yellow. We do not understand fully the reading of the spectroscope yet in this connection, but we look forward hopefully.

It is known and accepted by astronomers in general that the number of the stars of each of the fainter magnitudes rapidly increase in numbers until about the 9th magnitude is reached, after which there is a marked falling off. This fact must speak loudly when considering the size and form of the universe.

Whilst there are some bright stars very far away and some faint stars comparatively close, yet it is known that the larger stars as a class are nearer to us than the fainter ones, and that the fainter ones as a class are more remote. If the law of increase in the number of stars was the same down to the faintest visible in the telescope, and so on indefinitely as holds true from the 1st magnitude stars down to the 9th magnitude, starlight at night would be as bright as noonday, but as a fact the total of starlight is less than one thirty-seventh millionth of the sun.

But to go further in the study of the extent of the universe we must study the nature and distance of some of these stars, and I may say right here that the work of ascertaining the distance of the stars is no small task. However, this work has been pursued vigorously for many years past and is being pursued vigorously at the present moment. Dr. Gill, of the Observatory of Good Hope in South Africa, published in 1891 the results of attempts to measure the distance of Canopus and Rigel. These stars are amongst the brightest in the sky. Although having the best instruments the world could then produce, and he a very able scientific man, said that their distance is so great I cannot measure it. If, therefore, this be true of some of the bright stars in the sky, what can we say of the distance and the size of the fainter ones that bedeck our canopy? Up till now the distance of about 100 stars is ascertained with considerable accuracy, but the stars being so far away the mile unit of earth forms too small a part; as a grain of sand is to the entire globe, so the mile unit is to star distance. In measuring the distance of the planets the astronomer uses the distance of the earth to the sun as a unit, that is to say Jupiter, Saturn, Uranus and Neptune are so many times 93 millions of miles remote from the sun, but when we look into the stars even 93 millions of miles as a unit is by far too small and would make our mathematics stagger with the abundance of figures.

Light, we know, travels 186,330 miles per second. In a year there are 31,558,000 seconds; thus light would travel 45 millions of miles. Thus a light year is 45 millions of miles, or in other words, a light year is 63 thousand times the distance the earth from the sun. "Now let us take a light year as our measuring rule and let us go out to measure the distance of the nearest fixed star, which is A Centauri, which is more than 4 light years distance or nearly 4½ light years distance, which were we to use the mile unit would be 202 billions of miles. Leaving A Centauri we go out to 6 light years, and were we to describe a circle at that distance round the sun not likely more than A Centauri and the sun would be included in it, omitting our planets of course. Now let us double the radius and go out 12 light years, not likely in all this circle with a diameter of 24 light years would there be more than 8 stars. Add another 6 light years to this radius and describe another circle of 36 light years in diameter, and probably not more than 27 stars would be enclosed. But let us go another 6 light years and describe our circle this time 48 light years in diameter, and not more than 64 stars would be reached. Now, if we call a radius of 6 light years a unit, the first sphere having one star beside our sun, the second sphere with twice the radius contains 8 stars, the cube of the two; the third circle, the cube of 3 or 27 stars; the fourth circle, the cube of 4 or 64 stars. Now, speed on in flight until we have reached the eighth sphere, or a distance of 48 light years, and we will have reached our old familiar pole star. After we have thus done we then will have left behind us perhaps only 600 stars of the millions that we must consider in describing the size of the universe."

But with all this the astronomer has yet another step in considering what is called the proper motion of stars. We speak of some stars as "fixed stars"; perhaps we should not do this, as the term is very misleading. We believe that probably every star in the sky is in motion, moving from one mile to one hundred miles per second, and some perhaps with greater velocity than this.

There are two stars in the sky moving with such velocity that they move round the whole circle of the sky in the brief period of 160 thousand and 180 thousand years respectively. The proper motion of a star is the angular motion which the star seems to make from the point of observation measured not in miles, but in seconds of arcs; sometimes this motion is called "the right line motion or the star speed." Astronomers have studied the speed of stars for years, and their work agrees well in making the average speed of stars about 21 miles per second. The study of the proper motion of the stars has been prosecuted even longer and more generally than that of their speed, and the conclusion reached by this means that stars which have an apparent proper motion of 10 seconds of arc in 100 years must not be far from a distance of 180 light years, or describe the whole circle of the sky in 12,960 years. Now, then, if we apply the law of the cube of the number of stars related to distance, then we shall have reached the 30th sphere of light year distance and would have included in the list only about 27,000 stars. We know that there are about 10,000 stars whose proper motion is as large as 10 seconds of arc which have been made the basis of calculation. Astronomers have made careful study of this part of our argument, and have said: "On the whole it seems likely that out of a distance of 300 or 400 light years, or 18 trillions of miles, there is no marked inequality in star distribution." If we go on and on and on, until we have reached a distance of 3000 light years, or 135 trillions of miles, possibly there would be a beginning of the thinning of the stars ahead of us; but let us make the journey 10,000 light years, or 450 trillions of miles, then we might find ourselves nearly through that great ring of stars which we call the Milky Way, and the stars before us might probably have been thinned out so much that the great mass of them which we see from our terrestrial home would be left behind us.

Suppose we set a celestial mark 10 thousand light years from our sun and describe a great circle, the sun being the centre thereof, this circle would be 20 thousand light years across, or 900 trillions of miles in diameter.

I do not say, and astronomers do not assume, that such a circle would enclose the universe, but I do say that this is approximately the size of the universe as conceived by the astronomer of to-day. But don't misunderstand me. I do not say that this is the size or form of the universe, but this is the astronomers' conception, and although this is the astronomers' conception of the universe, yet he can fully follow the sentiment in the following words:

> "Come forth, O man, yon azure round survey,
> And view those lamps that yield eternal day;
> Bring forth thy glasses, clear thy wondering eyes;
> Millions beyond the former millions rise;
> Look further, millions more blaze from remoter skies."

And he can also with equal grace repeat from his inmost soul those undying words by Richter, as recited to the Society some weeks ago by Mr. G. P. Jenkins, F.R.A.S., which by his permission is here appended:

"God called up from dreams a man into the vestibule of heaven, saying: 'Come thou hither, and see the glory of My house.' And to the servants that stood around His throne He said: 'Take him and undress him from his robes of flesh; cleanse his vision, and put a new breath into his nostrils; only touch not with any change his human heart—the heart that weeps and trembles.'

"It was done, and with a mighty angel for his guide, the man stood ready for his infinite voyage, and from the terraces of heaven, without sound or farewell, at once they wheeled away into endless space.

"Sometimes with the solemn flight of angel wing they fled through Zaarahs of darkness, through wildernesses of death, that divided the worlds of life; sometimes they swept over frontiers, that were quickening under prophetic motions from God. Then, from a distance that is counted only in heaven, light dawned for a time through a sleepy film; by unutterable pace the light swept to them, they, by unutterable pace, to the light. In a moment the rushing of planets was upon them, in a moment the blazing of suns was around them. Then came eternities of twilight, that revealed, but were not revealed. On the right hand and on the left towered mighty constellations, that by self-repetitions and answers from afar, that by counter positions, built up triumphal gates, whose architraves, whose archways, horizontal, upright, rested, rose, at altitudes by spans that seemed ghostly from infinitude. Without measure were the architraves, past number were the archways, beyond memory the gates.

"Within were stairs that scaled the eternities below; above was below, below was above, to the man stripped of gravitating body—depth was swallowed up in height insurmountable—height was swallowed up in depth unfathomable. Suddenly as they thus rode from infinite to infinite, suddenly as thus they tilted over abyssmal worlds, a mighty cry arose, that systems more mysterious, that worlds more billowy, other heights and other depths, were coming, were nearing, were at hand.

"Then the man sighed and stopped, shuddered and wept. His overladened heart uttered itself in tears, and he said: 'Angel, I will go no farther; for the spirit of man acheth with this infinity. Insufferable is the glory of God.

Let me lie down in the grave and hide me from the persecution of the infinite; for end, I see, there is none!' And from all the listening stars that shone around issued a choral voice: 'The man speaks truly, end there is none, that ever yet we heard of!'

"'End is there none?' the angel solemnly demanded. 'Is there indeed no end? and is this the sorrow that kills you!' But no voice answered, that he might answer himself.

"Then the angel threw up his glorious hands to the heaven of heavens, saying: 'End is there none to the universe of God. Lo! also, there is no beginning.'"

I do not claim originality for some portions of this paper.—D. B. M.

JAMAICA.

Read before the Astronomical Section of the Hamilton Scientific Association, February 2, 1904.

BY ADAM BROWN, ESQ.

When I was invited by the President to contribute something to the winter programme I told him I could not pretend to write on an astronomical subject, but if he would be satisfied with an address on Jamaica I would be glad to accede to his request, so my theme to-night is "Jamaica."

Jamaica is a lovely island—a tropical paradise—in the Caribbean Sea. A crown colony 5,000 miles south of England, 2,000 south of Halifax, 1,500 south of New York, and 80 miles south of Cuba. It is 144 miles long, and varies from 21 to 49 miles in width. Its area is 4,193 square miles, and the population is about 850,000, nearly all blacks. There is a great variety of temperature, according to the height above the sea. The form of the coast is like a turtle, the mountain ridges representing the back of the turtle. Some of the peaks are 6,000 feet above the sea; the famed Blue Mountains rise in some cases to 7,000 feet. There are 114 streams in the island, but none are navigable. Jamaica has 16 harbors. Its principal exports are sugar, rum, ginger, bananas, oranges, coffee, pimento, logwood, pineapples, cocoanuts, cigars. Of late years the banana trade has increased enormously; it will take three or four years, however, to overcome the injury caused by the recent terrific hurricane. Canadians do not know what a first-class banana or orange is until they enjoy the genuine Jamaica article. I have heard it said that three good sized bananas contain as much nutriment as a fourteen ounce loaf of bread.

Jamaica, the Isle of Springs, was discovered by Columbus in May, 1495. Who has not read of the trials of the intrepid Genoese mariner in his voyages of discovery? Joaquin Miller, in his marvellous way, gave the fine pen picture of the sailors in their despair—

"They sailed, they sailed, then spoke the mate:
  This mad sea shows its teeth to-night;
He curls his lip, he lies in wait,
  With lifted teeth as if to bite.
Brave Admiral, say but one good word—
  What shall we do when hope is gone?
The word leapt as a leaping sword—
  Sail on, sail on, sail on, and on."

Columbus gained a world and gave that world its greatest lesson—"On and on." When he returned to Spain the Queen asked him what kind of a country he had discovered. He took up a sheet of paper, crumpled it up, and said "Ya ma ka," which means a land of mountains.

The Spanish surrendered the island to the British in 1655, it having been under Spanish rule for 161 years. It is, as I said at the outset, a crown colony. The members of the Government are all Imperial appointments. The members of the Legislature are elected by the people.

I went to Jamaica as Honorary Commissioner, representing Canada at the great International Exhibition, held in Kingston, Jamaica, in 1891, leaving New York in the good steamer "Hondo" on the 17th of January of that year. The voyage was delightful. One the second day out one began to feel like parting with sea wraps, and by the fourth day it was quite summer like, and gauzy garments were all that were required. The sight of the firmament in the tropics at sea is one of indescribable splendour. The "heavens are so beautifully blue and the stars so festally bright." These stars are like moons, and have to be seen to give any idea of their glory: they cannot be described.

"The starry firmament on high,
With all the blue ethereal sky,
And spangled heavens a shining frame,
Their great original proclaim."

I cannot trust myself to say all I felt when I first saw the Southern Cross, which was about midnight on the fifth day out, or of my surprise at the shoals of flying fish, like sea birds skimming the waves. We pass Hayti, that island of great fertility, and "where every prospect pleases and only man is vile." It is almost a continual scene of turmoil and bloodshed. Then we have a peep at

Cuba, and on to Morant Bay, but a few hours' steam from Kingston. As I stood on the deck, glass in hand, the distant hills looked as if covered with green fur, the whole scene suggesting one's conception of the Garden of Eden. What inviting spots—the green canes, cocoanut groves, and away up the mountains the huts of the natives, as if glued to the hillside. The sun had kissed the sea when we came to anchor at Port Royal. It was too late to enter Kingston harbour that night. There was a luxurious calm about everything as we sauntered about the deck; the electric lights in the distance sparkled like stars. Port Royal is an historic place. In time of war it is an important naval station. My British heart beat with pride as I saw the evidence of Britain's power—the guard ship, the batteries, the dear old flag. Memory became busy with the history of the gallant deeds of British heroes.

> "The spirit of our fathers
> Might rise from every wave,
> For the deep it was their field of fame
> And the ocean was their grave."

Nine-tenths of Port Royal was buried beneath the sea in 1692. There was an awful earthquake, and in two minutes Port Royal was swallowed up. The ruins of the place now submerged are still visible in a certain condition of the water. It was a place given up to wickedness of the grossest description, and by many the calamity was regarded as a visitation of an offended God on a place "wallowing in riches and abandoned to wickedness." Only 300 houses out of 3,000 were left standing. As we steamed along in the morning what a glorious scene feasted the vision. The island fresh, as if just out of a bath; the peaks of the Blue Mountains towering in silent yet glorious majesty; the hills and valleys glittering under the bright and azure sky, as a garden of the Lord. No two travellers will see the same picture. One will be looking in one direction and catch the grand amphitheatre of hills, the other may rest on the placid harbor; but look which way you will, you will find a charm, and one so different to anything you ever expected that you are filled with wonder and delight.

After landing at Kingston I was soon off to Constant Spring Hotel, six miles from the city of Kingston, and about 200 feet above the sea. Kingston is a busy place, with a population of about

50,000. The scavenger bird of Jamaica, John Crow as they call him, a beautiful large bird, keeps things sweet in the city, as they pick up all garbage. It is a crime to injure these useful birds.

I speedily sent my credentials to His Excellency the Governor, Sir Henry Blake, a splendid man, one of the best Governors Jamaica ever had. I was summoned to King's House by telephone almost at once, and from that moment until I left the representative of the Queen showered attention on the representative of Canada. The Exhibition was, considering all things, perhaps the most wonderful thing of the kind ever held. Just fancy, away right under the sun, all the nations of the earth except China represented, and in a place to be reached only by long voyages. The main building was 510 feet long and 81 feet wide, cruciform in shape, with minarets 74 feet high. It was a "thing of beauty." Besides the main building there were dozens of other buildings. Canada could not get half its exhibits in the space allotted in the main building, and had another one entirely for surplus exhibits.

Prince George of Wales, now Prince of Wales, opened the Exhibition. His landing from the "Thrush" was a grand sight. He passed through an avenue of war ships to the landing. The streets were lined with troops, white and native, the latter brave fellows. They fought like tigers in the Ashantee war. Many had medals, and I was told some had the Victoria Cross. After the opening ceremony I left the dais to receive His Royal Highness in the Canadian court. Well do I remember how his face lighted up as he read on our banner: "The Dominion of Canada welcomes the grandson of Britain's Queen." When leaving our court he said "Canada has done nobly." We carried off 94 gold medals, 74 silver, 15 bronze —183 medals in all; 37 honorable mention, 2 honorary diplomas for special services rendered, one being to myself, which adorns the walls of my library. As you know, my mission was to extend trade. I am glad to say in that respect it was a success. To give you an idea of methods adopted, I may tell you that I took out a baker with me, and had bread baked from Canadian flour, giving it to the visitors daily. Thus it was that our flour found its way to all the West Indian Islands, and better flour than that made from Manitoba No. 1 hard wheat they never had. One day it was understood that Scotch scones were to be baked and distributed to the crowds. The baker had forgotten my instructions, and only baked a few for Lady Blake, the wife of the Governor. I heard a lady with a Scotch tongue say to a friend: "There's nae scones the day." I at once said to her, and put on the Scotch as I spoke: "I see you are disappointed, but you shall not be; I will divide with you what was to go to King's House." The scones were handed to her. How her face lighted up as she said: "I've no tasted a scone since I left Glasgow." So you see the Scotch are there, as they are everywhere. There were 35 energetic young fellows who went out from Canada to represent various exhibits, and they did a good business.

While it is very hot in the middle of the day, there is always a good breeze morning and evening. Care should be taken to avoid draughts at night; if not prudent in this respect one is apt to get a chill, then fever follows. I say it is hot during the day, yet I have seen the officers of the regiment stationed at Kingston playing hockey at 2 o'clock.

After I felt that the Canadian court was in full swing I visited various parts of the island, speaking on Canada. My first trip for that purpose was to Brownstown, on the north side of the island. Let me endeavor to picture the journey to you, even though my description will be far from conveying all that my vision feasted upon. I took the train early one morning from Kingston to Ewarton. I had heard a great deal of the grandeur of the country, of the magic scenic effects, and the ever-changing character of the views, but all I heard was as nothing to what presented itself to my astonished vision. What scenes met the eye as we ascended Mount Diabola. At every twist and turn as the road wound its way up the mountain were sights which will be unfading as long as life lasts. As I speak to you I am in fancy enjoying that drive. After we had ascended some 1,500 feet, there were for miles and miles at our feet as far as the eye could reach, away in the valleys bounded by distant mountains, groves of cocoanuts, graceful palms, bamboos bending to the breeze, great banana leaves, and around the mountain side rare and marvellous creeping plants, hugging the trees from the roots upward.

> "O'er it all a soft and purple mist
> Hung like a vaporous amethyst."

We passed huts made of bamboo, thatched with broad tropical leaves; people clustered about them, from the little picanninies to the wrinkled grandmothers, all looking happy and contented. Here was this panorama before us, not to be surpassed in the world, of everlasting hills in the distance, with the sun and shade presenting one of the most magnificent sights that man could conceive. One became weary in speech and silent in admiration, as new scenes greeted the vision at every turn. Everywhere, as we drove along, we found God's messengers of love—stars in earth's firmament, flowers of every kind and of the most gorgeous hues. They seemed to enjoy the very air they breathed, as much as we did who delighted in their loveliness. In this land of cloudless skies, this land of eternal summer, were plants regarded almost as weeds there which would be treasured in Canadian greenhouses. Passing on we see coffee trees, pimento bread fruit, custard apple, figs, oranges; and I might go on and fill a page detailing the plants and trees which came within our reach of vision. It was a pretty heavy pull up this grand mountain, and our horses gave indication that the load was too heavy. I felt that I must set an example, in the interest of Prevention of Cruelty to Animals, so I jumped from the carriage. The others followed suit, and we made our way to the summit of the mountain on foot. We were somewhat thirsty when we got to the top, and our intelligent dusky driver seemed to anticipate our wishes. He climbed a cocoanut tree, knocked down some green cocoanuts, chopped off their heads with a machette, and we drank the cool, refreshing water of the nut. Every man in Jamaica owns a machette; he uses it for almost everything.

As we commenced our descent to the Carribbean Sea, we came upon a scene which no pen of writer or brush of painter has ever or can ever describe or portray. It is called the "Fern Valley." It has never been photographed, because it is impossible to do so. Three and one-half miles long, precipitous rocks on either side, and these covered with ferns to the very summit, creeping plants and flowers, with only here and there bits of the rock projecting, giving you an idea of its formation. There were great caverns with entrances festooned with tangles of vines and flowers. The drive down this wonderful place was cool, calm and inspiring. It was like a glimpse of heaven. The variety of scenic effects appear to be endless. Sometimes the rocks so nearly met over our heads that they formed a thick roof, and one had to look straight up to see the light, then the gully becomes more open and filled with the most fantastic shadows. The road was one of continual graceful curves, and the skill of some of the best engineers had been enlisted in its construction ; but I saw a sight distressing to any Canadian ideas—women breaking stones for road purposes. The day will speedily come when the women in Jamaica will find work consistent with their position and sex. At a meeting a day or two after I witnessed this sight, at which I addressed fully 1,000 people, I denounced this, and was cheered to the echo.

On we go, singing as we rolled along in the carriage till we reached Ocho Rios, the town of eight streams, snugly cuddled together on the seashore. The broad expanse of sea was not hidden, but beautified by groves of cocoanut trees. When Roaring River burst upon our vision it was in some places tumbling, rushing, roaring and tearing along ; in other places sparkling and gurgling like a Scotch burn or graceful brook quietly flowing to the sea—a picture of restfulness, after its racing and chasing down the mountain side. As we drove along to St. Anne's Bay in the evening the air was laden with the most delicate odours, the perfume of a thousand flowers being brought out with the falling dew. As Lady Blake one day said to me, the island was "the Garden of Eden without the serpent." There is not a snake to be seen in Jamaica.

We started off in the morning to Brownstown, and oh, what a drive was that. The morning was cool and breezy ; the sea to the right of us washed the golden sands, and the everlasting hills to the left were covered with verdure to the very top. Cabins of the natives away up the hillside, creeping flowering plants adding beauty to the logwood hedges, mingled with orange. There were the graceful tops of the cocoanut trees waving in the morning breeze, as far as the eye could reach, the invigorating breeze filling one's lungs and making boys of us all, causing us to burst into song. It was enough to make a dumb man speak, to say nothing of making us sing. As we drove along we saluted the natives, and in return received the graceful curtsey of the women and the respectful recognition of the men. Here and there we saw piles of limes on the roadside ready to be carted to market, carts filled with oranges ; we met vans with tires on the wheels very many inches broad, laden with coffee and sugar, some of them drawn by as many as sixteen oxen. The cattle feed on guinea grass. This grass grows all over, and is a great blessing. I came upon the ruins of an old sugar estate, everything showing great age. As I gazed upon this relic of the past, and thought of what some people called "the grand old days of slavery," when there were men who estimated glory and grandeur by the gold which they heaped up under the curse and cruelty of slavery, as a Briton I felt proud that that day had passed, and that the pure and stainless flag of our country now floated in Jamaica over a free people—free from the shackles of the slave and enjoying the blessings of schools and colleges -and humble though many of them were, yet having "Temples of God o'er all the pleasant land," the people all happy, loyal and contented, feeling that wherever our flag floats the subject is protected, no matter what may be the colour of his skin or the shrine at which he bends the knee.

> "It flutters o'er tropical seas,
> As free as the wind and the wave,
> And bondsmen whose fetters unloosened,
> 'Neath its shadows no longer a slave."

The slaves were emancipated in 1834. £6,000,000 was paid as a compensation to the planters. Over 300,000 slaves were liberated.

On we go, and reach Run-away Bay. It is said that it was near this spot that Columbus landed in 1495. Our road wound up through the mountains. We saw a group of young girls resting on the roadside, and hearing that the natives were fond of singing, I asked them to sing something. At once they responded, and sang "Far, far away, in heathen darkness dwelling," and one or two more well known hymns. We soon reached the lovely home of Rev. and Mrs. Johnston. The Johnstons have done and are still doing a great work among the natives, not only teaching them the lesson of the Cross, but also impressing on them that cleanliness is next to godliness, and that they must keep themselves and their houses clean and pure. In making our return trip to Kingston we took the interior road, passing through the centre of the country. There was in this drive a combination of pastural and tropical scenes. What a spirit of freshness and beauty there was that morning rising with the sun, as we drove along amid perfumed oranges and delicious pineapples. "The dewy morn, with breath all incense and cheek all bloom." It was like an enchanted land. How lovely it was to see the morning dew glistening on the leaves like diamonds, and the mist veiling the distant mountains as if they were modest maidens or mountain queens concealing their beauty. Our road skirted the mountains, the morning breeze blowing odors sweet as violets, every flower and fern, and even the mosses, bejewelled with dew drops. Oh, what a drive that was!

Whenever I had an opportunity and the time to spare, it was a great pleasure to me to take a run out with Canadians who had come over to show them Castleton Gardens, Bog Walk, Gordon-town and any other places of interest and importance. Castleton Gardens rank as second among the tropical gardens of the world. I accepted the invitation of the Director for myself and friends, and visited the wonderful gardens. We pass more ruins of old sugar estates of the ancient days of slavery, now covered with moss and creeping plants. There was a great acqueduct used originally by the sugar company at Constant Spring, and now used to convey water to Kingston. We pass hundreds of women on the road going to market with loaded baskets on their heads; light-hearted, modestly dressed. We visited the Industrial School—the building was formerly a barracks, and the site one of the finest in the world. It was interesting to visit tobacco plantations worked by Cuban refugees, who sought the shelter of the free flag of Britain from the rule of the hated Spaniard. The tobacco raised is used in the manufacture of cigars, and is profitable. The ping-wing hedges, over which flowers of every hue creep, are wonderfully beautiful. We travel over lovely winding roads, parts constructed in the very rocks sheltered in every way from the sun, cool and refreshing, and we involuntarily exclaim: "A great rock in a weary land." I could well fancy how pedestrians long for these shady bits of road. We pass lots of coffee and lime trees, orange groves, until there bursts upon our vision perhaps the grandest sight upon which anyone can gaze. We look down into the valley and up the opposite side, and see graceful bamboos with their feathery-like tops, as if waving their welcome to us.

At length we reach the gates of Castleton Gardens. Men were there ready to carry our hampers, and they were all filled with

Canadian things—Canadian bread, Canadian canned fruit, Canadian everything. There was a cool, shady spot beside the banks of the Wagwater. Here we unpacked our good things, and did ample justice to them. Spaniards used to call this river "Agua Alta," because in the rainy season it rose to a great height. Breakfast being disposed of, we set out for the gardens. These are laid out largely on the hillsides. The walks are beautiful; there was the Royal palm of Cuba, and you could almost fancy it was endowed with reason and knew it was king among trees; there was the Phimax palm, the Sago palm, the Ruttan palm, and others, and wonderful tree ferns. Perhaps the most marvellous of all trees was the Travellers' tree, which, when an incision is made at the base of the stem of the large leaves, pure water flows out. One was tapped and we all had a drink. Some were a little doubtful about trying it, but I first quenched my thirst and then the rest followed. It is not a native of Jamaica, but is a native of Madagascar, and flourishes where water is scarce. One of these large leaves was cut off to show the marvellous provisions of nature. I cannot conceive how any man could examine this leaf and deny the existence of a God. There was the Victoria Regia in the fountain; the wonderful flowering banana; and then, to cap the climax, there was a tree fully 60 feet high, without a branch or stem until the top is reached, and there the umbrella-shaped foliage is to be seen—a lovely mass of scarlet flowers, like a rocket bursting in the sky into balls of red fire, but then the balls of fire are evanescent, while these flowers are forever being renewed as the others fall; lovely orchids under the shade of trees. We saw the fernery, where were 440 different species. On our return it rained. We were protected in our carriages. The natives, who were walking, just had a banana leaf balanced on their heads, and that was their umbrella. As I sat that night on the balcony of my hotel at midnight, waiting to see the Southern Cross, the lines of Mrs. Hemans came forcibly to my mind—

"Is it where the feathery palm trees rise,
And the date grows ripe under sunny skies;
Amidst the green islands in glittering seas,
Where fragrant forests perfume the breeze,
And strange wild birds on their starry wings
Bear the rich hues of all glorious things;
Is it there, sweet mother, that better land?
Not there, not there, my child."

In the tropics the sun's rim dips, the stars rush out; at a stride comes the dark. The sun goes down with a jerk—no gloaming. I sat up until early morning in order that I might have a good view of the Southern Cross, and I had it.

There are many crosses in the heavens in these latitudes known as false crosses, but there is a real Southern Cross, which cannot be mistaken. I do not wonder at the religious sentiment of the Portuguese and Spaniards regarding this constellation with holy reverence as the sign of their faith. It is an interesting theme to travellers. There every morning about one o'clock the Southern Cross is erect; after that it declines. In South America the herdsmen used to say: "It is past midnight, the Southern Cross begins to bend." The stars in the tropics are like moons.

> "It is a land where the hue
> Of sea and heaven is such a blue
> As men dream not of; where the night
> Is irradiate with the light
> Of stars like moons, which, hung on high,
> Breathe and quiver in the sky."

On a dark night the effect on the vision of the fire-flies is something surprising. They are different to ours. They show light in their eyes, ours under their wings; they positively light up things on dark nights, and are called gig lamps; they shoot through the gloom in myriads; they glow like torches. In the old and cruel Spanish days these fire-flies were snared and made into necklaces for the Spanish women to wear at dances, the glitter remaining for hours.

One seldom sees white troops in the city of Kingston; it is considered safer to keep them in the breezy atmosphere among the hills. Newcastle, the principal military station, is 3,800 above the sea. There it is seldom over 60 degrees of heat. Talking of churches in Jamaica, Easter Sunday the number present at morning service in the Parish church at Kingston was at least 2,500, and over 1,000 remained for Communion. It was a grand sight—all hues, all classes kneeling together recognizing a common Father. Half-way Tree church is most interesting. Its walls are covered with tablets, in memory of British heroes who fought and died for British honour. The church was built in 1699. Admiral Benbow's tomb is there, and bears the date of 1702.

Jamaica is as healthy as any tropical country. There is the greatest care taken to insure good health. Each parish has an official doctor ; the last six appointed were from Queen's and McGill Colleges, Canada. When I heard this I felt proud. In the lowlands the temperature rises from 75 at night to 85 in the day, sometimes more. I brought out a great many curios with me—everybody wanted to load me among others the wonderful lace bark from which the most beautiful things are made ; the counterpane on Prince George's bed at King's House is made of this. You may think it strange, the people all walk in the middle of the road in Jamaica. I mean outside of Kingston. The very horses seem to know how to keep out of the way of pedestrians. In the space of two and three quarter miles we counted 764 women going to market with loads on their heads, and 74 laden donkeys. The women are all light-hearted, laughing and talking as with swinging gait they sail along. They travel night and day ; they think nothing of a thirty mile walk, carrying a basket with a load on their heads at that, enough to break any one of our backs. They are a little bit superstitious, and when they come to the bed of a dry river they generally stop until thirty or forty of them get together, and then they start across singing to keep up their courage, knowing that during the rainy season many people are drowned, and they have an idea that duppies or ghosts are fluttering round. As you pass along you see on the pillars of the gates of private residences the names of the places after great heroes of centuries ago, recalling names of men enshrined in British history for deeds of valor. The constabulary of Jamaica are all colored—good-looking fellows, well uniformed. The people are law abiding, with some vices, like others. They are easily led by those who win their confidence, and all are anxious for information. They are extravagant in language. For instance, one day in a tram car, I said to a negro that the climate of Jamaica was delightful. "Yes, sah," was his reply, "all in *consecution* ob de morning and evening breezes." It is great fun to hear some of their sayings. I will give you a few of them :

"Beggar beg from beggar neber get rich."

"Ebery dog know him dinner time."

"Hab money—hab friend."

"Hoss hab no business at cow fight."

"Man can't smoke and whistle at one time."

"No trus' pigeon in corn field."

"Neber trow 'way your stick till you get a top ob de hill."

"Play wid monkey, no play wid him tail."

"Spider and fly can't make bargain."

Often I have heard the people speak of the grand old days of slavery, but grander still and more glorious will be the position of Jamaica, when, awakened, she takes her place with other countries of the world in the march of progress, developing her vast possibilities. She will yet rise again the "Pearl of the Antilles," in greater glory than ever, her history illumined by an industrious and progressive people, free from bondage and enjoying all the blessings and influence of Britain's rule, recognizing the dignity of honest labor, a re-awakened people, ever loyal to the flag which freed the slave, and which is to-day the emblem of hope as well as protection the world over. Jamaica was among the first of Britain's colonies to offer to send a contingent of her sons to Africa to teach the tyrant Boer that he who insults the mother must answer to her sons. Nowhere have I witnessed more devoted loyalty to the British Crown—not even in Canada—than among the people of Jamaica, and their loyalty has had a severe test in their submitting in the past to British free trade policy destroying the sugar industry, but which injustice I hope will soon be remedied. Their love for our late beloved Queen was beyond description; they called her the Supreme Lady of Jamaica. They loved her not alone for her regal graces, but her noble womanhood and her tender-hearted goodness. They felt that love was her law. Never, indeed, was there such a monarch since the day of creation; her throne was an altar and her home a temple of God; death moulded into full completion the statue of her life. While the world was bowed with woe at her death, the records from Jamaica told how the natives and white people mourned as "one that mourneth for his mother." That same loyal devotion which they gave to the mother they render to-day to the son of his mother.

After bidding good-bye to the officials at the Exhibition I called at the Collegiate Institute to present the Principal with the large map of Canada we had in the Exhibition building, for the use of the school. I addressed the scholars, told them about Canada, and wound up by asking for a holiday, which was granted. Most of the leading merchants of Kingston were at the dock to say good-bye, and they followed me on board The gallant captain had the good ship "Alpha" gayly decorated with flags. The last bell rang. "All ashore!" was shouted from the bridge, and soon after the good ship began to move slowly from the dock. We were stormed at by the crowd on the dock with a perfect fusilade of oranges. The blue mountains of Jamaica by degrees receded from our view until they became specks on the horizon, and lovely Jamaica became but a beautiful memory. Leaving kind hearts behind us, we were rolling home to meet loving hearts in Canada: sky above, ocean beneath, trusting in Him "whose arm hath bound the restless wave." Clear and distinct as is the lovely picture of Jamaica on my mind, and charming as everything was to me, yet after all there's no place like home.

To the tourist who may desire to escape our winter months and has the money to spend, I say go to Jamaica between November and April. To the invalid who requires to recuperate, I say under advice go to Jamaica, to some such delightful spots as Mandeville, St. Annes, Brownstown—anywhere among the oranges and the odours of a thousand flowers. But for a land to live in, year in and year out, give me dear old Canada. No doubt about it, for a healthy life and the land for a happy home, there's no place under the blue sky to compare with Canada.

Each country is the complement of the other in articles of produce, and as regards climate, many from the West Indies who can afford it will pay Canada a visit during their summer or hotter months, while Canadians who need it or desire it will take a run to the island of eternal summer during our winter, and each while enjoying their respective trips will do much to strengthen trade relations. But life for life, land for land—all in all—who would change? Not I! Canada for me; the Maple Leaf forever!

Years have passed and gone since I left Jamaica, but its enchanting beauties are continually spreading out before me like a lovely panorama, and seems to me like a mid-summer dream. A word or two more and I have done. I felt as I said good-bye, and grasped the hands of warm-hearted friends, that friendships had been made that would last through life. I can never forget Jamaica and its warm-hearted people ; both will be forever green in my remembrance, and unfading in my memory will be the glorious scenery of this earthly paradise ; its grand mountain peaks pointing heavenwards in silent majesty, its feathery palms, its graceful bamboos, its wonderful gardens, its golden canes, its marvellous foliage, its gorgeous flowers, its spicy breezes, its Southern Cross, its "firmament of living sapphires," its "seas like skies and its skies like seas" And in all these I see a vision of the people of the British West Indies, true and loyal to King and country, grateful for the blessings which they enjoy, will in far greater measure than they have yet done, realize in all its vast significance what it is to be British subjects ; guided by wise counsels, elevated by religion and education, recognizing the dignity of labor, the lethargy of the past will give way to such activity as may be possible in a tropical country, and apart from the teaching of the churches, influenced by those modern missionaries of progress, the locomotive and telegraph, cable communication with other lands, fast steamships, the people of Jamaica will yet take no mean position in the general advancement of the Empire, which to them and to us has bequeathed her spirit and her fame. They will realize more than ever what it is to be subjects of Great Britain, sharers in all the glory of the Empire, heirs to the vast privileges which to Britons belong, and what it is to live under the protecting folds of the stainless Union Jack—the emblem of freedom, protection and power.

The new day dawned upon Jamaica when the wonderful Exhibition, to which I have referred, was opened. There was new life put into the people ; it was a revelation to them, not only showing them through the exhibits the advancement of the world, but it revealed to them what might be brought to pass in the development of the resources of their fertile island by their enterprise and energy. Should Mr. Chamberlain's policy prevail, and with proper provision for the fiscal conditions of each colony it ought to prevail, it will be a grand thing for Jamaica, especially the revival of the sugar industry, which Britain's extreme free trade policy has practically ruined, building up foreign interests in that great staple to the destruction of that industry of our West Indian colonies. Every true Canadian, no matter what his politics may be, ought to desire to see the foreign trade of Canada and of all the colonies of the

Empire grow and extend, especially extend within the Empire, thus strengthening the ties which bind us all to the greatest Empire the world has ever seen.

In the grand movement for the unity of the Empire inaugurated by Mr. Chamberlain, Canada is destined to play a great part. With preferential treatment of our products, Canada's illimitable and fertile prairies would attract settlers as it has never done in the past, and with its enormously increased population ere long fulfil the prediction that Canada will raise grain enough to supply the wants of the Empire, and a long way to feed a hungry world besides.

As Canadians our cry is, "Canada forever!" Britain over all.

> "Britain's myriad voices call,
> Sons be welded, each and all,
> Into one harmonious whole;
> One with Britain heart and soul—
> One life, one flag, one fleet, one throne,
> Britons hold your own."

RADIUM.

Delivered before the Astronomical Section of the Hamilton Scientific Association, February 16th, 1904.

BY J. M. WILLIAMS.

The museum of the public library building was the scene last evening of one of the most interesting lectures ever delivered in Hamilton—a lecture on the wonderful substance, Radium. It was the regular meeting of the Hamilton Astronomical Society, and the lecturer was J. M. Williams, well known in this city as an astronomical enthusiast. In point of interest, the lecture could not be equalled, as just at this time Radium is interesting all the civilized world. It was not a stereotyped lecture—one that was read monotonously from written document—but an address delivered in Mr. Williams' own words and ideas. He went over each thought carefully, repeating the idea twice when he considered that it was hardly understandable, and so lucid was the description, so interesting the subject, that those present departed with a better knowledge of Radium than they could have procured in reading innumerable books on the subject.

Mr. Williams paid a well expressed tribute to Madame Curie and her work, and described it as woman's triumph at the opening of the twentieth century.

The lecturer dwelt some time on Radium's great power of radioactivity, or its powers of inducing heat and light, saying that the rays of a small amount could penetrate through a foot of solid iron. He gave all its peculiar powers of penetration, the scope of its rays. These rays were entirely different from the rays of uranium or barium, inasmuch as they were more powerful and unlimited. He went on to show how the scientists worked step by step in their search for Radium, until success crowned their efforts. In the laboratories, they saw that there were scintillating rays of light in water, in a phosphorescent sea. But these rays, as from no other metals, produced an effect on exposed photographic plates, and the scientists devoted their years of toil and patience in endeavoring to discover the hidden

RADIOGRAPH OF SATURN.

By Dr. Marsh and Mr. J. M. Williams, from drawing made at the telescope (5-in. Wray) by G. Parry Jenkins, F.R.A.S.

source. The other chemicals already experimented with would not transmit radio-activity, but, on the discovery of Radium the rays travelled far and wide, and would stop at nothing. They would penetrate cloth, glass, and the chemicals on a photographic plate, and would not stop there. Radium rays went with ease through substances where uranium shafts failed to penetrate. And in their rooms, the discoverers of Radium found there were three degrees of rays—one that stopped at and would not penetrate paper ; the second that pierced paper and failed to pass a magnet on the other side, and the third and most powerful that pierced both paper and magnet and was strong enough to print on a photographic plate.

In the cure of human ailments, Radium would prove a valuable factor. When physicians and scientists realized the disassociation of the link from the link in the human body, and understood the proper application of the rays of light and heat, the substance could be used.

In a light-proof box a diminutive quantity of Radium intermixed with fifteen grains of other chemicals was passed around the audience. The powder was sealed in a glass tube, and by looking into the box the rays radiating from the chemical could be seen. The powder seemed to be highly phosphorescent, and the two chemicals mixed would hardly fill a thimble. The Radium contained there, little as there was, is the first ever seen in Hamilton, and is the property of J. R. Collins, Toronto. This little tube has been in Paris, New York, Toronto and other places, and when it is remembered that there are only four ounces of Radium in the world, its value can readily be perceived. It is in the temporary possession of Rev. Dr. Marsh and J. M. Williams, and these gentlemen made a few interesting experiments with the rays. They placed an exposed camera in a dark room facing a photo of Saturn, made by Mr. Jenkins, of this city, the only light being that proceeding from the powders contained in the tube. The exposure was of seven hours' duration, and the plate being developed it was found that the radiating light had been sufficient to make a fine impression of the view contained in the original photo. This view, with a few others, including a photo of Madame Curie, were shown by lantern.

At the close of the lecture a hearty vote of thanks, moved by

Adam Brown and seconded by Ald. Findlay, was tendered Mr. Williams. The owner of the tube was also thanked for the loan of it.

Mr. Jenkins, F. R. A. S., made a few remarks, in the course of which he declared that Radium might possibly settle vexed quesions of perpetual motion and the material of which the sun was composed.

The half-tone of Saturn accompanying this article is one of the slides shown at the lecture, being one of the first radiographs produced in Canada, and was made at the observatory of Dr. Marsh, who produced it in this way: He placed a sensitive Illford lantern plate in direct contact with the negative copy of the drawing; these together were put in the camera, and a small tube containing 1 gram of Radium (240 radio-activity), the property of and kindly lent by Mr. J. R. Collins, Toronto. The tube was placed inside the camera in the position of the inner lens of the camera; the bellows was then drawn until the Radium and plate holder were three inches apart; the slide of plate holder was drawn, and the sensitive plate exposed to the Radium light for thirteen hours. On being developed this picture of Saturn was the result. The drawing of the planet is the work of G. Parry Jenkins, F. R. A. S., of Hamilton. Mr. Jenkins drew the planet at the eye-piece of his own telescope in Wales, in 1895. The telescope was a 5-inch Wray. This drawing has been favorably commented on by astronomers of note. The shadow produced by the ball on the rays is especially well defined, which is only possible by the astronomer choosing the proper year in which to observe it. It was worthy of being the object to be first reproduced to demonstrate the power of Radium.

Rev. Dr. Marsh presided, and the attendance was large, standing room being hardly obtainable.

SKYWARD NOTES.

Read before the Astronomical Section of the Hamilton Scientific Association, March 15th, 1904.

BY DR. BEAVIS.

Residence of a year in Colorado has confirmed me in the conviction formed years ago, that this State is one of nature's favorites. With his feet on the earth, a man is conscious that his head is in a different air from anything he has been accustomed to. By day and by night he realizes that he is breathing an element which cannot be found even in the region of the great lakes, nor on the ocean shore, and certainly not in the Mississippi valley.

On the line where Kansas and Colorado meet you stand 3000 feet above the sea ; entering the door of the capitol at Denver your footsteps tread one mile above sea level. Colorado, comprising 104,000 square miles, is half mountain and half plain. Come to think of it, the mountainous half must greatly outmeasure the plains, as so much of it is set up on edge.

The Colorado sky seems to mean one thing out on the plains, and quite another where it is punctuated by the ascending Rockies. The former region is known as the "rain belt," while in the latter (comprising a wide strip of open country) irrigation is resorted to. But the term "rain belt" is rather misleading, for when you are well acquainted with that particular region you will conclude that it is so called because most of the time the people are praying for rain, and the rest of the time they are praying for it to stop. If you look southward for the approach of rain you will be surprised at its absence, but when the clouds are massed in the east you will be wise to seek shelter.

As Colorado, mountain and plain, has the reputation of exaggerated dryness, it is interesting to note the precipitation of moisture. At Wray, away out on the plains, there fell 21 inches in 1899 and 27 inches in 1902 Over at Grand Junction, thirty miles from the Utah line, and famous for fruit culture, the precipitation was 36 inches in 1899 and 32 inches in 1902. In the northwestern section of the mountains the sky released 112 inches of rain in 1899 and 113 inches in 1902. But you are correct in judging that sunshine is the predominant feature of the Colorado sky. Long cloudy spells are rare. Clouds cannot long survive; they must either be precipitated in moisture or be dissipated. At the same time it is to be noted that there is a marked tendency to the recurrence of given conditions for several days at a time. A start in snow or rain seems to develop a positive enthusiasm for moisture. As I write, this entire aerial region has resolved itself into a settled state of liquidation. At the present rate the atmospheric forces will soon have paid all back claims due this portion of the earth. It is in the nature of a rather grim joke to thousands of invalids from various parts of the world who are trying to fathom the moral perverseness of those who informed them that "Colorado is a land of perpetual sunshine." Years ago I was told "There is no winter in Denver nor thereabouts," and one day of the first January of my sojourn in that city the mercury registered 20° below zero at eight o'clock in the morning, at the suburban village of Arvada. It is comparatively easy to cherish a patient and charitable feeling towards an obstreperous opponent, but when one is inveigled by treacherous promises of climatic salubrity into an atmosphere belonging to Manitoba, or to the Pacific Coast in the rainy season, man's spirit becomes hard as he meditates upon suitable punishment for unconscionable prevaricators. This morning's paper contains the following:

First Denver Man: "Whom do you regard as the greatest humorist?"

Second Denver Man: "The man who first spoke of this as the arid region"

But this will soon be past, and Colorado's characteristic sky of indescribable clearness and beauty will cheer the heart, brace the nerves and heal the lungs of many a poor invalid.

In 1899 there were on an average 181 days, or 50 per cent. perfectly clear; 122, or 33 per cent., only partly cloudy; while 62, or 17 per cent., were cloudy. The average number of rainy days was 65, the least number, 40; but the western slope of the mountains enjoyed 113 rainy days. At Denver the average sunshine for the year was 75 per cent. of the possible, or 6 per cent. more than the normal—a rather surprising exhibit to those who take it for granted that the sun never ceases smiling at Denver.

The rarity and dryness of the atmosphere are very favorable to astronomic observation, as distant objects can be so clearly seen. In tracing the path of the comet last autumn, Prof. Howe, of Denver University, was able with a 20-inch telescope to hold the celestial wanderer as long as did Lick University with its 36-inch glass. That surely is a remarkable demonstration of the value of elevated dry atmosphere to the astronomer. And the same thing is to be noted when we compare this area with that of the Atlantic slope. The University of Virginia operates with a 26-inch lens, and it so happened that her astronomer and Denver's were at the same time closely examining the Milky Way. On comparing notes it was discovered that Colorado held the great cluster fully as long as did Virginia.

Another advantage of our aerie dryness lies in the fact that our astronomers see objects lower on the horizon than is possible in a denser atmosphere. But lest you conclude that I am afflicted with the alleged western propensity to exaggerate, and of claiming everything that is out of doors, I hasten to admit a single drawback. And it is our own blessed, boasted mountains that are the discounting element. These giant ranges are veritable storm centers. Around their heads the elements are battling. It is interesting to the ordinary beholder, but to the student of the heavens it is a distracting phenomenon, for atmospheric steadiness is impaired by this warfare, and sometimes observations must be suspended in consequence. This is the thorn amongst the roses, the fly in the ointment; but if Denver will indulge in the luxury of these ramparts of the continent—well, she must pay the cost.

In stating my impressions of the Colorado sky by day, it is obvious that the color must receive attention. "Cerulean blue" is a thoroughly orthodox term, but you will notice that it has a stronger significance out here, whether you gaze into the sky from the depths of the Royal Gorge (awe-inspiring), or contemplate its azure expanse from the apparently boundless plains, meeting the level horizon everywhere. I am at a loss to say which I find more impressive—the standpoint of the mountains (dark, grand, immense), or that of the plains, whose vast stretches of "flats" and "divides," make man seem as insignificant as the beast he drives. The open season lends itself readily to a playful imagination. Travelling through the intoxicating morning air, charmed by the view of animal and vegetable life, you are sure an island stretches before you a few miles away. That sod house, with its adjoining "tree claim," is surely surrounded by water; and off yonder a "bunch" of bronchos are standing in a lake. You lessen the distance and discover the tricks of the fantastic mirage.

The effect of the clouds in ever-changing variety—cumulus, cirrus, or stratified—impresses any observer. Mountains are different things as clouds of varying form and color partially conceal their massive fronts, or rest crown-like on the higher peaks, or form a magnificent background to the range of snow-capped heights.

A sunset is everywhere nature's coronation. From the heart of the Rockies, from the prairies of Illinois and Manitoba, from the romantic channels of Muskoka, from Mount Royal, overlooking the Metropolis of Canada, from Hamilton's beautiful mountain, I have watched the sinking god of day, but nothing can surpass his splendor as he clothes the sky of the great plains with his royal evening robes. Sometimes a huge cloud stands in the heavens,

> "A pillar'd bastion, fringed with fire;"

then the long-drawn strata appear as the stairway to eternity; then he waves aside each vaporous mantle, filling the firmament with indescribable color, as he leads poor, sordid, insensate man in the Doxology, "Great and marvellous are Thy works, Lord God Almighty, in wisdom hast Thou made them all!"

Whittier might well make his "Barefoot Boy" explain:

> "O'er me, like a regal tent,
> Cloudy ribb'd, the sunset bent;
> Purple-curtained, fringed with gold,
> Loop'd with many a wind-swept fold.
> * * * * * *
> I was monarch; pomp and joy
> Waited on the barefoot boy."

You will not likely forget the impression of a drive on the starlit plain, silent and sombre, making you almost question the existence of a busy world. You are alone; no—two prophets, one of the older and one of the later time, share your ride; and one calls out, "The heavens declare the glory of God and the firmament showeth his handiwork," while the other murmurs:

'And when I am stretched beneath the pines,
Where the evening star so holy shines,
I laugh at the love and pride of man,
At the sophist schools and the learned clan;
For what are they all in their high conceit,
When man in the bush with God may meet!"

(Of course you understand him to mean "plain," though he says "bush.")

On one particular night last autumn I was impressed with the practical value of the Milky Way, for it enabled me to keep in my eye a beautiful star in the south, and my journey was successfully made by the aid of that celestial guide. Henry Kirke White sang the praises of the Star of Bethlehem—that was his light, his guide, his all; and I shall always hail first in night's diadem that beauteous, though nameless, orb to me, which held its glittering finger over the nocturnal trail.

If one thing more than another is calculated on such a night to fix one's mind on strictly terrestrial concerns, it is the short, sharp, shrill yelp of the coyote. These rather undersized wolves are a combination of ferocity, cunning and cowardice. And though it is a far cry from stars to coyotes, yet the ranchman of the plains sees an intimate connection between the two, and keeps a sharp watch on his poultry yard and calf lot.

More than once have I been cautioned not to be overtaken by night on the plains unless I could count on a clear sky. Last winter a horizontally driven storm overtook me just before nightfall. Pushing on I reached an old sod cabin, and thought it wise to wait and see what the storm would do. In half an hour there were signs of improvement, and I concluded to strike out again for my objective point, four or five miles further on. I had not made more than a mile when the storm transformed itself into a regular blizzard. Now if you want to feel that business has accumulated on your hands, just make your way in such a storm, sitting first on one side of your buggy and then on the other, to keep the craft from capsizing, and aiding a horse whose percentage of blindness would be expressed by 75 per cent. for one eye and 100 per cent. for the other. The Milky Way, with whom or which I had established such friendly relations in the fall, declined to render any assistance at this juncture; and Miss Luna, whose genial service had more than once saved me from trouble, showed no signs of appearing—in fact seemed very much "put out." I lost my trail in consequence, and, after driving "Old Baldy" point blank against a barb-wire fence (whose points were not at all blank), the situation presented itself thus: either find that back trail to the old sod cabin or pass the night exposed to the storm. Fortunately the missing trail was found, and, after what seemed a whole night of painful effort, most thankfully the shelter was reached, and I finished my journey the next morning—the storm still on.

By day and by night this sky of Colorado is a helper, guide and friend—physically, mentally, and spiritually. Blazing in the noonday sun over the plain, or sparkling in stellar brilliancy above the mountains's crest, it is a boon to the weary invalid and an inspiration to all.

CLOUDS.

Read before the Astronomical Section of the Hamilton Scientific Association, March 15th, 1904.

BY SENECA JONES.

When the Rev. Dr. Marsh asked me to supplement the reading by Rev. Mr. Howitt of Rev. Dr. Beavis' paper on Colorado clouds, by my observations of Northwest clouds, I was taken, to use a familiar political expression, in a moment of weakness, with the idea that I might tell you something interesting of what I observed on one occasion at least, as it was certainly, to me, a very remarkable phenomenon. The moment I began to get my thoughts into shape, however, which I regret was put off till the last moment owing to pressure of other matter, it dawned on me that I could say, in about two and a half minutes, all there was to say of this remarkable appearance, and then, unless I had developed a severe enough cough with which to fill up the balance of my time, I would have to sit down. There is one thing certain, and that is, in looking up the subject of clouds I have found it a very fertile and interesting theme, and well worth all the time which might be devoted to it. It is so extensive, however, that the difficulty is to know how to do anything with it in the few minutes at my disposal.

There is no part of the world, I believe, without clouds, and for the reason that there is no part which is not more or less influenced by the sun. It is a mere truism to say that without the heat of the sun there could be no clouds. We learn that clouds are composed of extremely minute particles of water, called water dust ; that is, the composition more nearly resembles dust than anything else. The interest, therefore, seems to centre in the varied cloud conditions and manifestations which we observe. One time they are very high, another quite low. Sometimes they are dark and dense, other times light and vapory. Abercrombie has divided them into ten principal classes, with numerous sub-divisions, as follows : Cumulus, pure rocky cloud ; Stratus, pure sheet cloud ; Cirrus, pure wispy cloud ; Cirro-Stratus, thin, high, wispy or striated sheet cloud of all sorts; Strato-Cirrus, a similar low cloud; Cirro-Cumulus, fleecy cloud at high level; Cumulo-Cirrus, the same, lower down; Strato-Cumulus, extended, lumpy cloud; Nimbus, low rain cloud; Cumulo-Nimbus, rocky rain cloud. It is said that 90 per cent. of skies in all parts of the world can be sufficiently and accurately defined by these ten divisions. There are many forms of pure, hairy cirrus that indicate fine weather all over the world, while others, such as "Mares' Tails," "Cats' Tails," "Goats' Hair," "Sea Grass" and "Gashes" are forerunners of bad weather in every country.

If I were disposed to worship "other gods" I think the clouds would take me quicker than most other objects. Who has not seen them, especially in our Canadian climate, when they have been simply gorgeous and awe-inspiring in the extreme? If you should wish to describe mountain scenery, how could you illustrate it better than by the clouds, as you see them sometimes. I was once in our Canadian Rockies when the tables were turned, and on retracing my steps towards my hotel I mistook the side of the mountain for a great rain cloud, which I feared would burst upon me before I could reach shelter.

Referring to the cloud conditions which I have observed while in the Northwest, had I ever thought of trying to give others the benefit of my observations I certainly would have been a closer observer. The phenomenon I especially refer to, and which impressed me so deeply, was a cloud which I would classify Cumulus—pure rocky cloud. I think I will never forget the sight and impression which it made on my mind, as I had never seen anything like it before. It was at Yorkton, Assiniboia, at about 4.30 in the morning. We had been on the train all night, trying to get as much rest and sleep as usually falls to the lot of those who are obliged to make the best of a very ordinary passenger car four to five hours late. On reaching Yorkton I roused myself, and looking out of the car window everything had such a weird and ominous appearance as to really terrify me. I gathered up my traps as quickly as I could and got out of the car, my first thought being the safest place for shelter, for I felt that the worst storm and cyclone I had ever heard of might easily come out of that dreadful cloud bank. I ran as rapidly as I could with my grips to a brick hotel building across the street, which I thought would be the safest place, and there I waited the breaking of the storm. I soon observed that the residents did not seem specially alarmed, and that the terrible cloud remained almost stationary, and the wind, while becoming pretty fresh, did not seem particularly violent. The cloud appeared to be only about three or four hundred feet distant to the northwest, and seemed to extend from the ground upward, at an angle of about 85 to 90 degrees, to a mile or more in height. It appeared absolutely dense and solid with folds, shaded from a kind of dirty white to darker, interspersed with quite black streaks running perpendicular. I stood around for about half an hour, and all the outcome was a light shower of rain in very large drops, and by nine o'clock the sun was shining and the cloud had nearly disappeared.

Speaking generally of clouds in the Northwest, I would designate them as of the Strato-Cumulus class—extended, lumpy, or what we term thunder clouds. They are often very attractive from the standpoint of the admirer of the grand and wonderful in Nature, but to the farmer who is looking forward to reaping an abundant harvest of No. 1 hard these sights are less attractive, and more likely to bring visions of being "hailed out," and consequently heavy loss. I have never witnessed a sky free of clouds in the Northwest, but I understand they are clearer after the weather turns cold in the fall.

NEBULÆ AND STAR CLUSTERS.

Delivered before the Astronomical Section of the Hamilton Scientific Association, March 29th, 1904.

BY G. PARRY JENKINS.

On March 29th our members were delighted with an address on the above subject by Mr. G. Parry Jenkins.

The speaker gave in popular language a description of the best known Nebulæ and most familiar clusters from his personal observations with the various telescopes he had employed at different times; while the numerous experiments he made, at the close, by burning various chemicals, helped materially to explain how the composition of both Nebulæ and Star Clusters was revealed by "reading the light" from the Spectroscope.

He said the word Nebula was derived from the Latin and signified a little cloud, on which account all the misty patches of light we come across in the sky are appropriately termed Nebulæ. In our hemisphere a few Nebulæ could be detected without optical aid. One was the great Nebula in Orion, of which several magnificent drawings and photographs were exhibited. Another was that in Andromeda, and was illustrated by Dr. Isaac Roberts' famous photograph, taken December 29th, 1888. Through the courtesy of the late Professor Pritchard, of Oxford, Mr. Jenkins was privileged to see this photograph a few days after it was taken, and the Professor expressed the opinion that no amount of time during which a normal eye could endure to gaze on a field in a 15-inch mirror, would disclose all the traces of feeble lights brought into easy view on photographs taken by the aid of such an instrument. The explanation lay in the fact that the impressions made on a photographic plate were cumulative, while those on the retina of the eye were only transient. It was thus possible to actually photograph the invisible.

It had been proved that the Nebula surrounding the trapezium of Orion was composed of glowing gas, probably containing the raw material of a new world. It was a remarkable fact, that long before the famous Nebular Hypothesis was framed by LaPlace, the immortal Milton had anticipated it in a passage from Paradise Lost, which runs: "Sphered in a radiant cloud, for yet the Sun was not." Astronomy taught that worlds as well as individuals have a birth, mature and decay.

The wonderful Spiral Nebula in Canes Venatici, as drawn by Lord Ross, was exhibited and compared with recent photographs from the Lick Observatory.

In speaking of the Ring Nebula in Lyra, Mr. Jenkins said he had lately seen it to great advantage through the President's fine 5-inch telescope.

The different orders of Nebulæ—gaseous, stellar, planetary, ring formed, elliptical and spiral, were all touched upon by the speaker.

With regard to Star Clusters, it was shown that a fundamental difference existed between them and Nebulæ proper. Many of the so called Nebulæ are resolved into stars by instruments of sufficient power, but the true Nebulæ have defied every effort at their resolvability, and the Spectroscope showed that the Nebulæ which could not be separated into stars, as in the ordinary clusters, were not collections of stars at all, but masses of glowing gases. Examples of various clusters in Hercules, Capricornus, Aquarius, Libra and other constellations, were exhibited.

The cluster in Hercules was one of the finest in the whole heavens, and was discovered by Halle, in 1714, who says of it: "This is but a little patch, but it shows itself to the naked eye when the sky is serene and the moon absent." Messier was quite sure it did not contain a single star, but Professor Pickering, of Harvard, had succeeded in photographing this cluster, so that the stars of which it is composed can be easily numbered.

In conclusion a graphic description of some of the latest results of Spectrum Analysis was given relating to Nebulæ and Star Clusters.

THE EARTH AND ITS MOVEMENTS.

Read before the Astronomical Section of the Hamilton Scientific Association, April 12th, 1904.

BY REV. FATHER BRADY.

The subject naturally involves the different changes and evolutions of the earth, said the lecturer, but beware of false theories of evolution, such as Darwinism, where man's noblest ancestry would be the monkey, or which asked man to sit in dreamland until the oceans would merge forth into immense drinking fountains of lemonade. Beware of that more dangerous evolution which would exclude all creative and preservative power. "Science," says Lord Kelvin, "does not merely assert that there is a creative power, but that it is a miracle in itself."

The earth, our planet, has gone through ages of evolution, and is still progressing; but we all believe it to be an integral part of this vast universe created by God.

The lecturer then described the earth and its component parts; its position in the solar system, and its double movements around the sun in twelve months, and on its own axis every twenty-four hours. Attention was called to the fact that both those movements, as well as the movements of all planets, were from west to east. The rapidity and regularity with which we are carried through the heavens, riding on our favorite planet, is surprising.

The earth is round, said the lecturer, notwithstanding the many articles appearing just now in our newspapers in favor of the flat earth theory.

Then followed many proofs, elementary and scientific. The gradual disappearing of a ship at sea, as though it were sinking; the declining of the north star towards the horizon as we travel towards the equator; a journey around the world, which becomes shorter when made a greater distance from the equator, were all proofs of the sphericity of the earth. Seeing is believing, and the eclipse of the moon showed the shadow of the earth as being that of a globe. This proof, and that of Foucault's pendulum, were shown and explained by lantern slides.

A few interesting remarks were made regarding the relations between the earth and the moon, in size, gravitation, etc. The longitudinal and latitudinal lines and degrees were explained.

The lecture was brought to an end by a few words in favor of the astronomer's day and time-piece, which were not divided into two parts of twelve hours each, but formed one continuous day of twenty-four hours.

THE PLANET VENUS.

Read before the Astronomical Section of the Hamilton Scientific Association, April 26th, 1904.

BY J. J. EVEL.

You will remember that on a former occasion our President explained to you the difficulty he at times experienced in finding speakers and subjects for our meetings, and the method he adopted to induce certain gentlemen to read a paper on some astronomical subject. In my case, one of the arguments he used was that the date would be set about three months hence, and although I cannot say that distance lent enchantment in this case, yet, considering his readiness at all times to assist the members of this Society by the use of his instruments and works on astronomy, I found there was no way out of the difficulty, and against my better judgment consented to be responsible for this evening, and this must be my apology for appearing before you to discuss a subject requiring a more thorough knowledge than I claim to possess.

Most men feel the awkwardness of the situation when called upon at some little social event to respond on behalf of the ladies. Judge, then, of my feelings when it dawned on me that the subject assigned was nothing less than the Goddess of Love herself, and while I am free to confess that the pursuit of information in respect of this beautiful subject has been enjoyable and beneficial, for this reason: to form an acquaintance with Venus one has often to rise early on a winter morning, and then receive a cold reception for the pains;

> "For morning rises stormy and pale,
> No sun, but a wanish light,"—

yet, if one perseveres, he will be favored with her presence, when he may study the different phases of her character. When she beams upon you in all her loveliness, introduces you to her glorious mysteries, you will understand why ancient and modern poet and sage alike sang of her beauty. You catch the spirit of him who wrote

> "For a breeze of morning moves,
> And the planet of love is on high,
> Beginning to fade in the light that she loves,
> On a bed of Daffodil sky,
> To fade in the light of the sun she loves,
> To fade in his light and die."

Before we enter upon a proper consideration of the planet Venus, let us, for the benefit of beginners, try to get a clear understanding of our view point—the Earth. Two planets revolve between us and the Sun; the first is Mercury, the second is Venus. The first revolves at the mean distance of 36 millions of miles from the Sun, the second at 67 millions, and the Earth at 93 millions. Then outside and beyond our orbit we have Mars, 139 millions of miles; then a belt of minor planets beginning with Flora, 201 millions, and ending with Hygeia, 288 millions; then Jupiter with his five moons, 477 millions; Saturn with his nine moons, 871 millions; Uranus with four moons, 1752 millions, and Neptune with one moon, 2743 millions of miles. Besides these we have a number of known and unknown comets, thousands of meteors and shooting stars. This constitutes our solar system, which is totally distinct and separate, to the finite mind, from what is known as the stellar universe, the nearest star of which is "A Centauri," 25 billions of miles. Prof. Alfred Russell Wallace, in his latest book on astronomy, says truly that few of us have any visual idea of what a million miles mean, and tells us that if a wall 100 feet long and 20 feet wide was covered with paper and was ruled into 1/4 inch squares, and every alternate square was covered with a black spot 1/4 of an inch round, we could then see one million spots. Extend each spot a mile in length, place them end to end, join them together, and we would have a million miles in length. Multiply this length twenty-six times, and we have twenty-six million miles—the mean distance from the earth to Venus. Revolving around the Sun in 225 days, so flooded with his light that she needs no satellite such as the more distant planets have, yet shining with a brilliancy at times to cast a shadow upon the earth. Piercing the azure of the sky when the sun is above the horizon and shines in full daylight, peerless among the starry host, she is without comparison the most magnificent star in the sky.

To those who consult their almanacs the movements of Venus are well known, but most people discover the planet while admiring a beautiful sunset. Venus has not been thought of for months until she is seen just above the horizon. For week after week she rises higher and brighter in the western sky, until she attains to full brilliancy. After weeks of brilliancy the height of Venus at sunset lessens, its brightness diminishes, and it sinks again below the horizon to become once more a morning star. When Venus is at its greatest brilliancy it is between forty and sixty times more brilliant than any other object in the stellar sky, and yet at the time of its greatest brilliancy we see actually less of the planet than at other times. To the ordinary observer at such times it seems hard to believe that Venus is a dark body like the earth, and is only reflecting the light of the Sun. In her course around the Sun she presents to us all the phases of the Moon.

When Venus occupies the region of its orbit behind the Sun, with reference to us, this is called the point of her superior conjunction; it is then at its greatest distance from the earth, and comes almost imperceptibly towards us till it reaches its quadrature, then it is at its mean distance; here it presents the aspect of a half-moon. It attains its most brilliant light at the epoch when it shines at a distance of thirty-nine degrees from the Sun, and shows the third phase sixty-nine days before its inferior conjunction. Finally when it reaches the region of its orbit nearest the earth it shows us nothing more than an exceedingly thin crescent. Since it is then between us and the Sun, and presents to us its dark hemisphere, sometimes it passes directly between us and the Sun and appears a little larger, about 63 to 64 seconds of arc, but it is then an absolutely black disc, and is no longer, ordinarly speaking, a star. The phases of Venus were first seen by Galileo towards the end of 1610, and the discovery of these phases overthrew one of the first objections which were raised against the system of Copernicus. Venus is frequently visible in full daylight in astronomical instruments, even at the moment of its superior conjunction. It is then round and quite small.

It has been noticed by those who make a close study of Venus, that the interior of her crescent is less dark than the background of the sky, called the ashy light, though Venus has no satellite to produce it. It is supposed to arise from clouds on the planet, which hide its disc and perhaps the stellar light scattered through space. The eye instinctively continues the crescent shape, and imagines rather than sees its completion. The revolution of Venus is performed in an orbit almost exactly circular, in a period of 224 days, 16 hours, eight seconds.

As to the days of Venus, a great divergency of opinion exists. Camille Flammarion and Elard Gore, Cassini, Bianchini, Schroter and a host of others maintain that it turns on its axis in 23 days, some minutes, and it was supposed to be definitely determined in 1841, at Rome, by Devico, and fixed at 23 hours, 21 minutes, 22 seconds, but Schiaparelli, of Milan, turned his attention to this planet in 1877 and noticed a dark shade and two dark spots, all situated not far from the southern end of the crescent. He watched for 3 months and found there was no change perceptible in the position they occupy. This showed that Venus could not rotate in 23 hours, nor in any other short period. Week after week the spots remained unaltered until Schiaparelli felt convinced that his observation could only be reconciled with a revolution between 6 and 9 months. He naturally concluded that the period was 225 days, that is to say, the time which Venus takes to complete one revolution of the Sun. In other words, Venus always presents one face to the Sun. This has been confirmed by Mr. Lowell, who has published a number of drawings of Venus made by his twenty-four inch refractor. He finds that the rotation is performed in the same time as the orbital revolution, the axis of rotation being perpendicular to the plane of its orbit.

Man is a social being, and the question is Venus inhabited and if so what are its people? has engaged the minds of many able writers. The discussion of this subject alone would require more time than is at our disposal. It is admitted by all that Venus has an atmosphere twice as dense as ours, that her light and heat is twice as great as we receive from the Sun, and while some maintain that owing to her axial revolution the conditions are inimical to life, others are equally certain that under those conditions Venus would constitute an ideal abode.

When the light of the planet is examined by the Spectroscope we find the lines of the solar spectrum, and this is natural since the planet has no light of its own and merely reflects the light of the sun, but we also find several absorbtion lines similar to those which the terrestrial atmosphere gives, and particularly those of cloud and water vapor. The observations of Huggins, Secchi, Respighi and Vogel are in agreement. At the transit of Venus in 1874, Tacchini, stationed at Bengal, examined with care the solar spectrum at the point occupied by Venus, and also inferred the existence of an atmosphere probably the same as ours. 2500 miles from there, at the Island of St. Paul, and in Eygpt, the missionaries of France and England made a very different but confirmatory observation, at the ingress and egress of the disc of Venus on the Sun. The half of Venus outside the Sun was seen outlined by a faint arc of light, which was nothing else but the illuminated Venusian atmosphere.

Mr. Lyman followed Venus day by day at the epoch of inferior conjunction, and saw its crescent elongated until the two points ended by passing all round the dark disc and meeting, so that the planet showed in the telescope the aspect of a complete ring. This lead Mr. Lyman to complete the data, and he shows most conclusively the atmosphere on Venus to be twice as dense as our own. This dense vapor of water and these clouds appear very well adapted to temper the heat of the Sun and to give to this globe a mean temperature, but little different from that which characterises our own abode.

Attentive observation of the indentation of the surface of Venus shows it to be quite as uneven as that of the earth, and even more so. There are the Andes, Cordelleres, Alps and Pyrenees Mountains, and the most elevated summits attain the height of twenty-seven miles. It has even been ascertained that the northern hemisphere is more mountainous than the southern. Even the geography of Venus has been studied, but is extremely difficult, as the hours of pure atmosphere and possible observations are very rare. This will be understood, if we reflect, that it is exactly when Venus arrives nearest to us that she is least visible, its illuminated hemisphere being always turned towards the Sun. It is its dark hemisphere which is presented to us. The nearer it approaches us the narrower the crescent becomes. Add to this its vivid light and its cloud, and we can imagine the difficulty that astronomers have in dealing with it, but by observing it in daylight, to avoid the glare, and not waiting till the crescent becomes too thin by choosing the quadratures and making use of great atmospherical purity such as we find in Italy, observers succeed from time to time in perceiving greyish spots which may indicate the place of its seas.

This paper would be wanting in completeness without some reference to what is known as the transit of Venus. This cannot be described as a very attractive sight, or a spectacle challenging the attention of ordinary people, because it has taken place for thousands of years without astronomers even suspecting it. It is not a sight such as a comet, for instance, nor even as an ordinary shooting star, yet scientifically of the greatest importance, because it helps enquiring minds to solve one of the greatest problems that has ever engaged the mind of man. By the transit of Venus, astronomers determine the scale upon which the solar system is constructed. We have mentioned before, in the early part of the evening, the bodies composing our solar system. We may know the relative distance of the planets from the Sun, their size, etc. Difficulty arises as to the actual size of the system, as well as the shape. Flammarion says we may draw a map of Europe or America, outline its continent with rivers and mountains, or we may get an architect to draw the plan of a building ; we may see the position of the doors and windows, the shape of the roof and the position of the chimneys, but we know nothing of its size without a scale, showing us how much the scale is to the foot. Having the scale, the plan is intelligible and conveys to our mind the exact idea of the extent and proportion of the building. So astronomers need a scale to tell how many millions of miles on the heavens correspond to an inch of scale on the map. It is at this point that great difficulty has been encountered, and while there are several ways of settling the difficult problem, one of the best is that presented by the transit of Venus across the Sun's disc. Herein lies the importance of this rare event—rare because that while the transits of Venus occur in pairs of eight years between each transit, yet, after a pair of transits, one hundred years elapse before another transit, followed by another in eight years. A transit took place in 1761 and again in 1769 ; in 1874 and 1882. Then a long period, for another transit will not occur until 2004, followed by another in 2012. Why is this? How can astronomers tell to such a nicety? This is a question frequently asked, and one is of the opinion that if more pains were taken at our meetings to insure our members an acquaintance with some of the simple methods of ascertaining sizes of planets, distances and time measurements, the recurrences of eclipses and the appearance of comets, much needed information would be scattered abroad, much good would be accomplished, and one would not be called upon to give a reason in this day for believing in the theory of the earth's rotundity. I will try to make clear the reason for the recurrence of transit in pairs. The periodic time of Venus bears a remarkable relation to the periodic time of the earth. Venus accomplishes thirteen revolutions around the Sun in the same time that the earth requires for eight revolutions. If, therefore, Venus and the Earth were in line with the Sun in 1874, then, in eight years' time, the Earth having made eight revolutions, and Venus thirteen, a transit having occurred on the first occasion, a transit must occur in the second.

Now we said that transits occur in pairs at an interval of eight years. This is only approximately true, that thirteen revolutions of Venus are coincident with eight revolutions of the earth. Each recurrence of conjunction takes place at a slightly different position of the planets, so that when the two planets came together in 1890, or eight years after 1882, the point of conjunction was so far removed from the critical point, that the line from the earth to Venus did not intersect the Sun, and thus, although Venus passed very near the Sun, no transit occurred. Although many transits must have taken place hundreds of years before the year 1631, it was only in that year that attention began to be directed to the matter. The attention and success of Gassendi in observing the transit of Mercury, lead him to believe that he would be equally fortunate in observing the transit of Venus, which Keppler had foretold. Gassendi looked at the sun on the 4th, 5th and 6th of December, but saw no signs of Venus. We know now the reason the transit took place between the 6th and 7th, during the night, and must therefore have been invisible to European observers. Kepler had not noticed that another transit would occur in 1639. This discovery was made by a young astronomer named Horrocks, and it is the one which the history of the subject may be said to commence, as it was the first occurrence on which the phenomenon was ever actually witnessed, and then only by himself and a friend named Crabtree. Horrocks was a clergyman and had made calculation, and watched with great care, assisted with very poor instruments, and nothing of the data to guide him that we have at the present day. Add to this the fact that the transit was timed to occur on Sunday, when he had other important duties to perform, we can imagine, and only our President fully understands the perturbation of mind of this young enthusiast, divided between the delivery of a sermon and the expectation of seeing such an important sight as the first known transit of Venus. His name is handed down to us through his fidelity to science and as an astronomer. But for this fact his name would likely have been forgotten. Is it too much to say that his zeal in the cause of science carries with it an assurance of his faithfulness in his profession as a clergyman? Those of us who desire to learn how the transit of Venus will tell the distance from the Sun must prepare to encounter a geometrical problem of no little complexity. But we will try and explain the conception which is known to astronomers by the name of parallax, for it is by parallax that the distance of the Sun, or indeed any other celestial body must be determined. A simple illustration will enable us to understand. If we hold a pencil in front of us and look at a background, close one eye and note the position of the pencil on the screen or background, then close that eye and open the other eye, we will notice a difference in the position of the pencil on the background. Now our friends at the back of this room will see a different displacement to those nearest the front of the room, and so we can thus associate with each particular distance a corresponding particular displacement. Thus we have the means of calculating the distance from the observer to the screen. It is this principle applied on a gigantic scale which enables us to measure the distance of the heavenly bodies. Let Venus correspond to the pencil, let the Sun correspond to the object on the screen. Instead of the two eyes of the observer, we place two observatories in two distant parts of the earth; we measure the displacement of the observers and from that calculate the distance of the planet. All depends then upon the means we have of measuring the displacement as seen from the two stations, and the scale of the solar system is known. It was to ascertain this that the first of the celebrated voyages of Captain Cook was undertaken to Otaheite.

It may be asked what is the use of all the expense of time and money to ascertain the facts regarding Venus. What does it matter whether the Sun is 93 millions or 95 millions of miles from the Sun? Mariners tell us that a yard of room is of the utmost importance on a stormy night, and so many a gallant crew and many a splendid ship may be saved by the compliment of information which Venus is able to add to our nautical almanac. And if for no other reason, is it not far better for us to be in pursuit of information such as is to be found in nature and science?

To illustrate this lecture Mr. Evel used a set of slides which he presented to the Astronomical Section of the Society.

WHERE THE EARTH FIRST CRUSTED; WHERE MAN FIRST LIVED.

Read before the Astronomical Section of the Hamilton Scientific Association, May 27th, 1904.

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

It is thought by some that this is purely a religious problem, others that it is purely scientific; but looking at the subject carefully, as I have been doing for some years back, I have no difficulty in concluding that it requires the united efforts of theology, philosophy and science in all their varied branches. You will see at a glance that I have two problems to deal with: 1st, Where the earth first crusted; 2nd, Where man first lived, or, in other words, the location of the Garden of Eden.

Now, in dealing with the first, I shall have to confine myself chiefly to scientific facts, and enter perhaps somewhat into general geogony, that is, the science of the origin of the earth.

I wish to say nothing for or against the so-called Nebular Hypothesis of the origin of the world, as the friends and foes of this unproven hypothesis believe in what is termed the secular cooling or refrigeration of the earth, which is sufficient for my purpose, although, let me say, that I have no sympathy for the six-day creation theory as held by some, that is, that the earth was created in six literal days. That the earth was millions of years in reaching the conditions of habitability I think is without doubt, although I see by the Mail and Empire of May 23rd an account of Professor McDonald, Professor of Physics at McGill University, in a lecture before the Royal Institute, submitted the striking suggestion that the earth's heat was not attributable to the theory of a molten mass which has been slowly cooling for millions of years, but to the presence of Radium.

I think that it is premature for us to lay any particular stress upon the suggestion that the earth's heat is due to Radium, and for the present, at least, I hold to the old orthodox theory as has just been stated. He who considers the Bible a scientific text book knows but very little about either the Bible or science. The sacred volume opens with, "In the beginning God created," etc. Nothing can exceed the grandeur of this declaration, and no words are more suitable to express the creative fiat.

How far back these words "in the beginning" go no man can tell, and as to the creation days, certainly those were periods whose length is beyond our finding out. All authors hold that the time was when the earth was too hot to allow the existence of any form of life, and that by the process of cooling it has reached the present condition and temperature adapted to the necessities of living creatures and things.

The question comes: On what portion of this planet's surface would the proper conditions and temperature first be reached suitable to sustain life? Would such conditions be reached all over the earth's surface at the same time, or would there be one place more favorable than another for this cooling process? If so, what are those favorable conditions, and where is that place?

The heat of the Sun in early geological ages could not have been less than at the present time, and no doubt, as you likely are all aware, geologists and astronomers claim it to have been greater then than now. However, it matters not materially, for as soon as the earth's atmosphere became penetrable by the sun's rays, local differences of temperature must have been produced at the base of that atmosphere whether the body beneath that atmosphere was crusted or not.

That fiery, molten mass doubtless would have orbital as well as axial motion. These motions would cause sphericity of form and create equator and poles and thus, then as now, granting, if necessary, equal interior heat, and equal interior radition, the equator would receive more exterior or solar heat than the poles, and for the following reasons:

1. Owing to the more rapid motion at the equator of this great molten ball, whilst molten to the poles, the heat would by centrifugal gravitation be less at the poles and more intense at the equator.

2. The present axes doubtless correspond to the original axes, thus by their inclination to the sun the North Polar regions, receiving the sun's rays obliquely, would cool first.

3. As the earth at present, with its solid crust, is not a true sphere, but flattened a little at the poles, such, more or less, must have been its shape while it was still molten ; thus the rays of the sun fell more obliquely at the poles then as now, thus receiving less heat from the sun than at the equator.

The most advanced opinion of scientific men is, that from the reasons given the earth first crusted at the poles. I think I can produce convincing evidence that man first began life at the North Pole ; that I can establish the fact that the Garden of Eden was situated at the North Pole, and that Captain Bernier, in his effort to reach that spot, struggles only to reach the old homestead. Whilst accepting the scripture statement in reference to the ejection from the garden, yet man, by the cold, was driven from his most northern home and was compelled to flee before the ice monster. Driven by necessity, he did what no other amimal has done—clothed himself, made a fire, not only to warm himself, but to cook his food and to offer sacrifice to his God.

Perhaps in dealing with this subject I ought to begin first of all with the theological side of the statement, and I may say that theologians, both Christian and Jewish, have in all ages differed as to the cradle of the human race. The early Church, and also that of the middle ages, held many conflicting and curious opinions on this subject. Some say that Eden was not a place at all, but a state only ; that the four rivers spoken of in Genesis were not rivers, but four cardinal virtues. Others, however, held the historical character of the narrative, but it matters not to us ; the earth is here, and man is here, and as the earth was not always habitable, man could not always have lived upon it, hence a time for the habitability and a time for man to come upon it. The time was when some part of it was sufficiently cool, as it has, I think, been shown that it was not all equally cool at the same time. The first cool portion was evidently at the North Pole, and the place where man first lived, I think, can be shown was there. Let an ordinary reader of the Bible, unbiased, read the second chapter of Genesis, 8th verse—"And the Lord God planted a garden eastward in Eden, and there he put the man whom he had formed." Scarcely can such a reader doubt that this places the garden to the east of Palestine. But let the reader look carefully and he will see that the verse does not affirm anything as to the direction. It may mean that the garden was in the eastern part of the land, and many theologians hold this view ; but let us not forget that the word Miqquedem, here translated eastward, is frequently translated "in the beginning." It is only the Septuagint translates Miqquedem "in the east," or eastward. Other Greek versions and Jerome, Vulgate, the Chaldee paraphrase, and the Syriak render it "from the beginning," so that the verse with this rendering of the word Miqquedem reads : "And the Lord God in the beginning planted a garden in Eden, and there he put the man whom he had formed." But our enquirer reads verses 10 to 14—"And a river went out to Eden to water the garden, and from thence it was parted and became four heads. The name of the first is Pison, the name of the second river is Gihon, the name of the third is Hiddekel, and the fourth river Euphrates." Our reader has difficulty with all these rivers but the last one, and here he thinks that all is plain. Consulting theologians, however, he finds difficulty with even this fourth. Some one expresses a doubt about the genuineness of the verse. Another considers it an interpolation. At last he finds that the word Perath or Phrath, that is the Hebrew name for a river, is from the older form Buratti or Puratti, a word signifying "the broad" or "the deep," and, of course, such a term was used to describe other ancient rivers. Moreover, I think it can be clearly shown that in ancient times Phrat or Eu Frata, Euphrates, was the name of possibly two rivers in Persia ; one of these even in Pliny's time bore the name in the hardly changed form Ophradus. Many of the best Biblical scholars do not hesitate to consider the Phrath of the khorda-avesta identical with the Persian River Helmend. Africa also had its sacred broad Phrath or Euphrath, Euphrates ; therefore if this passage in Genesis is genuine, and if Moses wrote of the Phrath, it is not absolutely certain what Phrath or abounding river he had in his mind. Moreover, in any case the Euphrates of Mesopatamia is not one of the four off-shoots into which the one river proceeded out of Eden, dividing itself according to the statement of the text. Its source is from mountain springs, not from another river, hence then the Euphrates of Mesopatamia could not have been one of the rivers from Adam's home. I think we should be reminded here of the language of Josephus, according to which the Ganges, Tigris, the Euphrates and the Nile are all parts of one river which ran about the whole world, and he wonders whether the old shemetic term from which the modern Euphrates is derived was not originally a name for the general water system of the world before the flood, a name for that river which Aristotle describes as rising in the upper heavens, that river of which Homer speaks as feeding all fountains—as feeding every sea, and in like manner in mythology the term Euphrates was applied to the circling river—" the rope of the world ; the heavenly river which surrounds the world." Thus the reader discovers that it would not do to take the term Phrath or Eufrata as always and everywhere referring to the historic river of Mesopotamia.

Thus, then, I hold that God planted a garden in the beginning where he placed man. That garden was at the North Pole, and from that place ran out the waters of the world, the Eufrata, the broad, the deep, the supply of the rivers, the supply of the fountains of which Aristotle and Homer wrote.

The plural origin of man is a doctrine now superceded. The polygeny of the human race has no respectable support. The common descent of all races from a common stock is accepted virtually by all schools of reputation. If, therefore, this be the case, there must be some primeval point of departure for the race. The North Pole is the place of departure, as it was the natural watershed of the world. I think I am correct in stating that philologists, mythologists, anthropologists and archeologists of late years are strongly inclined to place the cradle of the human race within the Arctic circle. One of the most recent writers of note on this subject says : "The three fundamental types of all races can be traced to the Northlands, the negro races being the furthest removed in location." Another says : "No other region on the face of the globe presents similar reunion of extreme types of the human race distributed around a common centre as these northern regions." "One of the weightiest arguments," says a certain writer, "is drawn from philology. The three fundamental forms of human language are found in the same region and in analogous connection."

To our first parents, at the North Pole there would be but one day and one night during the whole year. The sun, the moon, planets and stars, instead of seeming to rise and set, would have an apparent horizontal motion, round and round, the pole directly over their heads. This would seem to them the fixed and the unmovable, hence the changeless seat of the Supreme Being. Every departure of a few miles in any direction from this polar position would impress man that his home was the centre of the whole world, and that God had placed him as monarch of all he surveyed, and that his God reigned supreme above him. Moreover, the stream already referred to, the Eufrata, flowing at his feet, being obviously fed not from any visible source, but from the sky in rainfall, would impress him with the idea that this broad Eufrata was part of a celestial stream flowing from his Maker's side, and there flowing in all directions, dividing the circumpolar lands into four quarters, would constitute a never-forgetting feature of that first home, and this would be and is no other than the broad or Eufrata, the rope of the world, flowing in four rivers out of Eden ; Eden rivers, methinks that this is the proper interpretation of the sacred Scripture. The north land, the home of the sun, combined with the nocturnal splendors of the aurora borealis, the whole top of the dome or the seat of the Eternal over-canopied with quivering curtains and banners of living, leaping flame, the equitable tropical temperature—all combining to make a home of beauty and joy—no wonder man could well have had a stature, strength and longevity never attained since the deluge. It is singular indeed that in this enlightened age such gross ignorance exists regarding those northern regions. Only recently my boy brought home from school some questions on astronomy which he was expected to answer. One of these questions was : "What portion of the earth north of the equator was there six months of day and six months of night?" The answer expected was : "At the North Pole." I may say that no such conditions exist at the North Pole. The most recent, and perhaps the best authorities, give the following table *re* the divisions of darkness and light in those far north latitudes :

30 days dark, except starlight.
30 days of moonlight.
105 days twilight and dawn.
200 days sunlight—continual sunlight.

I would like had I time to describe those divisions of darkness and light, but only a word, and in the words of another : "The moon obscured the stars seem to hang out like lanterns, and the aurora so beautiful that no poet can describe." "For 30 days the moon walks amid the hosts of the sky in majestic grandeur." Those 105 days of dawn and twilight are beautiful beyond the artist's power to portray. Here, indeed, is the true city of the sun. Here is the only spot on earth respecting which it would seem as if the Creator had said as of his own heavenly abode, "There shall be no night there."

Physiographical geography strongly supports the theory of a North Polar Eden. Prof. Wallace says: "The rich and varied Funa inhabited Europe at the dawn of the Tertiary period, as shown by abundant remains of Mammalia wherever suitable deposits of Eocene age have been discovered, proves that an extensive Polearctic continent then existed." Prof. Hur, of Zuric, states in one of his works: "The Arctic fossils plainly point to the existence in Meocene time of a no longer existing Polar continent, it being submerged, and that evidence is abundant that this now submerged continent was the abode of primative man and all forms of primeval life." The Arctic explorer, Baron Nordenskjold, speaks as follows of the territory north of 69 degrees north latitude: "That an extensive continent occupied this portion of the globe, but now submerged."

To say that a circumpolar Arctic continent existed, now submerged, is not merely assumption, but is supported by the best authority. In fact, it is known very well that within a comparatively recent geological period a wide stretch of Arctic land, of which Nova Zembla and Spitzbergen formed a part, is now submerged.

As to the forces which brought about this physical change it is not for me to discuss in this paper, as it would involve the question of the deluge, which cannot within the limits of this paper be gone into. I might, however, say in a word that as the earth's crust thickened at the equator the poles flattened, allowing the water to flow over. This pressure of water still flattened the earth at the poles, hence a submerged continent. Will this continent reappear? It may to some extent. As the earth's crust thickens the water penetrates deeper, hence less surface water, and the poles may yet, to some extent, protrude. Then tidal retardation might also be considered. This would lessen the size of the earth at the equator, deepening the water at the equator and causing the Poles to reappear. However, it is not necessary to discuss this now. I think it is clear that physical geography teaches us that the islands of the Arctic Ocean, with Nova Zembla and Sanjos and Spitzbergen, are mountain tops of a sunken continent, and this continent produces strong evidence of the early forms of life, which we will see more as we deal with the climate of prehistoric times relative to the north land home.

Leading scientific authorities agree that at one time the regions within the Arctic Circle enjoyed a tropical climate.

Prof. Nicholson says: "In the early Tertiary period the climate of the northern hemisphere, as shown by the Eocene animals and plants, had a much hotter climate than at present, and that these conditions extended to the Arctic Circle."

Mr. Grant Allen says: "One thing at least is certain, that until recently, geologically speaking, our earth enjoyed a much warmer climate even to the Poles, and that its vegetation was much of the same type as that which prevails in the modern tropics."

Nadullac, in alluding to distant ages, says that life freely abounded at the North Pole.

Prof. Croll says: "The Arctic regions even to the Pole was free from ice, and covered with luxuriant vegetation."

Dr. Koerl holds that the Pole was originally warmer than our equator is now, and tropical foliage abounded, and probably even reached to the Pole itself. He says: "In the Mesozoic ages the predominance of reptile life, and the general character of the fossil types of that great class of vertebrata, indicate a warm climate and an absence of frost between the 40 parallel of latitude and the North Pole."

The best authorities in Paleontological Botany, both in Europe and America, have reached the conclusion that all the floral types and forms revealed in the oldest fossils of the earth originated in the region of the North Pole, and thence spread first over the northern and then over the southern hemisphere, proceeding from north to south.

To give a chronological history in proof of the above statement would take too much time. Let me just mention their names: Prof Asa Gray, of America; Prof. Oswald Heer, of Switzerland; Sir Joseph Hooker, of England; Otto Kunbze, of Germany; Count de Saporta, of France, and many others whose names should be added.

Sir Joseph Hooker's studies of the floral types of Tasmania has gone far to establish the trans-latitude doctrine. Oswald Heer, of Zuric, in his Fossil Flora of the Arctic Regions, modestly affirms that in the northern region all the floral types of the more southern latitudes were originally in a great continuous Miocene continent within the Arctic Circle, and that from this centre they migrated southward. I ask you to note that the migration is from north to south, and not *vice versa*—never from south to north.

In Geikie Text Book of Geology, p. 874, we read :

"We have now only to notice the singular want of reciprocity in the migrations of northern and southern types of vegetation. In return for the vast number of European plants which have reached Australia, not one single Australian plant has ever entered any part of the North Temperate Zone, and the same may be said of the typical southern vegetation in general."

Also, Sir Joseph Hooker affirms, geographically speaking : "There is no Antartic flora, except a few lichens and seaweeds : all have come from the north."

If we circle our globe in any latitude from west to east or east to west we find, as we pass from land to land, we encounter animals specifically unlike. Everywhere we find, along with like climate and telluric conditions, different animals. As soon, however, as we reach the Arctic zone, and there make our circuit, we everywhere meet the same species ; or, on the other hand, if we take circles of latitude and pass from the Arctic region southward, we find in the abundant fossil evidences that we are moving from the seat of earlier life—leaving home ; that we are following the footprints of prehistoric migration of animal or plant life, and if we return from the south northward we find the reverse, that we are advancing counter to their movements.

From the above facts there seems but one conclusion, that the Arctic Pole is the mother region of all plants and animals, and, if so, certainly the region where in the beginning God created every beast of the earth and cattle after its kind, and where God placed the man whom He had formed.

As with other branches of science, so anthropology points to the North Pole as the cradle of the human race. Dr. Winchelles tells in "Preadamites" his belief that the Garden of Eden, the first abode of man, is to be sought in the now submerged continent situated at the North Pole.

Count Saporta says we are inclined to remove to the circum-polar regions of the north, the probable cradle of primeval humanity, and he says that this theory best agrees with the data to hand. Prof. F. Muller, also Dr. Moritz Wagner, both eminent anthropologists, place the cradle of the human family in the Polar regions.

Prof. William F. Warren, of the Boston University, also Mr. G. Hilton Scribner, of New York, men with much learning and ability, have no hesitation in stating plainly that in their opinion the evidence is conclusive that the earth first cooled at the Poles, and that there life to plants, animals and man first began.

Were we to turn to mythology and classics, much evidence could be produced in favor of the Polar region being the first abode of mankind.

I have shown that those parts which received the least heat from the sun, and under centrifugal influence cooled first, were at the North Pole. I have brought an array of scientific fact to support and confirm the assumption, the force of which must be apparent. I have, moreover, shown that the creation story in Genesis, when properly interpreted, points to the North Pole as the place where was situated the Garden of Eden, and I have confirmed the same by astronomical geography, physical geology, prehistoric, climatology, paleontological botany, paleontological zoology and anthropology. I have shown that these all point to the Pole as the place from whence came the earliest life to plants, animals and man.

Man began life on earth in that paradise at the gravitating centre of the earth; being driven from thence he wandered homeless with weary feet, finding, like the dove, no rest or shelter. He by the eye of faith seeks that heavenly paradise looking to Christ, that magnetic gravitating centre of both earth and heaven, who said: "And I, if I be lifted up, will draw all men unto Me."

THE SPHERICITY OF THE EARTH.

Abstract of Paper read before the Astronomical Section of the Hamilton Scientific Association, April 12th, 1904.

BY REV. DR. MARSH.

This lecture was illustrated by means of an equatorial telescope, transit instrument, compass, spheres, various drawings and lantern plate illustrations, which cannot here be represented. Below, however, are twelve of the principal arguments for believing that our Earth is a sphere.

1. The Sun is a sphere—so are the planets Mercury, Venus, Mars, Jupiter, Saturn, Uranus and Neptune. The earth is of the same family, governed by similar laws and conditions. Why should it be otherwise than a sphere?

2. The shadow of the earth on the moon during an eclipse is circular.

3. The horizon to an observer is circular, which would not be if the Earth were other than a sphere.

4. The Earth has been circumscribed in various directions.

5. Stars appear to rise and set, except the north and south Polar Stars. These appear to describe a circle.

6. The Earth's crust at the Equator passes stars 1000 + miles per hour; at longitude 60 degrees north or south of the Equator, but 500 miles per hour.

7. Lines of longitude diverge till the Equator is reached, then converge till the Poles are reached. A degree at the Equator east or west is about 69 miles; at Hamilton a degree east or west is a little over 50 miles.

8. The Sun is rising every moment of time on our Earth, because it is round. Were the earth flat the Sun would rise at the same moment all over its surface.

9. Perpendicular lines are not parallel. Two perpendicular lines may form an angle of 45 degrees, or an angle of any size, or two perpendicular lines may make one straight line, because of the sphericity of the earth.

10. In digging canals an increase depth of 8 inches to the mile is required to maintain uniform depth.

11. Surveyors in laying out large tracts of territory have "excess measurement" to deal with, because of the earth's sphericity.

12. The angles at the intersection of parallel and longitudinal lines are not right angles, because the earth is a sphere.

REV. D. B. MARSH PH. B., SC. D.,
PRESIDENT HAMILTON ASTRONOMICAL SOCIETY, AND VICE-PRESIDENT
HAMILTON SCIENTIFIC ASSOCIATION.

ABERDEEN OBSERVATORY, HAMILTON.

BY G. PARRY JENKINS.

To those members of ours and friends who have not yet availed themselves of the invitation so kindly extended by the President to visit his Observatory, with the object of seeing for themselves the various instruments in use, and, if the clouds permitted, of a peep at the stars through a good telescope, it has been felt by the officials that some account of the Observatory, and the nature of the work carried on therein, would be of interest and profit. The task of supplying a short narrative for insertion in our Annual Proceedings has fallen to my lot, and having spent many a pleasant evening under the revolving roof of Dr. Marsh's Observatory while the building was in construction and afterwards, space alone forbids a more extended account of the instruments and their doings.

In erecting the Observatory due regard was taken of a suitable location, with the absence of any impediment to a commanding view of the heavens, and this is well provided for on the outskirts of our city in Aberdeen avenue, from which the Observatory appropriately derives its name.

The building itself is a modification of the Berthon model, so well known to readers of the English Mechanic and the Intellectual Observer, and from which so many private observatories to house telescopes up to 66 inches aperture have been made. It is constructed of wood, and is circular in form, with a dome which is easily operated so as to allow access through a shutter to any part of the sky at the will of the observer.

Much ingenuity and mechanical ability has been bestowed upon its construction, all of which is practically the handiwork of its owner. As the performance of the best glass is easily marred by the slightest tremor of an insecure foundation—because the telescope magnifies all imperfections in proportion to the powers it bears—the greatest pains has been taken to have the groundwork of thick concrete, so that the iron pillar which carries the instrument rests on a solid base. The result of this, combined with the optical qualities of the object glass, is good definition, when climatic conditions are favorable, as I can testify from many repeated observations.

Attached to the Observatory proper is a very handy Transit Room, to which reference will be made later, and also a Laboratory, containing chemicals of assortment, two lathes, and many necessary appliances in the construction of scientific instruments.

The principal telescope in the Observatory is a Refractor of 5 inches aperture and 82 inches focal length, the object glass and tube of which were manufactured by Prof. J. A. Brashear, of Alleghany, Pa., an optician of world-wide reputation and of whose work it would be superfluous to add any praise. All the fittings to the instrument were made by Dr. Marsh. It is mounted equatorially and driven by clockwork to counteract the motion of the earth, which enables a star to be examined for an indefinite period in apparently a fixed position in the sky. The telescope has a battery of eight eyepieces ranging from 50 to 550 powers. In addition to the above it is fitted with a Brashear micrometer, star and solar prisms, a photographic attachment, together with a spectroscope (also by Brashear) with rotary grating and two eyepieces of 150 and 200 powers, for viewing the solar prominences. Lastly, but by no means least, the telescope is fitted with double hour and declination circles of 6 inches diameter, graduated to read seconds of arc, and made on the premises. It is only those who know the luxury of using this device, by which the instrument can be turned to an object, although invisible to the unaided eye, that can appreciate the time and labor saved in the course of working with a telescope equatorially mounted.

I feel I am justified if I go out of my way here just to give an instance of the truth of the old saying, ' Necessity is the mother of invention," and of comparing the happy position of our President with another astronomer in a humble sphere of life whom I knew, and had the honor of writing an account of his work in the transactions of the Astronomical Society of Wales ten years ago. Like Dr. Marsh, he felt the need of graduated circles with his home-made telescope, but, alas, he was poor and could not afford to buy the orthodox, costly article of brass ; so he constructed them himself out of slate ! Surely the first of their kind and last in existence. They read to minutes of arc, and are now preserved in the museum of Bangor city. But with finer tools, and consummate skill for an

INTERIOR VIEW OF THE BUILDING, SHOWING THE FIVE-INCH BRASHEAR TELESCOPE.

EXTERIOR VIEW OF THE OBSERVATORY.

THE CRESCENT MOON: PHOTOGRAPHED BY DR. MARSH WITH THE FIVE-INCH TELESCOPE AND COLOR SCREEN.
(THE TELESCOPE REVERSES THE ACTUAL IMAGE.)

amateur, the President of the Hamilton Astronomical Society has made his of brass, and they read to seconds. It thus happens that when it is required to see a first magnitude star, or a planet in broad daylight, he has only to find the position as recorded by the Nautical Almanac for his longitude, adjust his circles accordingly, and the object desired is in the field of view of his refractor, located in full sunshine to a second of time on the great dial-plate of the sky.

In the Transit Room is a Transit instrument of 2-inch aperture, by Troughton, which is firmly fixed on a concrete pillar reaching five feet into the ground. All determinations of time, which, by the way, form an important part of the work carried on in Aberdeen Observatory, are made with this instrument, and it has been verified from Toronto Observatory and other important astronomical centres that Dr. Marsh can obtain the time from both Solar and Stellar observations to a fraction of a second.

As photography has of recent years played such an important part in astronomical matters, it is interesting to note that some very good photographs of the moon have been secured with the 5 inch Telescope of the Observatory, as the accompanying photograph will bear out. Those who have had any experience of celestial photography will know the difficulty of taking photographs with a Refractor, as in this kind of instrument the visual and actinic foci are different. It thus follows that a suitable adjustment has to be made in the focus of the telescope before taking a negative. To overcome this difficulty a color screen has recently been utilized to exclude the out-of-focus blue light, which would destroy the sharpness of the photograph and allow only the sharp yellow or visual image to reach the sensitive plate. Dr. Marsh experimented independently in this field of research, and he is probably one of the first in Canada who has succeeded in producing photographs of the celestial bodies by this method.

General observations of the Sun, Moon, planets and fixed stars are constantly made at the Observatory, the results of which are from time to time laid before the Society, and the enthusiasm which our President throws into all the work he undertakes acts as an incentive to further study and research on the part of all the members who come in touch with him.

NATURAL HISTORY, METEOROLOGICAL AND GEOLOGICAL NOTES FROM BURFORD TOWNSHIP.

BY WM. YATES, HATCHLEY.

Feb. 14, 1904.—The present winter is proving an exceptionally severe one, with long continued blizzards, my thermometer indicating 14° below zero at 8 a. m. Let us hope that the Arctic cold will soon be exhausted. Some Chicadees come almost every day near to our house, and even in the coldest winds sing at times their pensive Phoebee note. My son found a half-dead muskrat two days ago burrowing through frozen snow drifts, seemingly on its way to our farm. On the same day the dog captured a stoat apparently after our poultry, while a pretty red squirrel got caught and killed in a rat-trap in our barn the day before yesterday. I observe that the Chicadees, and occasionally two Pine Grosbeaks, harbor in a hollow apple tree in my orchard. The Snow-buntings have not been seen much since the recent deep snow falls and drifts have covered the Solidago and other tall weeds.

We think spring will be doubly enjoyable after such a prolonged and unintermitting cold period. The small streams are now frozen nearly solid, and some of the local ice harvesters say it will be impossible to cut and gather the usual supply. The more far-sighted got in stores of it in December. The frost is also very deep in the ground, but if all goes well that fact is esteemed a favorable augury for maple syrup making operations.

March 7, 1904.—Winter seems now drawing towards its end. Rain and fog here to-day, with the thermometer at 42°. My son reports having seen ten or twelve Shore Larks on the highway near here a few days ago. In a piece of woodland about 2½ miles from here, in the midst of an extensive cedar swamp, my son tells me that Chickadees are numerous and familiar near to the wood-cutters' lunching spot. The dense evergreen growth gives warmth, food and security from many enemies to some hardy species of forest birds and rodent animals. When the trees fall there is debris and beetle larvæ, and pupa and hibernating insect imago disinterred, and the birds know that crushing sounds of falling trees means to them food supply. Last week his companion chopper noticed a big white Owl perched on a tree being mobbed by from twenty to thirty noisy Crows swooping near the Owl, who merely turned its big head from side to side as if to keep a weather eye on its tormentors.

March 22, 1904.—The much longed for spring-time seems looming up at last. The thermometer shows 50° this morning, and the Robins are proportionately "chirrupy." They were noticed here about two weeks ago. One frosty morning about ten of them in a party of pioneer adventurers appeared around our dwelling. I think they must have been very tired of "Dixie Land" to come here to an inhospitable snow-covered region, to explore fresh horizons of snow. The Song Sparrow was heard singing blithely on the 17th inst. What an amazing effect on the animal creation has a rise of a few degrees in the aerial temperature. It is now 49° at 2 p. m., March 22nd. The big Hawks are screaming and wheeling in their upper air flights. They, like the bees and wasps, pair aloft, and are seen to tumble to earth with talons clinched, male and female. In spite of this the Snow-buntings were said to be about several of our fields yesterday and to-day. My son assures me that the date of his first hearing the Blue-birds this year was the 10th of March. O hers who are much in the woods daily corroborate this fact for 1904.

There is much evidence that wild birds have strong local attachments. One of my friends has just been telling me the story of a Robin that had lost one leg by some misadventure returning in several successive spring seasons to a certain clump of verdurous grape vines in his garden for the purpose of nesting and rearing a number of families of young Robins.

Another instance of local affection or attachment was observed by the writer, and may be narrated as follows: A few summers ago a peculiar unfamiliar bird warble was heard to proceed from a small tree growing among other shrubs on the margin of a clover meadow. Curiosity impelled me to attempt to discover what new species of musician had sprung into notice, and an approach to the strange bird sufficiently near to ascertain its species was accomplished, and the adventurer was seen to be an ordinary Bob-o-link, with a damaged vocal apparatus, probably resultant from some accidental physical injury. Many of the well-remembered Bob-o-link quavers were poured forth, but the medley in toto was unmusical, and an unharmonious jangle. To our surprise the same bird (or what we logically believed to be the same) returned to the same field the year following, and showed a decided "penchant" for its first noted song perch, on the upper branch of the identical tree where its "bizarre" vocal effusions first rivetted our attention, and was repeated still another year.

A pair of Wrens nested and reared Wren families eight or ten summers in succession on a small shelf put up for bird conveniences under the projecting roof over the gable peak of an outbuilding. The good fortune of the birds came to an end eventually through the marauding propensities of a cat, who accomplished what had been supposed impossible—inserting a fore paw into the auger hole entrance to the Wren habitation, and so tearing out a large part of the nest material. Whether the ornithic occupants of the nidus escaped or not we were unable to determine. Anyhow, the site as a bird breeding convenience was never afterwards utilized. Although English Sparrows tried to enlarge the auger hole entrance by perseveringly nibbling the same with their strong pincer-like beaks, they ultimately gave up the attempt in seeming despair.

The Swifts evince the same propensity to occupy year after year the same inaccessible point on the boarding on the gable inside of a barn as long as unmolested, but if misfortune overtakes the enterprise a new locality is selected and the unlucky lodgement studiously given the go by, and there seems an evident power of communicating a dislike and abhorrence of a scene of bird tragedy to all of their kith and kin to contemporaries, if not to succeeding generations.

Some purple Finches occupied for quite a number of years as an annual nest site some clustered branches of a tall, solitary spruce tree, growing near to the door of our dwelling. At length, in an evil hour, perhaps, a pair of Grackles were allowed to nest and breed lower down on the same tree, and these aggressive interlopers soon piratically raided the nest home of the red Finches, who paid a final good bye to the home of their childhood.

One of the writer's friends is at considerable trouble to evict breeding-disposed Grackles from the shelter of his home grove of conifers, averring that the dusky thieves live on the callow young that they plunderously remove from adjoining nests of Robins and Thrushes to feed their own omnivorous crow-like young ones.

A similar affection for the scenes and surroundings of their earlier experiences, and comings on or dawning of consciousness, is to be observed in the families of the Ruffed Grouse, who are seen to stay in the same wooded valley or limited park-like area for at least the first season of their existence, unless driven away by malevolent enemies. And the notorious fact of these Grouse using the same "drumming log" or prostrate tree at breeding time for successive generations, is so familiar to foresters as to render comment superfluous. The catamounts, foxes, racoons and porcupines were well known to affect the same sheltering conveniences in caves or big hollow trees for winter dwelling places year after year, and a rather remarkable rendezvous, where a number of partly upturned large cedar trees served to over roof a big knowl in the heart of an extensive cedar swamp near here (this refers to a date fifty or more years ago), was known and referred to by the human forest frequenters as the "Wolf's Ancient Den," and with every sign of appropriateness.

April 25, 1904.—We are now experiencing a more genial temperature. There was some thunder heard here about 11.30 a. m., and several showers of rain.

The syrup making is now about over, as the maple buds are enlarging.

The first Swallows were seen here on Saturday, the 23rd inst., and again yesterday. The Robins have been seen at work nest-building for several days past.

The pastures are assuming a greener hue.

I happened to find a few Hepaticas in full blossom in our woods on the 22nd inst., and I believe they had opened the evening previous.

It is hardly probable that any spring seeding will be done in April this year, as the ground is wet now and frost not entirely out near to fences.

I am informed that there has been great mortality among bees during the past winter. My nearest neighbor had sixteen colonies last fall, and he tells me now that he has only six hives with living bees. He is an experienced apiarist. Others report that they have lost every colony.

I love to hear the song of the Meadow Lark *(Alanda Magna)*, who are all around our pastures now. Their song is brief, but melodious, and though not very varied, the notes are rich in tone, and have a decided resemblance (regarded separately) to those of the Skylark, and I can perceive but a very slight affinity in these birds to the European Starling, which some say exists.

The Grass Finches are now melodious. There are two or three species. The Red-wing Grackles are now much in evidence in the swales where *Typha latifolia* grows.

In an extensive timbered swamp about two and a-half miles from here Crane Clans are numerous. I was observing a day or two ago, in the presence of a young man (a well-known local gunner), that dozens of Crane nests could now be seen amid the leafless branches of the big trees, when the youth added : " It would be more correct if you averred that there are hundreds of Crane nests in that cedar swamp ; they are like wicker-work, and as big as a bushel basket." Where these birds nest is a perfect solitude and quite undrained. The Cranes could be seen during the snow and frigid spell of eight days ago cowering and wretched looking in their dreary last year's nests right down to the 19th, with a frosty gale blowing, and no visible open water. Yet the Vesper Sparrows came out about the hour of sunset from under their temporary shelter of the bottom rail of old fences, and sung falteringly a few blithesome notes.

The date of the Swallows' spring arrival here is with but little variation from the 24th April, and the Wrens almost invariably appear here, about their familiar nest houses put up for them on high posts, during the last three days of April.

The Orioles and Bob-o-links and *Rubicella Musicapa* now-a-days come a week or more earlier than in the former days ; to these may be added the yellow Orchard Warbler.

For some thirty years past I have been rather puzzled with a shrub very much resembling *Pyrus arbutifolia* of the botanies. It grows in bogs in rather dense patches, or did years ago. It is pretty when in blossom, and always reminds one of the hedge hawthorn of England, but has plum-like leaves. In " Floral Life " for last November it is called *Symplocos evataegioiors.* About an acre of this shrub formerly grew in a secluded bog near here, but it is now nearly exterminated. I used to believe it was a spirea or else *Crataegus prunifolia.* The berries are bluish black, and insipid sweetish, and about the size of a hawthorn berry, and have two pits.

Many years ago *Lonicera hirsuta* was found near here in great abundance, but that shrub, too, is nearly exterminated. In Wood's Manual of American Botany the plant is named *L. hirsuta var. Goldianum*, as the father of Mr. James Goldie, of Guelph, was said to have been the first to bring the shrub to the notice of plant classifiers.

The faculty of the honey bee for the construction of hextagonal cells seems to have existed in antediluvian ages, for among the drift fragments turned up by the plow in the soil of our fields fragments of well-preserved fossils of the *Favosites Niagarensis* are quite frequently met with and spoken of locally as petrified honeycomb. In Nicholson's "Palaeontology of Ontario" they are referred to the Guelph rock formation as follows: "The hexagon cells in the fossil of unknown aeons past are identical in size and form with the wax cells of the hive bee of the present day, and there seems to be no perceptible difference in geometrical design with the comb cells of our common wasps and hornets." A recent writer in one of our bee journals thus speaks of the hexagon: "Put a soap bubble on a plate, and surround it with six other bubbles; the equal tension of the meeting films will make the central bubble a hexagon, just as the thin wax with the bees working in it and pressing against each other makes it a hexagon. O, the marvellous geometry of the honey bee and also of the foam flecks on troubled waters!"

The writer above alluded to goes on by saying: "It is as certain as anything can be, that at one time the bee was simply male and female, but somehow they came to see the advantage of communal effect."

The queen of a bee-hive does not rule; she lays eggs, and a very prolific queen has the power to lay two or three thousand eggs in a day twice her own weight. She possesses the power, too, of choosing which of her offspring shall be drones (or males) and which shall be workers. Some have thought that this was automatic, but the queen will lay worker eggs in drone cells if she thinks fit; so that settles that. The worker in a hive is really the "new woman" of beedom, and she has given up her motherhood for a business career; sometimes, though, she lays eggs, but they always hatch out drones, of whom it is strictly true to say they have a mother, but no father, for if the queen's wings are crippled so that she cannot make her marriage flight her children are all drones.

An Italian queen bee in a hive of black bees will produce workers of mixed blood, but her sons are pure Italians.

Once when going a journey on the railway passing through a piece of bush pasture land near here, one of our relatives noticed a swarm of wasps clustering about the head and neck of a fine heifer that seemed to have aroused the wrath of the insects by inadvertantly rubbing against a decayed hollow stump in which the wasps' nest was situate. The bovine had evidently been goaded by the stings of the enraged wasp swarm to a state of temporary insanity, but the rapidly moving train afforded no opportunity of ascertaining what the denouement might be.

On a somewhat similar occasion, whilst we were driving to the harvest field with a span of horses and wagon, one of the horses in stepping near to a stump happened to disturb some humbles bees which evidently had a nest just underground in the vicinity of the stump. Several of the bees buzzed angrily around the horse's head and breast, and a few more bees seemed in a hurry to join in the fracas, and we were apprehensive of a runaway and smashup of our wagon; but such a misfortune was probably prevented by the nonchalent or unexcitable temper of our equine team, and the animal first assailed vetoed the danger by promptly stamping a number of times in quick succession with his expansive hoofs of one of his forelegs on the hole in the ground whence the venemous flies were emerging from the honey stores! The underground occupants of the citadel must have had an experience similar to what might have been produced by the descent of an aerolite on their habitation.

Men engaged in the work of mowing were sometimes unexpectedly assailed by hornets whose nests, perhaps attached to the forks of some tall weed growing among the meadow grass, had been levelled by the operation of the scythe. One of our neighbors, in one of these escapades a few years ago, to avoid being stung by the buzzing swarm that sorrounded his features, fell to the ground, and trying to protect himself by rolling about and half burying himself among the swathes of new-mown grass, calling excitedly to his son, who stood convulsed with laughter (at what he afterwards styled "the old man's harlequin antics)," "Come, drive him off, Jim"—the prostrated one vigorously whisking a bunch of grass about his ears—"Drive him off, or he'll jab me! he'll jab me!" then speedily, with loud emphasis, "He *has* jabbed me!" followed by sensational retaliatory flourishes of the hay wisps.

Accidents have been known to occur, caused in a similar way to the above, and also when the horse hay rake was being used, that unfortunately did not end as farcially as the above narrated. One of our neighbors, when engaged plowing during the month of August, seven or eight years ago, was subject to so much annoyance from colonies of humble bees that had nested in different parts of the field, stinging his plow horses to such an extent as to render them unmanageable, that his only recourse was to search carefully over the field, spade in hand, and with fire and weapons drive off or put to death the aggressive hymenoptera tribe.

Once as we were wending our way homeward about the gloaming time, after a day's work in clearing off fallen timber on an acre of fresh cut down timber land, we chanced to pick up a piece of a broken branch, on the under side of which a very large humble bee had apparently taken up its quarters for the night. The bee was probably a queen of the species indicated, and perhaps in an ill-tempered mood for lack of courteous attendants or wooers: however, the untimely and rude interruption to the quietus must have created an instantaneous resentful purpose. The bee arose and flew with great force and directness towards our face, and planted an exquisitely painful sting on our forehead, and then immediately disappeared with angry buzzing flight into the dusky distance. The manner of the act indicated that bee indignation is quickly raised to a white heat by such flagrant infringement of "squatters' rights," and that (unlike the Foolish Virgins of scriptural celebrity) bees are accustomed when in repose always to keep their "powder dry." The sting was a cause of severe pain, which lasted several hours, and was of a more acute sort than that resulting from the sting of the ordinary hive bee. The incident served to show quick insect perception of the logic of "cause and effect," and that even unintentional injustice is usually closely followed by its appropriate Nemesis.

The assumption that Glaciation, or the superincumbency of an ice-covering of vast thickness and immense pressure, in an age long since past, would give a clue to the explanation to some peculiar phenomena that continually attract notice in a survey of the undulating valleys and hills of our local scenery, the universal distribution of boulders of various sizes, and differing much in their mineral composition, causes frequent comment and excites curious enquiries among land tillers, road makers and others, and to read the descriptions of travellers and explorers of Alpine regions, such as have lately been published in Govermental reports regarding the formation of so-called "Moraines" by the downward motions and melting of vast ice accumulations in the elevated valleys in the Canadian Northwestern Territories, as our knowledge of such remarkable natural processes has become more precise and accurate, we may be better able to judge and to guide one's thoughts towards a solution of problems that have at times appeared inexplicable.

Prof. Agazzis was said to be one of the first theorists to announce (nearly seventy years ago) that, in his opinion, the numerous swampy depressions of the general level in North America had their origin in stranded glaciers, towards the break-up and termination of a glacial epoch, conjectured to have existed all over the temperate latitudes of North America many thousand years since. That eminent scientist stated that in numbers of ice choked up valleys in the Swiss Alps, glaciation was continually to be seen producing changes in the earth's surface identical with the condition of much of the agricultural areas of North America.

In many parts of Canada where level rock surfaces happen to be exposed there can be seen "Striæ" (so called) or glacial "scratchings," indelibly grooved into the face of the hardest rocks. Many of these peculiar "testimonials" are to be seen on Lake Erie shore, near Selkirk, near Kingston, on Lake Ontario shore, and in innumerable other localities.

At the edges of almost all our swamps heaps and ridges of rounded gravel of greater or less degrees of fineness exist, some of them thirty to forty feet high, and usually having one perpendicular side, as if deposited against an upright, solid, resisting rampart, whilst the opposite sides of the accumulated mass of "debris" slopes down gradually to the general surface level of the region around. And in a number of our deeper vales there is to be seen lying at the bottom long lines of big boulders, varying in form and mineral composition, that suggest the idea of having been spilled out of some mighty moving wagon (big as the wagon of "Thor"), whose hind board had suddenly given way.

The occurrence of what are commonly termed erratic boulders is of common frequency in almost all parts of this Province. In gathering some of the less massive ones that are found on the surface in boggy depressions, a few have been noticed having an unmistakeable resemblance to a coarse-grained rock of square fracture, and with eddy marks (or impressions that resemble such), and rocks in *situ* of this species are in immense abundance on the water edge of the Niagara river from Clifton to the Falls. The brink of the precipice not far below the Suspension Bridge is what is here meant as the rocky top of the river bank. These travelled fragments, always here in Burford, about 10 or 12 inches square, are found scattered among other boulders of distinctly different mineral composition and greater variety in form and size. The cube-like form and uniformity in size and unworn angles and eddy marks is what at once distinguishes the so-called Niagara river wanderers to ordinary non-geological land tillers. In the Muskoka district, very bulky boulder masses, some as big as a load of hay, are to be seen resting on ledges on the lofty hill sides, where a slight leverage would suffice to tumble them into the valley below, thus indicating that they had been brought to their present situation, imbedded in some matrix that has gently dissolved, for a slight impetus would have rendered their present perch-like stand an impossibility.

Several years ago, when enjoying a stroll on the high rocky river bank, about a mile and a-half below the village of Elora, our attention was drawn to a curious scene, known locally as "the hole in the rock," where a tunnel-like opening just a few feet below the steep cliff edge had afforded an entrance to the river of the waters of a small rivulet that drained the surface of a large field on the south side of the river. Into this tunnel, which seemed to be 18 or 20 feet long, and jagged in its sides and roof, the sewer-like opening being through the regular limestone formation of that region, a very large, well-rounded granite, or gneiss boulder, had become fast jammed about two-thirds the way through the tunnel. The erratic must have been perhaps one and a-half tons in weight, and there would seem to be no possibility of a current of water having formed in modern times of sufficient power to force the monstrous pebble into its present imprisonment. At varying distances from the river edge, in the same locality, are outlying isolated pinnacle-like masses of stratified limestone, some of them with a base of several roods of superfices, which are apt to excite the curiosity of an observer, and suggesting in his mind that the whole region around was once a continuous area of these ancient rock layers, and that denudation agencies have formed the now fertile pastoral and arable surroundings. The rock strata all through the Elora region shows innumerable perpendicular fissures, as if since the deposition and hardening of the horizontal beds the entire formation had been violently disturbed and shaken by subterranean upheavals.

The local Elora geological theorists differ in opinion as to the original cause of the tremendous Grand River chasm there existing, whether water-worn or of volcanic earth eruptions? Is there not probability of both these agencies having contributed? The jutting promontories or miniature capes are much worn away below high-water mark, and the curious pillar-like rock left standing in mid-stream at the Elora Falls is so eroded near the water level and below as to have become now quite top-heavy looking, and with portions of the same cedar shrubbery and botanical growths as still are to be seen on the near-by river margin, thus testifying unequivocally that the intervening space was once occupied by the continuous limestone layers, and the testimonial relic monument seems destined to topple over by the assaults of the ice masses that strike it with such force and impetuosity at the period of the spring break-up. Limestone is more easily corroded by rain water than many other sorts of either sedimentary or primary igneous rocks. The river chasm has curves, and varies much in width. Some narrow rifts give but faint tokens of grinding abrasion from the river current. The problem presented is interesting from the point of view of mental culture, elevating and profitable in the science of logic and tracing of cause and effect. The large object lessons written everywhere on the earth's surface compel inferences and inuendoes that are never to be forgotten or treated with indifference or disdain as "finger-pointing" to wisdom.

BIRDS AND MAMMALS OF ONTARIO.

Read before the Hamilton Association December 10th, 1903.

BY O. J. STEVENSON, M. A.

The lecturer introduced his subject by the recitation of a poem from Whitcomb Riley, entitled "The Hoosier Folk Child," and concluding,

"The Hoosier Folk Child! rich is he
In all the wealth of poverty!
He owns nor title nor estate,
Nor speech but half articulate;
He owns nor princely robe nor crown;
Yet, draped in patched and faded brown,
He owns the bird songs of the hills,
The laughter of the April rills;
And his are all the diamonds set
In morning's dewy coronet;
And his the dusk's first minted stars
That twinkle through the pasture bars,
And letter all the skies at night
With glittering scraps of silver light,
The rainbow's bar from rim to rim,
In beaten gold belongs to him."

The lecture proper was divided into four parts, dealing respectively with Autumn, Winter, Early Spring and Later Spring. The first section dealt chiefly with the common mammals found in Southern Ontario. These were divided into two classes those which are active during the day and these which are nocturnal in their habits. The former class includes the squirrels, black and red, the chipmunk and the woodchuck the habits of all of which were described. The latter class includes the wood hare, the skunk, the raccoon and others, which were considered in turn. In connection with the birds and animals whose habits are nocturnal, the owls were described, and the following passage from the lecture gives an account of the two most common species:

"Among the various sights and sounds of an autumn evening are two which the nature lover cannot readily overlook or forget—the quavering and not unmusical whistle of the little screech owl, and the hoarse horn of the Great Horned Owl, Bubo Virginicanus, coming faint and far from the distant woods.

"The little screech owl is the farmer's best friend, though mercilessly hunted out and shot down by the thoughtless and ignorant who know nothing of his better qualities. Most people know the screech owl only by the quavering whistle or screech, which has given him his name. But for my own part I like to think of him at his best by his song—yes, the screech owl's song, for song he has—the peculiarly sweet and musical trill, tremulous, quavering and faint, which sometimes comes up from the heart of the woods in a dim October afternoon, or which mingles with the evening note of the wood thrush and adds an additional charm to the tender airs and faint indefinable earthy odors of twilight in early spring.

"But the big brother of the little owls, Bubo Virginicanus, the Great Horned Owl, the black sheep and rascal of the family, is in reality of greater interest to the student than the smaller screech owl. Bubo is the hen thief, the midnight marauder, the mortal enemy of hawks, crows and farmers alike, who never fail to make it warm for the rascal when they catch him abroad in the daytime.

"Watch his eyes and you will see a curious thing, for the black pupil is small in the daytime, but at night the yellow covering is drawn back and the big black glowing disc remains, with the retina set to catch every wandering glint of faintest light. Besides this he has a special covering of film which he can let down over the eyes when the light is too strong. His tongue too is curious, and is set in his mouth "t" fashion, so that it literally wags at both ends. Another interesting feature is his ability to turn his head in any direction so that he can look directly over his back, as illustrated in the slide. Try it for yourselves and see if you can do it.

"When the Great Horned Owl eats a hen or a rabbit he devours it entire, fur, feathers, bones and all, and in a short time a little ball of feathers or fur is disgorged, the indigestible part of the feast. But the strangest feature of the owl's conduct is his fashion of feigning death. I have seen these owls in captivity many a time relax their wings, fall over, and lie for a long time apparently dead. But touch their wings with a stick and they soon come to life again.

And what wonderful wings! Strong, soft, beautiful; but withal, to the wild creatures of the wood, the sure, swift and inevitable ministers of death."

The second division of the lecture, dealing with the winter months, was devoted in the first place to the consideration of the evidence of the snow regarding animal life in winter. The common winter birds were then described, including among others the red-bellied woodpecker, the juncos and tree sparrows, the chickadee, nuthatch and kinglet, and the cedar wax wing. The lecturer concluded with an interesting account of the pine grosbeaks, the wonderful red birds of the north, who occasionally spend a part of the winter in Southern Canada when the weather is severe. The song of some of these birds in captivity was described as follows:

"So far I was familiar only with their rather plaintive call or twitter, and I fancied that, as with the cedar wax wings, they had in reality no song. But one morning in late February as I put my head into the loft I heard from the top of the little evergreen that I had set up the delicate tinkle of a bird's song. I listened. Sure enough! I could not be mistaken—tinkle, tinkle, tinkle! At first it seemed to me like the purling of a little brook in the leafy summer woods; and then as it sounded clearer it seemed like the purest notes of the cat birds' song among the evergreen boughs on an evening in June; and then I caught the sweet note of the thrush, and the plaintive call of the wood-peewee and the far away melody of the blue-bird on the wing. Tinkle, tinkle, tinkle. It ran on without a pause or a break, and without a variation in its sweet and delicate strain. The inspiration of the sunshine was infectious. A moment later another took up his position on the bough, and then a third, and another and another still, until the whole wide loft chamber was for the moment a winter paradise of sunshine and song."

The third section of the lecture, dealing with Early Spring, was introduced by some general remarks on the migration of birds, after which the commoner birds of early spring were described in turn including the robin, blue bird, song sparrow, chipping sparrow, kildeer, horned lark, meadow lark, flicker, phaebe and marsh black bird. The following account of the kildeer may serve as an illustration:

"The land call of the kildeer—'kildeer, kildeer, kildeer'—is well known to those who are familiar with the river sides and the rough and broken pastures in the less cleared portions of the country. The kildeer is the first cousin of the spotted sandpiper or peetweet, and the nest and eggs of the two species are similar. The eggs are always arranged with the pointed ends together, and as the young, like young chickens, are able to run as soon as hatched, the nest is not elaborate, being composed of only a few dried straws placed in a shallow depression in the ground. If you approach the nest or young of the kildeer the old bird adopts the ingenious artifice of pretending to be lame, limping and trailing the wings, in order to attract your attention and draw you off in pursuit. A short time ago I read an interesting account of the kildeer's nesting operations, written by an invalid who watched them closely. When the young were hatched the mother bird used the empty shells to carry water to the nest to wash the fledgelings off, and afterwards destroyed all traces of the shells by dropping them into the stream."

This section of the lecture was concluded with an account of some of the common migrants, notably the white-crowned and the white-throated sparrows.

In treating the birds of later spring the lecturer divided them into three groups, classifying them according to beauty of song, brilliancy of plumage and peculiarity in nesting habit. Under the first group were considered the brown thrasher, cat-bird, Wilson's thrush, wood thrush, bobolink, and rose-breasted grosbeak. The song of the Wilson's thrush, for illustration, was described as follows :

"The weirdest music of spring-time is, without doubt, the song of the Wilson's thrush or Veery. The leaves are already coming out in the thickets when I hear it for the first time in the evening twilight on the hill-side. I do not know why, but the peculiar alto diminuendo seems to suit with the growing dusk, and with the mystery of the bird itself, for as I pass from thicket to thicket the song appears likewise to advance or recede, until on every side of me, from hill to hill, runs the weird incantation, and the whole circle of the valley is for the moment over flowing with eddying waves of song."

"The laverock sings a bonnie lay
  Above the Scottish heather ;
It sprinkles down from far away
  Like light and air together.
He drops the golden notes to greet
  His brooding mate, his dearie ;
I only know one song more sweet,
  The wood notes of the Veery."

In considering the class of birds noted for their brilliancy of plumage three come in for special attention --the tanager, the oriole and the indigo bird. In this connection the account of the nesting operations of the oriole was perhaps especially interesting.

"The oriole or 'hang-bird,' is an adept at house building. I watched one last spring weaving the threads of its nest together in the bough of an elm, and truly an interesting operation it was. It began by tying four strings to the twigs and joining them together at the lower ends. Then other bits of string, bark, hair and other materials were added and carefully woven together by the bill of the architect. Then, by and by, when the structure began to take shape, the feet and body of the bird came into play also, till the nest was rounded out and given its proper form. Sometimes a string was brought which was not needed, and it was carefully tied to a twig near by until it should be required. The neighborhood around was of course thoroughly searched for building materials, and I noticed among other things that a last year's nest was despoiled of its available strings and hair. A little fellow warbler was building at the same time in a tree across the road and the little rascal sometimes made sad havoc of the oriole's carefully collected materials. She did not seem to be in the least disturbed by the morality of the thing, for she evidently deliberately watched until the oriole was absent on other business, and then slipping quietly over, took her choice of a string or a hair to line her own nest. Once or twice the oriole returned rather sooner than was expected and then the little yellow pilferer beat a precipitate retreat. During the whole operation of nest building the bright coated paterfamilias was enjoying life at its sweetest among the apple trees in my garden, leaving the solicitous mother bird to perform her arduous task and warn off inquisitive intruders alone and single-handed."

In dealing with the last group of birds four were selected to illustrate a few of the peculiarities and points of interest in bird study, viz., the king bird, the oven bird, the chimney swift and the cuckoo.

"In a review of this nature," the lecturer concluded, "it is impossible to touch on the thousand and one items of interest which the mention of each well known name may suggest, and still less is it possible to give in language, which is all too gross, the impression of grace and beauty and the memories of the delightful hours spent in the study of nature and her beautiful forms."

> "Age cannot wither her
> Nor custom stale her infinite variety."

"No one, whether grounded or not in the knowledge of scientific detail, can come into contact with nature without being impressed and influenced by her beauty and her variety. And whatever our religious creed may be we can at least join with the psalmist of old in the expression of our admiration and delight in the never-failing wealth and beauty which the passing seasons bring to one and all."

> "O, Lord ! how manifold are thy works ! in wisdom hast thou made them all ! the Earth is full of thy riches!"

The lecture was illustrated throughout by limelight views, many of which were colored, and the numerous quotations of passages in prose and poetry, both in the body of the lecture and between the divisions, were an interesting feature.

NEW MUSEUM SHOW CASES.

The half-tone engraving forming the frontispiece is of the new cases installed by the Association. They are made up of three wings, hinged together for mutual support. When closed they occupy a small space, the necessity for which is due to the Museum being used as a lecture room by the Association and its sections. It was with the object of saving the large space occupied by lateral cases that these cases were designed by J. M. Williams, of the Astronomical Section. The cases are of oak: they are eight feet long by seven feet high, and eighteen inches wide, and, being nearly all glass, objects can be seen from all points, and when the wings are open the cases are accessible for viewing to a number of people at once, an improvement over the lateral cases which are generally used, and in which objects can be seen by but one or two at a time. The cases are provided with shelves and screw pointed wire brackets, specially designed and made for the purpose. The cases were made in the Alex. Thomson cabinet works, of Hamilton. The illustration is from the office of P. L. Scriven, Hamilton. The objects will be labelled and numbered as they are assembled in the cases, so that in catalogueing they can be made easy of reference.

HAMILTON SCIENTIFIC ASSOCIATION.

Treasurer's Statement, May, 1904.

RECEIPTS.

Balance from 1903	$129 31
Government Grant	400 00
Members' Fees	99 00
Horticultural Society and other rent	16 50
Unclassified	4 10
	$648 91

EXPENDITURE.

Rent of Museum	$130 00
Rent of Dark Room and Water Rates	26 00
Caretaker	62 50
Gas Account	11 10
Printing Annual Reports	162 00
Printing and Engraving	43 25
Printing, Astronomical Section Account	50 00
Postage and Stationery	18 50
Lectures	43 80
Expenses to Ottawa (Rev. Dr. Marsh)	24 10
Photographic Section Expenses	38 88
Insurance	10 00
Sundry Accounts	28 60
	$648 73
Balance on hand	18
	$648 91

P. L. SCRIVEN, *Treasurer.*

This is to certify that we have examined the vouchers and found them correct.

ALF. H. BAKER, J. F. BALLARD, *Auditors.*

MAY 11th, 1904.

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 the 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.
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 Antiquaries du Nord......Copenhagen.

(5) France.

Academic Nationale des Sciences, Belles
Lettres et Arts.........................Bordeaux.
Academic Nationale des Sciences, Arts et
Belles Lettres..........................Caen.
Academic 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 Gesell-
schaft..................................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.

The Late John Alston Moffat.

Death has again thinned the already small number left of the old time active members of the Hamilton Scientific Association by claiming John Alston Moffat, who for many years was one of the most regular and active members of the Association.

Mr. Moffat was born on the family estate of Milton, about three miles from the City of Glasgow, Scotland, in the year 1825. Through business misfortune his father lost his wealth and removed to the City of Glasgow and engaged in mercantile pursuits, but not liking city life he came to Canada alone, purposing to seek a home for his family in this new country. Soon after he left Scotland his wife, Mr. Moffat's mother, died. He at once sent for his family, who landed at New York on July 1st, 1836, and settled in the Township of Nassagaweya. There the father married again.

The homestead is still in possession of the only son of that marriage. After a time John's eldest brother, William, took up land and settled in the Township of Binbrook, and John Alston made his home there for some years.

After a time he came into this city and engaged in business as a merchant tailor, but being in indifferent health he was in the habit of taking long walks in the open country as a relaxation from business. It was during these walks that he formed those habits of observation in relation to insect life which he saw around him that shaped all his future career. He found so much enjoyment in the capturing of insects and observing their life history, and became so absorbed in the science of entomology that in spite of considerable good natured ridicule from his friends he gave up his city business altogether, and "going from bad to worse," as he expressed it, devoted his whole time to the study of insect life.

He soon became well known to all the entomologists of Canada, as well as to many in the United States, and was a most industrious

THE LATE J. ALSTON MOFFAT.

collector of specimens. His habits of observation were exact, and as a result he found a new species, which was acknowledged to be so by Grope, an entomological expert, and named by him *Scopelosoma Moffatiana.* It figured in Holland's "moth book," plate xxvi., fig. 33, Moffat's Sallow.

Mr. Moffat never married. He was appointed Librarian and Curator of the Entomological Society of Ontario in London some years ago, a position he was well suited for, and the duties of which he discharged with great acceptance to the members.

He long suffered from weak digestion, and died on the 26th February, 1904.

He was a nephew of the well-known Dr. Wm. Moffat, who was surgeon to Wellington during his conflict with Napoleon, and also of Bailie Alston, a well known philanthropist of Glasgow.

Mr. Moffat was a man of quiet and retiring disposition—one of nature's noblemen. At his death he was in his eightieth year. He was to the end as straight of body and clear of mind as he was in youth.

He passed away honored and respected by all who knew him as a friend, and our Society and the one he was most intimately connected with are much the poorer.

Alexander Gaviller.

BORN 1814, DIED 1904.

Mr. Gaviller, who for nearly twenty years acted as Curator of our Museum with so much care, has also passed over to the great majority. He was born in the year 1814 in Lower Clapton, Hackney, London, and the meeting of the "allied sovereigns" was responsible for his name. He was educated at the well-known Mill Hill School near London. After engaging in business for some years in the City of London his health gave away and he came to Canada in the year 1844, via New York, from which he travelled by boat and stage to the Township of Tecumseh, County Simcoe. He was one of the earliest settlers, the deed of his farm being direct from the crown. He was also among the very few who were taxed for being the owner of a spring carriage. For many years he acted as Justice of the Peace, and his decisions, always savoring more of justice than of law, were never questioned or appealed against. He acted too as one of the Board of Examiners of those aspiring to the position of school teachers, while as a member of the County Council he was for long a well known figure in the County of Simcoe.

As a staunch member of the Anglican Church he was in constant requisition as a speaker at missionary meetings, and with hardly one intermission was chosen as lay delegate to the Synod of Toronto for seven consecutive years.

About 1876 Mr. Gaviller came to this city and was soon asked to assist the Lady Managers of the Boys' Home, during the building of the present institution on Stinson street. In this and kindred institutions he always took an active interest.

For more than twenty years he was connected with the Hamilton Scientific Association, during most of that period being the efficient and painstaking Curator of the Museum, the specimens and objects of interest in which he guarded with the most jealous care, and spent much time in arranging and keeping in order the various collections.

By his death we are again reminded that the number of the old and steadfast friends of the society are reduced to a very few.

THE LATE ALEX. GAVILLER.

LIST OF MEMBERS

OF THE HAMILTON ASSOCIATION.

HONORARY.

1881 Grant, Lt.-Col. C. C., 293 Bay south, Hamilton
1882 Macoun, John, M.A., Ottawa
1885 Fleming, Sanford, C.E., C.M. G., Ottawa
1885 Farmer, Wm., C.E., New York
1885 Small, H. B., Ottawa
1887 Charlton, Mrs. B. E., 280 Bay south, Hamilton
1887 Dee, Robert, M.D., New York
1887 Keefer, Thos. C., C.E., Ottawa
1890 Burgess, T. J. W., M.D., F.R. S. C. Montreal
1898 Carry, Mrs. S. E., 29 Caroline south, Hamilton

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

ORDINARY.

Would members kindly notify the Secretary, Mr. J. F. Ballard, of change of address or omission of name.

Acheson, Percy, 164 Emerald north
Acheson, Wm., 165 Queen south
Adam, John, 55 Victoria ave. south
Alexander, A., F. S. Sc., 182 Wentworth south
Alexander, A. G., 182 Wentworth south
Anderson, John, 259 York
Arnott, Mrs. H., 1 Emerald south
Asman, H. O., B. A., 150 Victoria ave. south
Bailey, W., Ontario Normal College
Baker, Hugh C., Bell Telephone Co.
Baker, A. H., 99 King east
Ballard, John F., Sophia street school
Bale, F. J., 217 Victoria ave. north
Baldwin, T. O., 294 Hannah east
Bartlett, H. F., 168 Market
Barton, Geo., 274 Hannah west
Beasley, Thos., 421 Main east
Beasley, Mrs. Thos., 421 Main east
Bertram, James B., Dundas, Ont.

Black, Geo., 70 East ave. south
Blake, A. C., P. O. Dept.
Blatz, Adam, 187 Hannah east
Brown, Hillhouse, Alma street
Broughton, Benj., 18 Inchbury
Brady, Rev. R. E. M., 475 Mary
Bradwin, F. W., 204 Catharine south
Brass, Peter J. B., 109 Bay south
Bruce, Wm., 17½ King east
Burnside, J. W.
Campbell, Robt., 222 Main west
Campbell, Mrs. R., 222 Main west
Campbell, C. C., 38 Queen south
Campbell, Mrs. C. C., 38 Queen south
Caswell, Rev. W. B., 139 Herkimer
Child, W. A., M.A., 377 Hess south
Clark, D., D.D.S., 54 King west
Cloke, J. G., King west
Coburn, H. P., 262 James south
Crawford, A., King west
Crossley, Miss M. E., 182 Herkimer
Darling, E. H., 109 Hughson north
Davenport, T. J., 170 Young
Dickson, J. M., 22 Bruce
Dixon, Jessie B., 61 East ave. south
Duffield, Miss E., 123 Duke
Eastwood, Jno. M., Times office
Easter, Arthur, Main west
Evel, J. J., 51 Stanley ave.
Fearman, F. W., 90 Stinson
Fearman, R. C., 17 McNab n
Findlay, W. F., 47 James south
Findlay, W. M., 387 Aberdeen ave.
French, Thos. E., 114 Maria
Gadsby, J., 314 Caroline south
Gaviller, E. A., M.D., 70 Main west
Gill, James, B.A., 45 Maria
Grant, W. J., 137 East ave. south
Grant, A. R., 144 Erie ave.
Greene, J. J., Sanford Mfg. Co.
Hansel, Franklin, D.D.S., 40 East ave. north
Hamilton, Aubrey M., 276 Hannah west
Henry, Rev. E. A., M.A., Knox Church
Herald, Chas. A., 91 Queen south
Herald, Wm. C., 91 Queen south
Hardy, Capt., 129 Erie ave.
Hill, R. J., 56 Erie ave.
Hill, W. E., 6 James south
Hore, J. G., 249 Victoria ave. north
Howitt, Rev. F., 108 George
Hunt, Fred, Turnbull's book store
James, W. A., 86 Bay south
Jenkins, J. P., F.R.A.S., Burlington
Jones, C. J., 6 James south
Jones, Seneca, Hughson south
Johnston, Geo. L., B.A., 11 Walnut south
Kelley, Chas. T., M.D., 225 King west
Kemp, Geo. B., 198 Herkimer
Knott, Thos. O., 20 Blyth
Lee, Lyman, B.A., 15 West ave. south
Lees, Geo., 5 James north.
Lees, W. A., Poplar ave.
Leggat, Matthew, 23 Duke
Little, Hector J., 59 East ave. north
Livingstone, Rev. H. J., 18 William
Lucas, E. H., 309 King east
Luxon, James, 5 Nightingale
Marsden, Miss, Main west
Marsh, Rev. D. B., Sc.D., 258 Aberdeen ave.
Marsh, Mrs. D. B., 258 Aberdeen ave.
Millard, J. W., Meriden Britannia Co.
Milne, C. G., Hamilton Bridge Co.
Morrow, J. A. C., 79 King east
Moodie, J. R., Main and McNab
Moodie, Jas., Main and McNab
Moore, H. S., 23 Grant ave.
Moran, J.
Morgan, S. A., B.A., D.Paed, Emerald south
Morton, Jas., Markland street
Mulvaney, W., 20 Stinson
Macpherson, F. F., B.A., Wellington south.
McKenzie, A. M., 134 Erie ave.
McLaren, Col. Henry, 301 James south.

McNair, W. G., 52 Rebecca
McMillan, Miss M. G., care B. Greening Wire Co.
Neill, A. T., City Hall
Orr, Thos., 166½ Main east
Patterson, Jessie, 176 Victoria ave. north
Peene, Miss M. W., Blythe street
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Pearce, Henry, Dundas, Ont.
Powis, A., 64 King east
Presnail, H., 74 George
Ptolemy, R. A., 209 McNab south
Penson, S. R. G.
Reid, Miss Louisa, 220 Hunter east
Robinson, W. A., 34 Hannah east
Roger, Thos. A.
Ross, Chas. M., Prov. & Loan bldg.
Rutherford, Geo., Winer & Co.
Saeger, W., King west.
Scriven, P. L., 13 King Wm.
Seymour, A. J., Box 264, City
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Sintzel, John, 63 Victoria ave north.
Souter, D. A., 275 Caroline south
Steele, R. T.
Strathy, Stuart, Traders Bank
Tansley, Harry, 170 East ave. north
Taylor, A. J., 130 Markland
Tilley, Leonard F., 103 Wellington South
Tyrrell, J. W., C.E., 42 James north
Unsworth, Miss C., 20 Hannah west
Wallace, R. S.
Walker, Miss I. M., 116 George
Wegoner, Wilhelm, 25 York
White, Miss F., care D. Moore Co.
White, Wm., 9 James north
White, J. G., Hamilton Prov. bldg.
Whitney, H. A., Room 2, T. H. & B. Ry.
Whitton, F. H., 353 Bay south
Witton, H. B., 16 Murray west
Witton, W., 24 James south.
Wilson, Wm., 78 Victoria ave. south
Williams, J. M., 8 Devenport
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Wodell, J. E., 123 Emerald north
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JOURNAL AND PROCEEDINGS

OF THE

Hamilton Scientific Association

SESSION 1904-1905

NUMBER XXI

CONTENTS:

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

PRINTED FOR THE HAMILTON SCIENTIFIC ASSOCIATION
BY DROPE AND HARPER.

1905

Journal and Proceedings

OF

The Hamilton Scientific Association

FOR SESSION OF 1904-05.

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

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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.

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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.

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

1903—J. M. Williams; Geo. Black; Jas. Gadsby; A. H. Baker; R. A. Ptolemy.

1904—Wm. Acheson, Jas. Gadsby; J. M. Williams; Robt. Campbell; J. G. Cloke.

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF THE

Hamilton Scientific Association

DURING THE

SESSION OF 1904-1905.

THURSDAY, NOVEMBER 10th, 1904.

OPENING MEETING.

Retiring President, J. M. Dickson, introduced President George L. Johnston, B.A., who, in the course of a masterly essay on War, really gave an epitome of the world's great historical events.

At the conclusion of his address, the President gave the meeting over to the various sections.

The Camera Section showed a set of Interchange slides, consisting of very fine amateur productions.

The Astronomical exhibit of instruments and apparatus, by Messrs. Marsh and Darling, was very instructive.

The Biological display, by Mr. Alexander, was the most elaborate attraction of the evening, although many were deeply interested in the Microscope, by Mr. Bailey, and in the exhibit of Metals, by Mr. Williams.

THURSDAY, NOVEMBER 30, 1904.

Special business meeting to consider the affairs of the Association as to future occupation of premises.

DECEMBER 13th, 1904.

Combined meeting addressed by Professor A. T. DeLury, M.A., Ph. D., of Toronto University, on Eclipses, with special reference to the approaching Solar Eclipse.

THURSDAY, JANUARY 19th, 1905.

President Geo. L. Johnston, B.A., in the chair.

Minutes of regular meeting read and confirmed.

Rev. F. W. Fallis, S. F. Lazier, K. C., J. O. McCulloch, W. J. Locheed, B. A., G. S. Bale, B. A., and H. T. Drope were elected members of the Association.

The President then introduced Chas. B. Fox, B. A., who gave an excellent paper on Chemistry Applied to Industry, in which were given most astonishing results of the application of science to commercial enterprise.

THURSDAY, FEBRUARY 16th, 1905.

The President in the chair.

Minutes of last meeting were read and confirmed.

Dr. Locheed, J. B. Turner, M. A., Chas. B. Fox, B. A., and Mrs. H. Henly, Vice.-President Astron. Soc., Meaford, were elected members of the general Association.

J. B. Turner, M. A., gave a deeply interesting and very instructive lecture on his recent discoveries in investigating the probable course of evolution in plants.

THURSDAY, FEBRUARY 28, 1905.

Another combined meeting to hear Prof. Warner, of Cleveland, lecture on the Panama Canal. An audience of about a thousand expressed deep appreciation of the entertaining presentation of the subject.

THURSDAY, MARCH 9th, 1905.

Minutes of last regular meeting read and confirmed.

Prof. W. R. Warner, F. R. A. S., of Cleveland, was elected an honorary member of the Association, and Frank Quance, a regular member.

Prof. S. R. Coleman, M. A., was introduced to the audience and gave an excellent lecture on The Conquest of Wild Canada, showing great familiarity with the subject of which he spoke.

The fact that he was one of Hamilton's Old Boys was made known to the members in the course of some highly appreciative remarks by S. F. Lazier, K. C., and others.

THURSDAY, MARCH 30th, 1905.

Special meeting to hear Professor G. W. Johnston, B. A., Ph. D., of Toronto University, who delivered an exhaustive and intensely interesting lecture on Pompeii: Its Life and Art, as Revealed by Modern Excavations. High appreciation of the lecture was expressed by the overflowing audience.

THURSDAY, APRIL 13th, 1905.

A regular meeting of the Association, with President Geo. L. Johnston, B. A., in the chair.

The President called upon Prof. W. A. Parks, Ph. D., who read a very instructive paper on Formation of Coal Beds and Life of the Coal Forming Age. A hearty vote of thanks was passed to the lecturer. Messrs. Myles and McIlwraith were made members.

THURSDAY, APRIL 27th, 1905.

SPECIAL MEETING.

President Geo. L. Johnston, B. A., in the chair.

Stuart Strathy, Manager of the Traders Bank, was introduced and delivered a historical and exhaustive lecture on the Origin of Banking in England, during which, while showing thorough knowledge of the subject, he interspersed many amusing descriptions of the frequenters of the Bank of England.

Dr. Marsh's resolution to perpetuate the memory of past Presidents was favorably received and referred to the Council, by whom it was confirmed.

THURSDAY, MAY 18th, 1905.

Annual meeting, at which the affairs of the Association in their various bearings were fully discussed.

41 new members were elected to the Association.

The following reports were read and adopted:

Report of the Council, by the Secretary.

Report of the Curator, by Col. C. C. Grant.

Report of the Treasurer, by P. L. Scriven.

Report of the Geological Section, by A. A. Neill.

Report of the Photographic Section, by Walter E. Hill.

Report of the Astronomical Section, by E. H. Darling.

Report of the Corresponding Secretary, by R. J. Hill.

The following officers were elected for the ensuing year:

President, Geo. L. Johnston, B. A.

First Vice-President, Rev. D. B. Marsh, Ph. D., F. R. A. S.

Second Vice-President, James Gadsby.

Corresponding Secretary, R. J. Hill.

Recording Secretary, J. F. Ballard.

Treasurer, P. L. Scriven.

Curator, Col. C. C. Grant.

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Council: Wm. Acheson, Robert Campbell, J. M. Williams, A. H. Baker, G. Parry Jenkins, F. R. A. S.

REPORT OF COUNCIL

1904-1905.

Your Council take pleasure in submitting the following report:

There have been ten meetings of the Council, about half of which number were devoted to the consideration of the pressing needs for enlarged accommodation for the increasing museum and the crowded gatherings.

We have not yet succeeded in finding available premises more suitable than those at present occupied, nor are there discernable indications of immediate change, concerning which the feelings are more favorable, if possible, than at the beginning of the year.

We hope our Municipal Committee may succeed in providing more commodious quarters for the coming session.

One of the fathers of our Association (Mr. Witton) has been much missed from our Council Board this winter. We sincerely wish he may soon be restored to health and activity, and that we may long benefit by his superior judgment and generous assistance as in the past.

Of the Association we have the pleasure of reporting the following ten very successful meetings, viz.:

Nov. 10—Opening meeting—President's Inaugural Address on War—assisted by the Photo, Astra., Biol., Geo. Sections, making it the most varied and complete in recent years.

Nov. 30—Art School Request.

Dec. 13—Prof. DeLury—Eclipses.

Jan. 19—Chas. B. Fox, B.A.—Chemistry Applied to Industry.

Feb. 16—J. B. Turner, M. A.—Probable Course of Evolution in Plants.

Feb. 28—Prof. Warner—Panama Canal.

March 9—Prof. Coleman—Conquest of Wild Canada.

March 30—Prof. Johnston—Pompeii: Its Life and Art, as Revealed by Modern Excavations.

April 13—Prof. Parks—Formation of Coal Beds and Life of Coal Forming Age.

April 27—Stuart Strathy—Origin of Banking in England.

Our Corresponding Secretaries and Astro. Secretary deserve an expression of gratitude for securing the talented persons who have lectured during the session—covering as they do almost every field of scientific investigation, Industrial progress and commercial enterprise in which the world is employing and enlightening its teeming millions of to-day, from the benighted barbarian to the advanced scientist in his research for knowledge deeper than man yet knows.

We are pleased with the number and quality of those on our new membership list.

We have taken advantage of the privilege of enrolling Prof. Warner, of Cleveland, among our Honorary members.

We have secured new show cases and planned improved features in our proceedings and museum.

All of which is respectfully submitted.

GEO. L. JOHNSTON, B. A.,
President.

J. F. BALLARD,
Secretary.

INAUGURAL ADDRESS

G. L. JOHNSTON, B. A., PRESIDENT.
Nov. 10, 1904.

Ladies and Gentlemen, Members of the H. S. A.:

I thank you for electing me to this position, which has been made honorable by a long line of worthy and distinguished predecessors. I shall endeavor not to allow the idea of the honor to dominate my mind, but shall look upon the office rather as an opportunity for service, and by doing my best to advance the interests of the Association justify in some measure the trust you have reposed in me.

The topic which I have chosen on which to address you is one which has been brought very close to all our minds and hearts during recent years and months—the subject of War.

As this subject is one which directly affects human life, it must not be treated lightly. It has, however, been brought very closely to our attention during the opening years of the Twentieth century. During the late Boer war, with which we, as a part of the British Empire, were connected, blood was freely shed, and lives were freely sacrificed on their country's altar. And during the months of the past year in the Russo-Japanese war, the horrors of war have been displayed in an intensity seldom seen in our own day—men rushing to their death and being slain by thousands, or standing firm amid a murderous rain of shot and shell, refusing to surrender, others going by hundreds to a watery grave. I shall not attempt to picture the agonies of the wounded, the hardships of the campaign, or the bereavement and sorrow in far-off homes. Each of us has had these things brought as closely to our attention as the callousness of our natures would allow, and some of us perchance very closely by the severance of family ties. Enough to say and to realize that war brings us face to face with the great realities of life and death, face to face with weariness and hunger, and suffering on a scale so intense that no other situation in life can equal. "War is hell," said one who had experienced its horrors, and we instinctively feel that the description is none too vivid.

We are naturally led from these considerations to ask, "Is it necessary"? An answer to this question can only be given by a consideration of three things—man's nature, the evidence of history, and the results produced. First, then, when we consider man's nature, we find universally present a pugnacious quality which leads us to resent wrongs, to give blow for blow, insult for insult. This is illustrated in the lives of children, of adults, and of nations. I am speaking of the natural tendency unregulated by the higher part of our nature. So amongst nations we find the tendency to fight, practically unrestrained, amongst savage nations, and amongst civilized nations the influences opposed to the spirit of war increase with the advance towards a higher civilization. This will account for the almost inhuman ferocity and delight with which the North American Indians pounced upon a neighboring tribe, and the fiendish ingenuity they displayed in torturing their prisoners. We could readily understand their making war on the English or French, who were dispossessing them and inflicting wrongs upon them, but find it difficult to understand their savage attacks on one another, which were not inspired by lust of conquest, for there was plenty of room and to spare for the 200,000 Indians scattered over the continent of North America. With them war was a tribal occupation. It and the chase being the only employment befitting the men of the tribe.

The history of the English nation, with which we are all
sist the distressed Britons against their foes, these bold sea-rob-
familiar, will show us how that the advance of a country's civilization puts a check on the readiness with which that country plunges into war. When, for example, our Saxon forefathers were invited over from their forest homes in Germany to as-
bers proceeded to seize upon their pay in the shape of the country itself, and helped themselves so forcibly that during the

next hundred years they had practically supplanted the Britons, either driving them in flight to the extremities of the island or retaining them amongst themselves as servants. With them might was right. They had no excuse and wanted none. The fierce elements of their nature lusted in conquest. In a somewhat similar manner might we speak of the Danish and Norman invasions, or in late years, of the Hundred-years' war. The nations and people of the time were in such a condition that there was none to say nay to the conqueror, and so he plunged his own and a neighboring country into a costly and tedious war on the slightest pretext, bringing untold misery on the people. As time passed on and the nations crystallized into definite forms, the people gradually worked their way up to higher civilization. Men dared to claim their rights even against kings. The spirit of liberty, the love of freedom, which the old Anglo-Saxon sea-kings brought from Germany remained with them; and although often crushed to earth, rose again, phoenix-like, and strengthened with the passing years. Thus the people of England gradually gained their rights as a self-governing nation. Thus was gradually formed in the course of the centuries that wonderful force for good—the public opinion of a free and enlighened people—and which at the present time is so strong a determining factor in the matter of war, that kings and ministers watch its nod and do its bidding.

We judge, then, that there is inherent in man's nature that which leads him to war upon his fellows to maintain his right, to avenge his wrongs, or to add to his conquests. Is war, then, justifiable on these grounds? Yes and no. With a low state of civilization, yes; in a sufficiently high civilization, no. The question can not be answered in the same way for all ages. To the North American Indian war was a glorious occupation; to the minds of right-minded men of our own nation at the present day, it is a horrible necessity. Among the lower classes of society the street brawl and bar-room fight are still too common. Amongst the better class of citizens there is no resort to brute force in the settlement of disputes. The law is appealed to as arbitrator. So with nations. If all were raised to the same plane of civilization and the same standard of moral right, that we are thankful the British nation has attained to, war would no longer be needed, and would soon become only a memory. But, alas, such is not the case. Without any spirit of boastfulness we may safely say that the number of those nations which compare favorably with our own is very small. The others are struggling upwards from various depths of national and social darkness. The British nation would not enter upon war at the present time from any wrong or unworthy motive, but only in defence of the right and from dire necessity. Not so, however, with those nations where the national conscience is not so true, so noble, so generous. All the world knows that Russia had no moral right to instigate the present war with Japan. The motive, that of territorial aggrandizement, at the expense of a supposedly weak neighbor, was an unworthy one, and entirely unjustifiable. The conscience of Russia is evidently on a par with that of the bully who depends upon his size and brutal appearance to frighten his victim into submission; and in case this fails his animal ferocity bears him on perhaps to defeat. When men shall rise to the level of the Golden Rule, strife shall cease. When the message of the angels hovering over Bethlehem's plains shall become the spirit of the nations, then swords may be beaten into plow-shares, and spears into pruning-hooks, the instruments of war being transformed into the implements of peace.

But what says History as to war's necessity? It also answers yea and nay. Many of the great wars—notably those of Alexander and Napoleon—appear to have been simple wars of conquest, having no basis of right and seeking none. Waged because these great generals wanted exercise for their remarkable genius for war. Not caring for right or wrong, not considering at all the miseries they brought to their own armies as well as to the vanquished foe, they seemed to be actuated only by a selfish desire to revel in the intoxication of their own success. Such wars to outward appearance bring only hatred and distrust of our fellow-men, empoverish the nations concerned;

and steep the people in sorrow and despair. But who shall say that out of all this evil no good has come?

Alexander was completing the work begun so gloriously on the plain of Marathon. There we see the hosts of Persia come forth from the centre of Asia to determine the destinies of Europe. The East with its effeminacy, its sophistry, its elastic morality, and its heathenish religions, seeking to trample in the dust the more vigorous civilization, the more manly institutions, the truer and more practical philosophy, the purer morality and the higher order of society and government of the West. On the field of Marathon nothing is visible except confusion, carnage and victory on the part of the brave Athenians; but the historian now sees in it results far-reaching and permanent. Ten years later the noble band of Spartans made a Thermopylae, forever famous in the same cause, and a Salamis and Plataea finished the work as far as the Grecian States were concerned. In time Greece was swallowed up by Macedon and Alexander the Great rolls back forever the tide of Orientalism from Europe. But he did more than act as the Sentinel for the West; he opened a highway between Asia and Europe, which brought into barbarous Europe whatever of the civilization, learning, refinement, and arts of Asia were worth transplanting.

The effete civilizations of Egypt, Syria, and of the East, generally had to give place to the more virile energies of the West. The fruitage of the seeds thus planted is seen in the grand results produced by the occupation of Egypt and India by British power at the present day.

Did the wars with Napoleon produce no good? Who shall say that the shock to the nations of Europe did not electrify and energize them; thus doing much to bring into being modern Europe. It gave to England the immortal memories of a Nelson and a Wellington, of a Trafalgar and a Waterloo. Who shall estimate the value to the world of such object lessons of courage and strength—lessons that will thrill the hearts of Britons for all time, and be high and noble incentives to duty in every sphere of life.

Again, how often in England recourse to arms has been necessary to secure or maintain the rights and liberties of the people—notably in opposing the tyranny of King John and wresting from him the Magna Charta. In defying the Spanish Armada, and preserving the liberties of England. In the civil war of Charles I.'s reign, the people vindicated their right to oppose unjust taxation; and by a resort to arms the revolution of James II.'s reign was accomplished and England freed from religious despotism. In the past, when might was right, there seemed to be no other way to preserve liberty, to bring about reforms, to oppose the despotism of kings, or to defeat the selfishness and greed of nations, than to stand and fight the evil in whatever form it appeared; and in the end those standing for right generally proved the stronger and prevailed.

Have the nations arrived at that state when war is no longer necessary? Some have; many have not. The time is fast approaching, however, we believe, when amongst the civilized nations there will be formed a national opinion which will prevent war amongst themselves. The less civilized nations, however, to whom the morality of this national opinion would not appeal, must be left to develop, and if need be to fight their way up to the same condition.

In the third place, we may now ask, Do the results of war justify or condemn it? The N. A. Indian seems to have considered war necessary for the display of his manhood. It developed in him the qualities of courage, strength and cunning, and you say of cruelty as well—ingenious, devilish cruelty. Yes, but cruelty no worse than has been shown in times of peace, and under the guise of religion—the Spanish Inquisition being an example. In seeking for an explanation of the feverish desire of tribe to make war upon tribe, I have concluded that it was a means of giving vent to the strength, the skill, the cunning, and the vindictiveness of their natures. What else had they, in their state of civilization, to do but hunt and make war? Better, then, that they should engage in war and develop themselves, than remain sluggish and inactive. In later years the

Six Nation Indians proved themselves brave and intrepid soldiers, and faithful allies of our own; these being the fruits of their previous training in the hard and cruel school of warfare.

Again, was the warfare that the Israelites were called upon to wage against the inhabitants of the Promised Land till they were completely exterminated, necessary or justifiable? Yes, decidedly, it was for the good of the race. The Amorites, and other races inhabiting that land, were so steeped in vice, that they were a menace to the morals of the world. The surgeon's knife is necessary to remove a cancerous growth in the human body. So the use of the sword is oftentimes necessary to remove plague spots from the human race. Never was the punishment of war more just. Great were the benefits resulting to the race.

Look at yonder scene in the streets of Paris. The mob frienzied, the streets slippery with blood, men's heads being carried about in baskets, the air resounding with the groans of the dying, and the execrations of the living—a most terrible picture you say. Yes, but terrible also was the cause of it all. The court and nobility of France were diseased and rotten to the core. Profligacy, immorality, oppression of the poor, were the order of the day. The toilers of France had been crying to heaven for relief, and at last retribution came like a thunderbolt from the blue and removed those who were a disgrace to the name of king, and prince, and noble, the world over. Who can say what good has resulted to the cause of good government, from this great object lesson of a wronged and down-trodden people rising, at length, in their might and casting down the oppressor?

When at the battle of Plassey, India was won for the British Empire, did any good result? Compare three hundred million people under several hundred native princes, whose government consisted either in making war upon one another or oppressing their own people with taxes and extortions; no safety for life or property; no hope of a better future; only a struggle for life that was not worth living; scarcely a ray of civilization penetrating the darkness of that heathen land. Compare this with the present condition of India. A strong and stable government to guarantee to every man, woman and child in India, safety and protection for both life and property. No more robbery and extortion. No more internal wars to waste the lives and impoverish the people. But instead a country opened up to progress, to commerce, to civilization, to enlightenment, and to Christianity. Time would fail me to tell how the German Empire, standing at the present time as one of the guardians of the peace of the world, was born amidst the strife and bloodshed of the Franco-Prussian war; or to refer to numberless other examples of how the nations have been evolved through the stress and tug of war.

What, we might ask, are the qualities chiefly called forth by warfare amongst civilized people? Courage, strength, patriotism, and self-sacrifice. Truly a worthy quartette. What is grander than courage to face any foe, and any danger? What has the charge of the Light Brigade done for humanity? It has thrilled the hearts of men and inspired them to do and dare greater things in every sphere of life. What shall we say of the self-sacrifice of a thousand battlefields? Men freely giving their lives in defence of home and loved ones far away. Oh! What a wealth of sacrifice is here! What blood and treasure! Is it worth while? What good is accomplished? What good, think you, is accomplished by the mother wearing out her life inch by inch for her family? She is dying that they might live. What good, say you, is accomplished by the father who toils year after year, early and late, until he finally drops into the grave, that his sons and daughters may be fed and clothed and educated? It is the law of self-sacrifice that is at work. This law runs throughout life. The seed falls into the ground and dies that it may bring forth the hundredfold. The animal world instinctively suffers for and protects its young, and let it be reverently said, the law ascends to the throne of God itself. In this world suffering and progress seem to be inseparably linked. The poets learn in suffering what they teach in song. For everything that is worth having the price must be paid in work, in hardship, in suffering. So although the sacrifice on the battle-field is beyond computation, yet since it is a willing sacrifice, it has an ennobling influence on mankind. But what of the heartaches of the bereaved ones at home? This is a subject too delicate for me to handle, too sacred to discuss. And so I leave it to good old Father Time, who hath balm to heal and oil to anoint the wounded and stricken in heart. Was any good accomplished by the late Boer war? Yes, you say, the British Empire was knit more firmly together. The spirit of the Colonies was revealed to the Motherland in a way she could not but understand. An object lesson was put before the world which showed the solidarity and strength of our empire, and which did much to command the respect of our foes, and so maintain the peace of the world. The long and sinewy arm of Britain was felt at the ends of the earth. A Magersfontein showed forth once again the mettle of the old world soldier, and a Hart's River the dash and daring of the new. Is any good being accomplished by the present war? Russia is being taught much-needed lessons. Her duplicity and greed are being rebuked. The government of Russia, her administration of justice, even her national church are amongst the most corrupt institutions on the face of the earth to-day. After the late China-Japanese war, Russia stepped in and prevented Japan from reaping the fruits of her victory, under the pretence of preserving the integrity of China, but with the secret object of acquiring Manchuria for herself. If Japan succeeds in carrying to a successful conclusion the contest she has so gloriously begun, she will have accomplished results for Russia herself, and for the world at large, which it would have taken centuries possibly, otherwise, to bring about. Japan will come forth from this baptism of blood chastened and enriched, and prepared to go forward even more rapidly than before in the path of civilization and progress; thus becoming a beacon light of hope set before the gaze of the millions of the yellow race. Russia will turn her attention less to extension of empire and more to the good government and development of her Sclavonic people. So the world will move on towards the goal of peace between man and man, unity of nation with nation, the brotherhood of man gradually being evolved from the Fatherhood of God.

In conclusion let me say that I do not seek to glorify war. Far be from me any such intention. What I do say, however, is that it has been one of the means of the advancement of the world, and of the evolution of the nations. It is a necessary evil. When the nations all rise to the same level of enlightenment and national conscience as our own, war can cease. Till then arbitration may partly, but cannot wholly take its place.

I thank you, ladies and gentlemen, for your patient hearing.

SYNOPSIS OF PAPER ON "ECLIPSES"

Read before the Hamilton Association, December 13, 1904, by PROF. DeLURY, OF TORONTO.

By the use of a series of well executed diagrams the speaker showed clearly why the obscuring of the sun and moon did not occur as frequently as their constant and uniformly regular motions might naturally lead us to expect.

The inclination of the moon's orbit to the plane of that of the earth partly accounts for this.

The path of the moon intersects the apparent path of the sun at an angle of about 5 degrees, thus preventing them from being in true alignment with the earth except at these points of intersection.

But owing to the acuteness of the angle with which these lines cut each other, eclipses of greater or less magnitude may occur according as the moon is in a position of relative proximity to these nodal points.

Beyond a comparatively limited range of arc, however, it is plain that the diameter of the moon is not sufficient to throw us a shadow and obscure our view of the sun and there can be no eclipse visible to us at least until the moon approaches the next node.

Each succeeding pair of related nodes does not have the same position as the preceding ones, but they seem to follow the line of a curve marked out by these constantly recurring points of intersection of the orbit of the moon and the apparent path of the sun.

This curve seems to make a complete circuit in something like 18 years and some 10 or 11 days.

This complete round of retrogression of the moon's nodes constitutes a cycle of eclipse, and therefore the eclipses occurring during one such period may be expected to be repeated in the next, due allowance being made for variations caused by the influence of other heavenly bodies.

From this the lecturer proceeded to show the cause and course of the approaching solar eclipse, which will become visible somewhere near the northern limits of New Ontario by James' Bay. The centre of pathway of the shadow of the moon moves in an easterly direction through Labrador, where the best Canadian view is expected to be obtained. Thence it crosses the Atlantic and passes over the eastern hemisphere.

The breadth of shadow increases as it approaches O of British Longitude in the latitude of Spain, where the time of totality is about three minutes.

A hearty vote of thanks was tendered.

CHEMISTRY APPLIED TO INDUSTRY.

Read before the Hamilton Association, January 19, 1905, by CHAS. B. FOX, B.A.

Mr. President and Members of the Hamilton Scientific Association:

It was with some diffidence that I consented, on the request of your Secretary, to prepare a paper for this Association. The scope of the subject, the scientific audience and the high character of the papers usually presented to you made me reluctant to appear with the hope of presenting anything new or of presenting what is already familiar to you in a new and interesting form. I rely entirely on that generous courtesy which my friend Mr. Williams in a previous paper has described as the characteristic of the highly intellectual.

While the title of this paper is Chemistry Applied to Industry, you will find that the illustrations are drawn principally from the iron industry. This is done not only because in all its branches it is perhaps the largest in point of tonnage and invested capital of any industry, with the exception of agriculture, but mainly because it is the one I am most familiar with; and our teachers of composition used to tell us that we could only write a lucid explanation of any subject when we first had a clear conception of it in our own minds.

Chemistry is the youngest of the great divisions of science. The alchemists, working under the stimulus of being able to transform ordinary metals like lead into gold, though they did not succeed in accomplishing that which they undertook, they collected a great number of unorganized chemical facts and laid the foundation of what has since become the science of chemistry. The science of chemistry may properly be said to have begun with the investigations of the great French chemist, Lavoisier, about 1770. In order to show just how crude the science was in his time it may be of interest to recite one or two of his experiments. It was generally believed in his time that water is transformed into earth by boiling, because it was a matter of common observation that whenever water is boiled for a time in a glass vessel a deposit of earthy matter is formed. In order to determine whether a transformation takes place or not Lavoisier boiled some water in a closed vessel. He weighed the water and vessel and the deposit and found they were just the same as before. He therefore concluded that the deposit came from the disintegration of the glass vessel by the action of the boiling water. The history of the experiment does not say whether he used distilled water or not. If it was not distilled water the conclusion, though natural, was erroneous. He repeated his experiments, weighing the vessel, the water and the deposit separately. He found there was just as much water as before, and that the weight of the deposit was exactly equal to the loss in weight of the vessel.

This shows conclusively that the water he used was distilled water, and it proved beyond doubt that the water he boiled was not transformed into earth. Lavoisier followed these investigations with further experiments and was enabled to give an explanation of the process of burning which up to this time had been a subject of study. The result of his experiments, which has entitled him to his eminent place in science, was to establish the fact that in all reactions the weight of the substances entering into action is in every case equal to the weight of the substances formed by the action. This is now known as the law of the indestructibility of matter.

Innumerable experiments since Lavoisier's time have served to impress this doctrine so firmly in the minds of scientists that it seemed to be a truth apart altogether from experiment. Indeed, Mr. Herbert Spencer, in his First Principles, went so far as to say that the doctrine of the indestructibility of matter has its foundation independent entirely of teachings of chemistry.

He claimed that this doctrine is the product of the mind itself, and that the reason of our strong belief in the law is our inability to conceive of matter being destroyed. He says it takes an educated mind to appreciate this, but that the real foundation of the law is the impossibility of a trained intellect to conceive of the process by which something is transformed into nothing or of the process by which nothing is evolved into something. Now, while this seems to me sound and logical, the discoveries of chemists during the last few years have thrown some doubt on our most cherished ideas, and have led some of our foremost men to think that when our minds become more highly trained the things which now seem inconceivable may prove to be real and tangible facts. Prof. Ramsay has said recently in an interview that all previous calculations of science are likely to be upset by radium. We may soon be compelled to revise some of the scientific theories which are now regarded as cardinal. One extraordinary quality of radium salts is that the evolution of heat and energy goes on continuously apparently without combustion without chemical change of any kind and without adulteration of its molecular structure. At the expiration of a month of activity the salt is quite as great as it was in the beginning of the experiment. Such phenomena as these seem very difficult to reconcile with the laws of the conservation of matter and energy.

I have made these references to chemistry, past and present, in order to show you that while chemistry lays claim to credit for a large share of the advance in modern industry, it is still too young to be without some unsolved problems. But I think it will be agreed that having started so late the science of chemistry has made wonderful progress and has been of inestimable advantage to nearly every industry.

There is a peculiar virtue in the application of chemistry to manufacture that is characteristic of nearly every branch in which it is introduced. Nearly every commodity that is made for human needs has its beginning in the hands of "practical" workmen, men without scientific training, who have some special aptitude for the work chosen. There is no disputing the value of these men to any industry. Thirty years ago the manufacture of iron was wholly in the hands of these men. They made iron from the ores and converted it into steel, or rather wrought iron, by methods handed down from their fathers and improved upon by their own experience. They worked "by rule of thumb," and in the making of pig iron they had about reached their limit. With the introduction of chemistry, iron-making became an accurate, scientific process. The defects and limitations of old methods were pointed out and direction was given to the lines along which the industry could be improved. As I have said, this is the peculiar virtue of chemistry, that it comes to the industry when it has been developed to its highest point mechanically, decides if any further improvement can be made, indicates along what lines such improvement is possible, and tells us exactly how far such improvement will extend.

To illustrate, Sir Lowthian Bell was the first to study scientifically the chemical reactions which take place in the blast furnace, and the result of his investigation was to show that the carbon in the fuel is burnt to carbon monoxide in the hearth of the furnace. That this carbon monoxide then acts on the ore in the upper part of the furnace, taking hold of the oxygen of the ore and setting the iron free. Now, it was shown that though this is the way in which a good deal of the ore is reduced, it was also shown that considerable of the ore found its way into the hearth, where it was reduced by the white hot carbon of the fuel. Now, here entered the special function of chemistry. By calculating the heat units absorbed and evolved in these reactions it was proved that the more ore which reached the hearth unreduced by the gas and which had to be reduced by the solid carbon the more fuel would be required for the operation. It was apparent from this that if the ore could be kept from direct contact with the fuel and allowed to be acted upon only by the gas a great economy in fuel would result. The only way to accomplish this perfectly was to build two shafts or furnaces, charging the one with coke only and the other with ore only, burning the coke in one and driving the resulting gas through the other. This has never been done, but an improvement has been made on the old method which has fully justified the calculations of chemists. Formerly furnaces were charged by mixing the ore and coke on the bell before dumping into the furnace. In this way each piece of ore was practically in contact with each lump of coke. The present method, which has displaced the former at all well-managed furnaces, is to charge separate layers of ore and fuel in order that coke and ore may be as nearly separated as possible. The saving of fuel accomplished by this method has been abundantly proved, and in its train have followed an increased output and more uniform grade of iron.

There is another improvement in furnace practice due to chemistry which has received a practical demonstration only within the last few months. The chemical study of blast furnace operation has shown that any moisture entering the furnace with the blast of air was decomposed by the white hot carbon into its elements hydrogen and oxygen. By analyzing the gas given off at the furnace top it was shown that the hydrogen escaped as such and that the heat absorbed in separating hydrogen from its combined oxygen was lost to the furnace. The amount of moisture commonly present in air is small, but when you consider the enormous volume of air blown into the furnace the content of water becomes a factor in furnace economy. A medium sized furnace making 300 tons of iron per day requires 33,000 cubic feet of air per minute, equivalent to 18 million cubic feet in 24 hours. Assuming this air to have 6 grains of moisture per cubic foot throughout the day we find that in the 24 hours no less than 36,000 pounds of water have been introduced into the furnace. Now here was a loss which chemistry has pointed out to iron makers, and which would never have been realized without its assistance. Now, just as an astronomer observing the deviation in the course of a planet can locate its cause, measure the deflection in its path, and tell that in a certain place, at a certain time, we shall see a new heavenly body, just as exactly has the chemist observed a waste of heat in the hearth of the furnace, located its cause, and told us that when certain interfering elements are removed certain definite improvements will follow.

The experiment was made last September at the Isabella furnaces of the Carnegie Steel Co., at Pittsburg, of drying the air before blowing it in the furnace, by means of refrigeration. The air is passed over pipes containing a brine by which the air is cooled to such a degree that the moisture is condensed into water and frost. The air enters the furnace practically dry, and the immediate result was to reduce the fuel consumption nearly 25 per cent. Before using the dry blast the furnace averaged for two weeks 340 tons per day, with a fuel consumption of 2,200 lbs. of coke per ton of iron. Without making any other change the dry blast was introduced, and for two weeks following the output was nearly a hundred tons a day more, and the fuel consumption 1,700 lbs. per ton of product.

There is one more illustration drawn from the iron industry where chemistry has been a very great aid in securing economy of operation, which is applicable to all cases where power is produced from the combustion of coal. Analysis of the composition of coal and determination of the heat evolved in the combustion of its elements has shown that but a very small part of the energy of the coal is developed into useful motion. The best boilers constructed and maintained under the best conditions do not show more than 65 per cent. of the energy of the coal in the form of steam, and the best engines do not develop more than one-third of the energy of the steam into useful motion. Now, these are the best types and they show that with combination of engine and boiler not more than one-fifth of the energy of the coal is transformed into motive power. We must remember that chemists have done a great deal to show what is the most suitable amount of air and the best design of grates and combustion chamber in order in the first place to get the coal properly burned. They have done enough to show that with proper grate surface and sufficient air supply and combustion chambers of the proper temperature, there is no necessity for factories using the worst kinds of soft coal to contaminate our atmosphere and soil our best buildings with dense clouds of black smoke. So that when we speak of engines showing 20 per cent. efficiency, we are already indebted to chemistry, for it is doubtful if the average engine in this country or the United States shows anywhere near this efficiency. But, as I have said before, the science of chemistry has served to show us the great amount of power we are wasting in every steam-producing plant using only 20 per cent. at best of the power in the coal, and allowing 80 per cent. to go to waste. In every case where permanent improvement has been made, it has always followed a vivid realization of the inadequacy of the method in use. And in the production of power this is what chemistry has done. The application of these ideas to the iron industry has already borne fruit. Probably because the fuel for producing power is already in the form of gas, and perhaps also because the figures for this industry are so large that the economy attainable appears a very tempting prize, engineers have designed and constructed gas engines or internal combustion engines in which the waste gas from the furnace is led directly into the cylinder of engine without the use of steam at all. When the waste gas from a furnace is used directly in the gas engine instead of being burnt under the wasteful boilers to produce steam for the still more wasteful engines, we find the saving so great that where previously thousands of tons of coal were being burnt to assist the gas in producing power, the blast furnace has now assumed a commanding position as a power-producer with power for sale.

In the last few years gas engines have made tremendous strides in relation to iron production, and it is now predicted that the iron industry will follow the course of its kindred industry, the manufacture of coke. In this case the coal, originally burnt or distilled for the sake of the coke, allowing the gases and coal tar to escape, is now distilled in retorts, or ovens, for the sake of the coal tar, ammonia and gas, the question of marketing the coke being a secondary matter. It is curious to observe how these substances were originally termed bye-products in the production of coke, whereas now the coal tar, gas and ammonia, far exceeding the coke in value, has made the latter a bye-product. So it is claimed we shall soon see blast furnaces built with the object primarily of supplying power, and producing iron as a bye-product.

In connection with the elements recovered from heating coal, there has grown up an industry more purely reliant on the science of chemistry than any I have mentioned: the manufacture of indigo. At one time the making of a substance like indigo in the laboratory had a glory about it for chemists which the advance in science has made commonplace. Indigo is a coloring matter obtained from various plants which grow in warm countries. It was at one time believed that organic compounds like indigo, elaborated under the influence of the life process, must have something about them which distinguishes them from the inorganic compounds like minerals, in whose formation the life process has no part. Gradually, however, this idea has been abandoned, for one by one the compounds which are found in animals and plants have been made in the chemical laboratory.

Indigo is a very valuable article of commerce, and not many years ago all the indigo used in manufacture was made by fermentation from the glucoside, **indican,** which occurs in several plants commonly grown in the East and West Indies. At the proper stage of growth the plants are cut off to the ground, put into a large tank, and covered with water. Fermentation takes place, the indican of the plant breaking up and yielding indigo. The liquid becomes green and then blue. When the fermentation is finished the liquid is drawn off into a second tank. This liquid contains the coloring matter in solution. In contact with the air it is oxidized, forming indigo, which, being insoluble, is thrown down. Finally the clear liquid is drawn off, the precipitated indigo pressed and dried, and then sent to market.

At the present time the artificial, or chemically made indigo, has outstripped the natural article, and will, I think, eventually drive it out altogether.

The starting point in the manufacture of indigo, as well as of the group of substances included under the head of aniline dyes, is coal tar. It is a thick, black, tarry liquid, obtained by heating coal in retorts. It is an extremely complex mixture, from which a great many substances have been obtained. When the tar is heated of course the most volatile liquids pass over first. These are collected in vessels containing water. The first portions of the distillate float on the water and constitute what is called the **light soil.** After a time substances of greater specific gravity pass over, which sink under water and constitute the **heavy oil.** From the light oil we obtain hydrocarbons, benzene and toluene. As these hydrocarbons form the basis of a number of important industries, they are separated from coal tar on a large scale. Starting with toluene, benzoyl, chloride is obtained by treating wth chlorine. This is converted into cinnamic acid. This dissolved in nitric acid yields ortho-nitro-cinnamic acid. Treated with alcoholic potash this is converted into ortho-nitro-phenyl-propiolic acid, which, on being reduced with sugar yields indigo. I don't think I need say anything else to convince you that this is a purely chemical industry. Indeed, some of you may think that while the previous illustrations were examples of chemistry applied to industry, this ought to be classed as an example of industry applied to chemistry.

If time would permit, and I had the ability, I might show you how chemistry has been a benefit to industry in almost every line of human activity: how it has helped the farmer, showing him not only the value of rotation of crops, but exactly what are the best crops to sow in rotation; how it has helped the foundryman to make good castings, showed him what class of iron is suitable for light, thin castings like stove plates, sewing machines, etc., and what iron will give the requisite strength and toughness for engine beds; how chemistry has transformed the cement industry from a rule of thumb process to an exact scientific industry; how it has made gas mantles to improve the quality of lighting and decrease the cost; how it has purified sewage and in a thousand different ways been of benefit to the human race. I have shown you how substance, developed in the process of life, can be made in the laboratory; and some imaginative chemists have pictured the time when meat, flour, coffee and food stuffs generally will be made artificially, in place of by the natural process of plant and animal life. And with the developments which have come in the short space of three generations, since Dalton enunciated the atomic theory, one must be bold indeed to set limits to the accomplishments of chemistry.

SYNOPSIS OF LECTURE ON PANAMA SEA-LEVEL WATERWAY.

Delivered before Hamilton Scientific Association, February 28, 1905.

BY W. R. WARNER, F. R. A. S., OF CLEVELAND.

Mr. Adam Brown introduced the lecturer as follows:

I regard it a very high honor to preside at a meeting at which so distinguished a man as Professor Warner is to speak. Seldom has Hamilton been honored as it is to-night. Mr. Warner is head of the firm of Warner & Swayze, Cleveland, Ohio, who are manufacturers of fine machinery. What I mean by fine machinery is not that it is necessarily small machinery, because they manufacture the most ponderous things; but all, large or small, that comes out of the hands of the firm has the stamp of neatness and accuracy. They are manufacturers of mathematical and physical instruments, and the largest telescopes in the world have come from this firm. That wonderful Yerkes telescope, which so many of us saw at the World's Fair in Chicago, was made by them, as also the Lick telescope. They are great naval telescope manufacturers, and also of transit instruments for taking time; and it is from instruments made by Warner & Swayze that the time is flashed through the world. The magnificent telescope, which has just been sent to Ottawa, was the product of their factory, and when we Canadians look through that splendid instrument we will think of our friend Mr. Warner.

His firm are also manufacturers of range finders for warships. You may want to know what a range finder is. In the case of war, when a vessel of the enemy comes in sight, the range finder of the war-ship on the watch discovers the exact distance she is away, everything is adjusted, a button is touched, then boom goes the cannon. That is the war feature. It has its good uses in peaceful commerce as well.

I am told by one who has seen them that the large works of Warner & Swayze in every department are models of neatness and order; everything so bright that it is like a scientific palace. Every day at ten Mr. Warner meets the head of each department to talk over matters. All must be there to the second.

Mr. Warner, in addition to being a large manufacturer, is one of the grand kind of men who can find time to take an interest in educational and church matters, apart from the great affairs he has to think about. He is on the Senate of two Universities in Cleveland, one being the Western Reserve University. Besides this he is an elder in the Presbyterian church, and, as did another great man, Mr. Gladstone, considers it an honor and privilege to assist in the services of his church when such help is required of him.

This audience will be pleased to know that Mr. Warner invited our President, Rev. Dr. Marsh, to visit their works and examine the instruments made for the St. Louis Exposition before they were sent there.

On the invitation of the United States Senate, our distinguished friend went to Panama as a scientific expert to examine a sea level waterway and to report. A committee of the Senate accompanied him. That subject is one of such importance that language fails to describe it. You will hear of this wonderful work to-night, a work that will revolutionize the commerce of the entire world. It is more than kind of Mr. Warner to come to Hamilton. He is a very busy man, and is off in the morning early to lecture in New York before the American Society of Civil Engineers. He is building his own monument while he lives as a benefactor of his race. His good name, his personality and fame have preceded him here. I will not keep you longer from the treat in store for you and have unusual pleasure in introducing our distinguished American friend, Mr. Warner, of Cleveland, who will address you on "The Panama Sea Level Waterway."

Mr. Warner prefaced his remarks by a short history of Panama. This is the second oldest city in America, having been founded in 1515, and as early as 1555 a commission had reported on the possibility of making a waterway connecting the two oceans. The report which was made at the request of Charles V. of Spain, stated that it was an impossible undertaking and that there was no king powerful enough to do it. Nothing was heard of the proposition again until the middle of the last century. In 1855 the first railway was built across the isthmus. The first mention of a United States commission was in 1869. Mr. Warner referred briefly to the efforts of De Lesseps Company, who spent, or rather threw away, $275,000,000 on the undertaking. Their successors had sold out to the United States Government, and since then the whole plan of the undertaking is changed. A commission had been appointed to examine all the routes metioned, and this commission recommended that the Panama route be chosen provided a clear right of way could be obtained. This led up to the appointment of the last commission, of which Mr. Warner was a member, and as a result of whose labors and investigations the United States Government has decided to abandon the old lock system of canal started by the French company and construct a sea-level waterway. Just a day or two ago the first definite engineering plans for the construction of the Panama Canal were laid before the Isthmian Canal Commission by the Engineering Committee of that body, consisting of Commissioners Burr, Parsons and Davis.

The principal recommendations were summed up in this resolution:

That this committee approve and recommend for adoption by the commission a plan for a sea-level canal, with a bottom width of 150 feet and a minimum depth of water of 35 feet and with twin tidal locks at Miraflores, whose usable dimensions shall be 1,000 feet long and 100 feet wide, at a total estimated cost of $230,500,000.

Such estimate includes an allowance for administration, engineering, sanitation and contingencies, amounting to $38,450,000, but without allowance for interest during construction, expenses of zone government and collateral costs, and water supply, sewers or paving of Panama or Colon, which last items are to be repaid by the inhabitants of those cities.

The committee estimated that a sea-level canal could be completed within from ten to twelve years from the present time.

The committee decided that under no circumstances should the surface of the canal be more than sixty feet above the sea, and estimated that at this level the cost would be $178,013,406. A thirty foot level was estimated to cost $194,213,406.

With the aid of a number of fine stereopticon views the lecturer was able to show his hearers more clearly the various points of interest and important incidents of the trip. In this connection he gave a little lecture on geography, imparting a few bits of information not generally known. He said that it might be surprising to know that the Pacific end of the proposed canal was east of the Atlantic end. To illustrate how little people generally refer to their maps and globes, he said that many would hardly credit that Rome was no further south than Buffalo, and that Liverpool was east of Edinburgh. The views showed in a striking way the shocking recklessness and wilfulness of the French in building the canal.

CONQUEST OF WILD CANADA.

Abstract of paper by PROF. COLEMAN, *on March 9th, from Minutes.*

The struggle implied in the title was not of a military nature, but rather an attempt to trace the enterprise of those that had most to do with founding and developing our country.

Every surviving animal conquers its surroundings and makes use of its environment.

In this country other animals than man had made his work easier. The deer beat runways connecting drinking places with pasture lands and browsing grounds, and these runways were utilized by explorers and the early settlers.

He referred to the part the beaver had played in helping man by making clearings in the forest and spoke highly of the great intelligence shown by him as hydraulic engineer, in being able, by the placing of comparatively small obstructions in the streams, to flood such extensive food-yielding areas.

The first conquerors in the shape of man were Indians. Without metal for making weapons or implements of any kind it must have been difficult for them to live. They opened trails which were found by the white man to be the **dry, quick, short way** from place to place. Travelled much by water. Had to devise their own craft; built the bark canoe so well that it has never been surpassed for short windings and portages. Canoe only available for summer. For winter use the snowshoe and the toboggan stand above all other devices. With these and his bow and arrow and traps he obtained part of his living, and his garden supplied the rest.

Gardening was carried on by the Indians far more extensively than is generally known. They got corn from some place unknown, and pumpkins and beans. Gardening was brought to so advanced a stage probably because the noble red man himself was above such low pursuits and in his generous nature allowed the squaw to do all the work. Fire was the most important discovery of the Indian and he soon learned to apply it. He thus reached the starting point of a whole civilization whose further development was broken in upon by the coming of the white man.

The next conquerors of Canada were the Frenchmen. Shrewd as the Indian and possessing great advantages in the gun, the steel axe, and tools and implements of metal, they became very proficient with the canoe on the numerous water stretches and as runners of the forest, and explored the whole country as far as the Rocky Mountains. The lecturer said the enterprise of the early French was really marvellous.

He next told of the conquest of the country by the English as being of an entirely different kind. There were no clearings except beaver meadows and Indian gardens. He described the war against trees in overcoming the great hardwood forests, which he said were the finest in the world and whose destruction he deeply regretted; vast quantities being burnt for ashes, which yielded the only available article of export in early times.

He told of the early settler's shanty, constructed without nails or metal in any form, with its scoop roof and clay fireplace; described the hardship and privations of the pioneer life and means of communication by killhorse roads up hills 400 or 500 feet high, over which it was necessary to go sometimes forty or fifty miles to a flour mill.

Later, when timber became a marketable article, the lumberman controlled the forest with his log rollway, snow road, ice road and watersleigh, on which the load sometimes contains twelve cords of logs. He introduced the pointer, made of heavy plank, long, narrow and flat-bottomed, to replace the frail canoe. He devised the timber raft, with its detachable sections for passing rapids, as a means of conveying his timber to shipping ports.

Professor Coleman referred to the great havoc wrought by the forest fires, describing some he saw that extended over fifty miles of forest, and made the remarkable statement that one-half Canada's timber has gone up in smoke.

In the last five years the explorers, surveyors and geologists (often combining all three in one) of the Ottawa Survey, have done much hard work and given good results in filling up the gaps in our information concerning the northern forest land.

The next part of the lecture dealt with the prairie lands. The prairie is the horse's paradise, he said; but the earliest Indians there had no horses and so were hampered in their movements. Horses had been there long before, but had disappeared. Those used by the Indians were of the stock brought by the Spaniards. The Indian's love for his horse is partly owing to the fact that he can do so much towards taking care of himself on the prairie. They had their wheelless carriages constructed by lashing poles to the sides of the ponies and having one end trail on the ground. The white man improved on this when he devised his Red River Cart of wood, whose groaning and wailing were so well described by the lecturer. Then came the prairie schooner, with its motive force of twenty horses or oxen, and finally the railroad, completing the conquest of the plains.

Man's struggle with the Rocky Mountain ranges was graphically described—the pack-train, with its pony load of 250 pounds, and its famous diamond hitch. The roads of British Columbia are the most remarkable in the world, leading to almost inaccessible places, and can be accounted for only by the fact that "where gold is man will be, if he knows it."

He described river navigation in flat-bottomed, stern-wheel steamers and the famous dugout of the Chinook Indians and the remarkable dexterity with which they descend the mountain torrents.

A fine chart of the results of the geological survey of the Dominion was shown and explained, showing how small a part of our vast country (3,000,000 square miles) has yet been utilized.

Professor Coleman in conclusion made patriotic reference to his faith in the growth of Canada and predicted that this century would be our century of advancement to greatness among the nations of the world.

ORIGIN OF BANKING IN ENGLAND.

Compiled by Stuart Strathy, *from Macaulay and other sources.*

Lecture delivered on April 27, 1905.

"In the reign of William, Prince of Orange, old men were still living who could remember the days when there was not a single banking house in the city of London. So late as the time of the Restoration of Charles II. every trader had his own strong box in his own house, and, when the acceptance was presented to him, told down the crowns and caroluses on his own counter. But the increase of wealth had produced its natural effect, the subdivision of labor. Before the end of the reign of Charles II. a new mode of paying and receiving money had come into fashion among the merchants of the capital. A class of agents arose, whose office was to keep the cash of the commercial houses. This new branch of business naturally fell into the hands of goldsmiths, who were accustomed to traffic largely in the precious metals, and who had vaults in which great masses of bullion could lie secure from fire and from robbers. It was at the shops of the goldsmiths of Lombard street that all the payments in coin were made. Other traders gave and received nothing but paper.

This great change did not take place without much opposition and clamor. Old-fashioned merchants complained bitterly that a class of men who, thirty years before, had confined themselves to their proper functions, and had made a fair profit by embossing silver bowls and chargers, by setting jewels for fine ladies, and by selling pistoles and dollars to gentlemen setting out for the Continent, had become the treasurers, and were fast becoming the masters, of the whole city. These usurers, it was said, played at hazard with what had been earned by the industry and hoarded by the thrift of other men. If the dice turned up well, the knave who kept the cash became an alderman; if it turned up ill, the dupe who furnished the cash became a bankrupt. On the other side the conveniences of the modern practice were set forth in animated language. The new system, it was said, saved both labor and money. Two clerks, seated in one counting house, did what, under the old system, must have been done by twenty clerks in twenty different establishments. A goldsmith's note might be transferred ten times in a morning; and thus a hundred guineas, locked in his safe close to the Exchange, did what would formerly have required a thousand guineas, dispersed through many tills, some on Ludgate Hill, some in Austin Friars, and some in Tower street.

Gradually even those who had been loudest in murmuring against the innovation gave way and conformed to the prevailing usage. The last person who held out, strange to say, was Sir Dudley North. When, in 1680, after residing many years abroad, he returned to London, nothing astonished or displeased him more than the practice of making payments by drawing bills on bankers. He found that he could not go on Change without being followed round the piazza by goldsmiths, who, with low bows, begged to have the honor of serving him. He lost his temper when his friends asked him where he kept his cash. "Where should I keep it," he asked, "but in my own house?" With difficulty he was induced to put his money into the hands of one of the Lombard Street men, as they were called. Unhappily, the Lombard Street man broke, and some of his customers suffered severely. Dudley North lost only fifty pounds; but his loss confirmed him in his dislike of the whole mystery of banking. It was in vain, however, that he exhorted his fellow citizens to return to the good old practice, and not to expose themselves to utter ruin in order to spare themselves a little trouble. He stood alone against the whole community. The advantages of the modern system were felt every hour of every day in every part of London; and people were no more disposed to relinquish those advantages for fear of calamities which occurred at long intervals than to refrain from building houses for fear of fires, or from building ships for fear of hurricanes. It is a curious circumstance that a man who, as a theorist, was distinguished from all the merchants of his time by the largeness of his views and by his superiority to vulgar prejudices, should, in practice, have been distinguished from all the merchants of his time by the obstinacy with which he adhered to an ancient mode of doing business, long after the dullest and most ignorant plodders had abandoned that mode for one better suited to a great commercial society.

No sooner had banking become a separate and important trade, than men began to discuss with earnestness the question whether it would be expedient to erect a national bank. The general opinion seems to have been decidedly in favor of a national bank. Two public banks had long been renowned throughout Europe, the Bank of St. George at Genoa, and the Bank of Amsterdam. The immense wealth which was in the keeping of those establishments, the confidence which they inspired, the prosperity which they had created, their stability, tried by panics, by wars, by revolutions, and found proof against all, were favorite topics. The bank of Saint George had nearly completed its third century. It had begun to receive deposits and to make loans before Columbus had crossed the Atlantic, before Gama had turned the Cape, when a Christian Emperor was reigning at Constantinople, when a Mahommedan Sultan was reigning at Grenada, when Florence was a Republic, when Holland obeyed an hereditary Prince. All these things had been changed. New continents and new oceans had been discovered. The Turk was at Constantinople; the Castilian was at Grenada; Florence had its hereditary Prince; Holland was a Republic; but the Bank of Saint George was still receiving deposits and making loans. The Bank of Amsterdam was little more than eighty years old; but its solvency had stood severe tests. Even in the terrible crisis of 1672, when the whole Delta of the Rhine was overrun by the French armies, when the white flags were seen from the top of the Stadthouse, there was one place where, amidst the general consternation and confusion, tranquility and order were still to be found; and that place was the Bank. Why should not the Bank of London be as great and as durable as the Banks of Genoa and of Amsterdam? Before the end of the reign of Charles the

Second several plans were proposed, examined, attacked and defended. Some pamphleteers maintained that a national bank ought to be under the direction of the King. Others thought that the management ought to be entrusted to the Lord Mayor, Aldermen and Common Council of the capital. After the Revolution the subject was discussed with an animation before unknown. For, under the influence of liberty, the breed of political projectors multiplied exceedingly. A crowd of plans, some of which resemble the fancies of a child or the dreams of a man in a fever, were pressed on the government. Preeminently conspicuous among the political montebanks, whose busy faces were seen every day in the lobby of the House of Commons, were John Briscoe and Hugh Chamberlayne, two projectors worthy to have been members of that Academy which Gulliver found at Lagado. These men affirmed that the one cure for every distemper of the State was a Land Bank. A Land Bank would work for England miracles such as had never been wrought for Israel, miracles exceeding the heaps of quails and the daily shower of manna. There would be no taxes; and yet the Exchequer would be full to overflowing. There would be no poor rates; for there would be no poor. The income of every landowner would be doubled. The profits of every merchant would be increased. In short, the Island would, to use Briscoe's words, be the paradise of the world. The only losers would be the moneyed men, those worst enemies of the nation, who had done more injury to the gentry and yeomanry than an invading army from France would have had the heart to do.

These blessed effects the Land Bank was to produce simply by issuing enormous quantities of notes on landed security. The doctrine of the projectors was that every person who had real property ought to have, beside that property, paper money to the full value of that property. Thus, if his estate was worth two thousand pounds, he ought to have his estate and two thousand pounds in paper money. Both Briscoe and Chamberlayne treated with the greatest contempt the notion that there could be an over-issue of paper as long as there was, for every ten pound note, a piece of land in the country worth ten pounds. Nobody, they said, would accuse a goldsmith of over-issuing as long as his vaults contained guineas and crowns to the full value of all the notes which bore his signature. Indeed, no goldsmith had in his vaults guineas and crowns to the full value of all his paper. And was not a square mile of rich land in Taunton Dean at least as well entitled to be called wealth as a bag of gold or silver? The projectors could not deny that many people had a prejudice in favor of the precious metals, and that therefore, if the Land Bank were bound to cash its notes, it would very soon stop payment. This difficulty they got over by proposing that the notes should be inconvertible, and that everybody should be forced to take them.

The speculations of Chamberlayne on the subject of the currency may possibly find admirers even in our own time. But to his other errors he added an error which began and ended with him. He was fool enough to take it for granted, in all his reasonings, that the value of an estate varied directly as the duration. He maintained that if the annual income derived from a manor were a thousand pounds, a grant of that manor for twenty years must be worth twenty thousand pounds, and a grant for a hundred years worth a hundred thousand pounds. If, therefore, the lord of such manor would pledge it for a hundred years to the Land Bank, the Land Bank might, on that security, instantly issue notes for a hundred thousand pounds. On this subject Chamberlayne was proof to ridicule, to argument, even to arithmetical demonstration. He was reminded that the fee simple of land would not sell for more than twenty years' purchase. To say, therefore, that a term of a hundred years was worth five times as much as a term of twenty years, was to say that a term of a hundred years was worth five times the fee simple; in other words, that a hundred was five times infinity. Those who reasoned thus were refuted by being told that they were usurers; and it should seem that a large number of country gentlemen thought the refutation complete.

In December, 1693, Chamberlayne laid his plan, in all its naked absurdity, before the Commons, and petitioned to be heard. He confidently undertook to raise eight thousand pounds on every freehold estate of a hundred and fifty pounds a year which should be brought, as he expressed it, into his Land Bank, and this without dispossessing the freeholder. All the squires in the House must have known that the fee simple of such an estate would hardly fetch three thousand pounds in the market. That less than the fee simple of such an estate could, by any device, be made to produce eight thousand pounds, would, it might have been thought, have seemed incredible to the most illiterate fox-hunter that could be found on the benches. Distress, however, and animosity had made the landed gentlemen credulous. They insisted on referring Chamberlayne's plan to a committee; and the committee reported that the plan was practicable, and would tend to the benefit of the nation. But by this time the united force of demonstration and derision had begun to produce an effect even on the most ignorant rustics in the House. The report lay unnoticed on the table; and the country was saved from a calamity compared with which the defeat of Landen and the loss of the Smyrna fleet would have been blessings.

All the projectors of this busy time, however, were not so absurd as Chamberlayne. One among them, William Paterson, was an ingenious, though not always a judicious, speculator. Of his early life little is known except that he was a native of Scotland, and that he had been in the West Indies. In what character he had visited the West Indies was a matter about which his contemporaries differed. His friends said he had been a missionary; his enemies that he had been a buccaneer. He seems to have been gifted by nature with fertile invention, an ardent temperament and great powers of persuasion, and to have acquired somewhere in the course of his vagrant life a perfect knowledge of accounts.

This man submitted to the government in 1691 a plan of a national bank; and his plan was favorably received both by statesmen and merchants. But years passed away, and nothing was done, till, in the spring of 1694, it became absolutely necessary to find some new mode of defraying the charges of the war. Then at length the scheme devised by the poor and obscure Scottish adventurer was taken up in earnest by Montague. With Montague was closely allied Michael Godfrey, the brother of that Sir Edmondsbury Godfrey whose sad and mysterious death, had, fifteen years before, produced a terrible outbreak of popular feeling. Michael was one of the ablest, most upright, and most opulent of the merchant princes of London. He was, as might have been expected from his near connection with the martyr of the Protestant faith, a zealous Whig. Some of his writings are still extant, and proved him to have had a strong and clear mind.

By these two distinguished men Paterson's scheme was fathered. Montague undertook to manage the House of Commons, Godfrey to manage the city. An approving vote was obtained from the Committee of Ways and Means; and a bill, the title of which gave occasion to many sarcasms, was laid on the table. It was indeed not easy to guess that a bill, which purported only to impose a new duty on tonnage for the benefit of such persons as should advance money towards carrying on the war, was really a bill creating the greatest commercial institution that the world has ever seen.

The plan was that twelve hundred thousand pounds should be borrowed by the government on what was then considered as the moderate interest of eight per cent. In order to induce capitalists to advance the money promptly on terms so favorable to the public, the subscribers were to be incorporated by the name of the Governor and Company of the Bank of England. The corporation was to have an exclusive privilege, and was to be restricted from trading in anything but bills of exchange, bullion and forfeited pledges.

As soon as the plan became generally known, a paper war broke out as furious as that between the swearers and the nonswearers, or as that between the Old East India Company and the New East India Company. The projectors who had failed to gain the ear of the government fell like madmen on their more fortunate brother. All the goldsmiths and pawnbrokers set up a howl of rage. Some discontented Tories predicted ruin to the monarchy. It was remarkable, they said, that Banks and Kings had never existed together. Banks were republican institutions. There were flourishing banks at Venice, at Genoa, at Amsterdam and at Hamburg. But who had ever heard of a Bank of France or a Bank of Spain? Some discontented Whigs, on the other hand, predicted ruin to our liberties. Here, they said, is an instrument of tyranny more formidable than the High Commission, than the Star Chamber, than even the fifty thousand soldiers of Oliver. The whole wealth of the nation will be in the hands of the Tonnage Bank—such was the nickname then in use—and the Tonnage Bank will be in the hands of the Sovereign. The power of the purse, the one great security for all the rights of Englishmen, will be transferred from the House of Commons to the Governor and Directors of the new Company. This last consideration was really of some weight, and was allowed to be so by the authors of the bill. A clause was therefore inserted which inhibited the Bank from advancing money to the Crown without authority from Parliament. Every infraction of this salutary rule was punished by forfeiture of three times the sum advanced; and it was provided that the King should not have power to remit any part of the penalty.

The plan, thus amended, received the sanction of the Commons more easily than might have been expected from the violence of the adverse clamor. In truth, the Parliament was under duress. Money must be had, and could in no other way be had so easily. What took place when the House had resolved itself into a Committee cannot be discovered; but while the Speaker was in the chair, no division took place.

The bill, however, was not safe when it had reached the Upper House. Some lords suspected that the plan of a National Bank had been devised for the purpose of exalting the moneyed interest at the expense of the landed interest. Others thought that this plan, whether good or bad, ought not to have been submitted to them in such a form. Whether it would be safe to call into existence a body which might one day rule the whole commercial world, and how such a body should be constituted, were questions which ought not to be decided by one branch of the Legislature. The peers ought to be at perfect liberty to examine all the details of the proposed scheme, to suggest amendments, to ask for conferences. It was therefore unfair that the law establishing the bank should be sent up as part of a law granting supplies to the Crown. The Jacobites entertained some hope that the session would end with a quarrel between the Houses, that the Tonnage Bill would be lost, and that William would enter on the campaign without money. It was already May, according to the New Style. The London season was over; and many noble families had left Covent Garden and Soho Square for their woods and hayfields. But summonses were sent out. There was a violent rush back to town. The benches which had only been deserted so lately were crowded. The sittings began at an hour unusually early, and were prolonged to an hour unusually late. On the day on which the bill was committed the contest lasted without intermission from nine in the morning until six in the evening. Godolphin was in the chair. Nottingham and Rochester proposed to strike out all the clauses which related to the Bank. Something was said about the danger of setting up a gigantic corporation which might soon give law to the King and the three Estates of the Realm. But the peers seemed to be most moved by the appeal which was made to them as landlords. The whole scheme, it was asserted, was intended to enrich usurers at the expense of the nobility and gentry. Persons who had laid by money would rather put it into the Bank than lend it on mortgage at moderate interest. Caermarthen said little or nothing in defense of what was, in truth, the work of his rivals and enemies. He owned that there were grave objections to the mode in which the Commons had provided for the public service of the year. But would their Lordships amend a money bill? Would they engage in a contest of which the end must be that they must either yield, or incur the grave responsibility of leaving the Channel without a fleet during the summer? This argument prevailed; and, on a division, the amendment was rejected by forty-three votes to thirty-one. A few hours later the bill received the royal assent, and the Parliament was prorogued.

In the City the success of Montague's plan was complete. It was then at least as difficult to raise a million at eight per cent. as it would now be to raise one hundred millions sterling at four per cent. It had been supposed that contributions would drop in very slowly, and a considerable time had therefore been allowed by the Act. This indulgence was not needed. So popular was the new investment that on the day on which the books were opened three hundred thousand pounds were subscribed; three hundred thousand more were subscribed during the next forty-eight hours; and, in ten days, to the delight of all the friends of the Government, it was announced that the list was full. The whole sum which the Corporation was bound to lend to the State was paid in to the Exchequer before the first instalment was due. Somers gladly put the Great Seal to a charter framed in conformity with the terms prescribed by Parliament; and the Bank of England commenced its operations in the house of the Company of Grocers. There, during many years, directors, secretaries and clerks might be seen laboring in different parts of one spacious hall. The persons employed by the Bank were originally only fifty-four. They are now nine hundred. The sum paid yearly in salaries amounted at first to only four thousand three hundred and fifty pounds. It now exceeds two hundred and ten thousand pounds.

It soon appeared that Montague had, by skillfully availing himself of the financial difficulties of the country, rendered an inestimable service to his party. During several generations the Bank of England was emphatically a Whig body. It was Whig, not accidentally, but necessarily. It must have instantly stopped payment if it ceased to receive the interest on the sum which it had advanced to the government; and of that interest James the Pretender would not have paid one farthing. Seventeen years after the passing of the Tonnage Bill, Addison, in one of his most ingenious and graceful little allegories, described the situation of the great Company through which the immense wealth of London was constantly circulating. He saw Public Credit on her throne in Grocers' Hall, the Great Charter over her head, the Act of Settlement full in her view. Her touch turned everything to gold. Behind her seat, bags filled with gold were piled up to the ceiling. On her right and on her left the floors were hidden by pyramids of guineas. On a sudden the door flies open. The Pretender rushes in, a sponge in one hand, in the other a sword which he shakes at the Act of Settlement. The beautiful Queen sinks down fainting. The spell by which she has turned all things around her into treasure is broken. The money bags shrink liked pricked bladders. The piles of gold pieces are turned into bundles of rags or fagots of wooden tallies. The truth which this parable was meant to convey was constantly present to the minds of the rulers of the Bank. So closely was their interest bound up with the interest of the Government that the greater the public danger the more ready were they to come to the rescue. In old times, when the Treasury was empty, when the taxes came in slowly, and when the pay of the soldiers and sailors was in arrear, it had been necessary for the Chancellor of the Exchequer to go, hat in hand, up and down Cheapside and Cornhill, attended by the Lord Mayor and by the Aldermen, and to make up a sum by borrowing a hundred pounds from this hosier, and two hundred pounds from that ironmonger. Those times were over. The Government, instead of scooping up supplies from numerous petty sources, could now draw whatever it required from an immense reservoir, which all those petty sources kept constantly replenished. It is hardly too much to say that, during many years, the weight of the Bank, which was constantly in the scale of the Whigs, almost counterbalanced the weight of the Church, which was as constantly in the scale of the Tories."

The original capital of this Bank was the beginning of the national debt of Great Britain.

Looking back over two hundred years we see that the Bank has been of the greatest assistance to every Government. It started with tremendous opposition, as already shown, which, however, made the management exceedingly careful, and, in this way, the opposition which was shown to it was really a blessing in disguise. The capital of the Bank has been increased from time to time. In 1709 it was increased to four million pounds sterling, and, at the present time reaches the large sum of fourteen million five hundred and fifty-three thousand pounds sterling, at which figure it was increased in 1816 by a dividend of twenty-five per cent. of the stock to the shareholders of that date.

The shareholders that year, however, had to forego the usual dividend.

The Bank has been ready and able to assist the Government in every time of trouble. It was conspicuously helpful during the tremendous disaster which occurred to the financial world at the bursting of the South Sea Bubble, and, to instance a more recent assistance, which is still before the mind of the public, was the help that it gave to the financial world in coming to the rescue of the House of Baring.

The premises which the Bank now occupies is on Threadneedle Street, and comprises about four acres of land. The building is constructed in the shape of a fort and was built to resist attack by force from without, and, consequently, the architecture of it is somewhat plain. The building is entirely lighted by skylights and windows from the courts within. In 1772 the Bank was attacked during the Gordon Riots. It was repelled by the officers, who mounted guard, and by the assistance of the militia. Ever since that time a military force marches to the Bank at sunset and is on guard there until the Bank commences its business the next morning.

In 1826 the Bank surrendered its monopoly of issuing notes in the Provinces, retaining the sole right, however, of issuing notes within a radius of sixty-five miles of London.

In 1884 the Bank Act, introduced by Robert Peel. divided the Bank into two separate departments. The Bank was allowed at this time to issue fourteen million pounds sterling against securities, eleven million pounds sterling representing the debt owing by the Government to the Bank. All issue above this fourteen million pounds sterling has to be against gold coin or bullion of equal value to the issue, and which now amounts to about fifty million pounds sterling. There is no limit to this issue, but coin or bullion of equal value has to be deposited with it for every pound it issues beyond the amount allowed against securities. The Bank also has the right to take up two-thirds of the issue of all the Provincial Banks which had power to issue notes at that time and which had ceased to issue. It will thus be seen that the amount allowed the Bank to be issued against securities increases from time to time as it absorbs the issue which lapses with the Provincial Banks.

The Bank by this Act had to pay for all gold bullion of standard weight and fineness which was presented to it £3.17.9 per ounce. The English mint coins gold bullion free and pays £3.17.10½ per ounce for gold of standard weight and fineness, but, as a matter of fact, all bullion passes through the Bank of England, as the depositor can immediately get the equivalent of the amount of gold bullion deposited with the Bank at the above specified rate. In this way the depositor immediately realizes upon his deposit, which thus enables him to more than make up the difference which he would receive from the mint, as considerable time must elapse before he obtains returns from the mint. The Bank sells this gold from time to time when the market is favorable, and this profit, together with the 1½d. is only a fair profit for the transaction.

The ebb and flow of gold in the issue department is quite immaterial to that department. If gold is presented the Bank issues its circulation in lieu of the same, and, if the notes of the Bank are presented to the issue department, the Bank pays out the gold which has been deposited with it. This, of course, is altogether apart from the reserve held by the banking department, which, of course, has to be kept up at a very high standard at all hazards.

The principal functions of the Bank of England are three: First, it carries the balance of the Government; secondly, it is the bankers' bank, and thirdly, it carries accounts of individuals and corporations, but on no deposits of any kind whatsoever does it allow any interest.

The huge capital which the Bank possesses gives the greatest stability to the institution; but, from the shareholders' point of view it is not as profitable as some of the great Joint Stock Banks of England. The dividend which it pays ranges from eight to ten per cent. It competitors pay very much larger dividends on account of carrying a larger line of deposits which they attract by allowing interest on the same, besides which the capitalization of the great Joint Stock Banks is on a much smaller scale.

The Government account is the largest account which the Bank enjoys. There generally is at the credit of the Government between six and ten million pounds sterling. When the last war between Japan and China came to a close and China had to pay an indemnity to Japan of ten million pounds sterling, so great is the credit of the Bank of England that Japan instructed China to deposit this indemnity with the Bank of England on its account, and Japan actually issued paper currency which it circulated in its own country based upon this deposit. This was a unique compliment which no other Bank in the world has ever received.

The Bank controls the discount rate of the United Kingdom. Of necessity it must do this, as it carries the only reserve which maintains the whole credit system of Great Britain. This discount rate as it is raised or lowered has a very far-reaching effect. All listed securities of whatever kind are influenced by the discount rate established by this great Bank. The interest allowed by the Joint Stock Banks in England, or the interest which Joint Stock Banks charge to their customers are all affected by the open discount rate which is determined upon by the Bank directors week by week. International exchange and the flow and ebb of gold is all affected by this rate, which gives one only a small idea of the importance which this institution exerts not only in England but in the whole civilized world. When it raises its rate it attracts deposits from abroad. When it is necessary to strengthen its reserves, during ordinary times, on account of the competition of the Joint Stock Banks of England, the discount rate it establishes is not always responded to promptly; but, in any time of crisis, the Bank of England is able to control the market. This it must do because it carries the reserves of the country.

It has now been established over two centuries and the utmost confidence is placed in the Bank, as the wealth and credit of the British Empire is at its back. It is now, however, a Government Bank; it is entirely a distinct corporation by itself and is managed by its directors; but, while closely identified with the Government, is entirely a separate and distinct institution. It is not like the Bank of France in this respect. The great Joint Stock Banks keep only the till money necessary for their daily requirements, but the reserve in the Bank of England upholds the deposits of the country, amounting to over six hundred million pounds sterling. The average percentage of the reserve amounts to about forty-nine per cent. of its liabilities. Of every pound which is deposited with the Bank, nine shillings is kept in cash and eleven shillings is invested in securities. The fluctuations in this reserve have enormous influence on the money market and it is the duty of the bank to maintain it at all times at a high ratio to its liabilities. It must control the money market and raises its rates from time to time when necessary, and the other Joint Stock Banks have to follow suit sooner or later for fear they should have to borrow from the Bank themselves. If, however, conditions arise that the other banks have a plethora of money and do not readily respond to the raised rate the Bank itself steps into the market and absorbs the surplus funds. This it does by selling consols through its official broker and buying them back for the account.

While this Bank is situated in the centre of London, not a vestige of vegetation is to be seen outside the walls of the Bank. However, within the courtyards of the same are magnificent trees and flowers to delight the eye of those who have the privilege of seeing this little bit of country in the centre of London.

The issue department of the Bank buys fifteen thousand reams of paper yearly. It is the only article in connection with its issue which is not manufactured upon the premises. The water-mark, which is most beautifully designed, is really more strictly speaking a wire-mark. The moulds in which the pulp is placed have upon their face little bits of wire twisted into a beautiful design which reduces the thickness of the paper where the pulp comes in contact with the wire, and, consequently, the impression of the wire is reproduced upon the paper, as the paper is more opaque where these lines appear. Everything else in connection with the issuing of the notes is manufactured, and the printing of the same done on the premises. Five hundred pieces of this paper make 1,000 notes. The paper is simply cut in half, and, by an examination of the note, all the edges of it will be seen to be "deckelled" with the exception of one edge which has been cut through to form the note. The Chief Cashier regulates the issue from time to time as occasion requires and when he instructs the printing department to create a new issue he advises the Chief Accountant of the amount of the issue, who thereupon opens a general credit for the whole amount and also a ledger account for each individual note; in these ledgers are placed the date and number of each particular note. There are two ways in which the notes of the Bank go into circulation, viz., either by the payment of gold into the Bank or through drawing accounts. Now, at the same time, of course, redemption of notes is going on, and as each note is returned to the Bank the individual ledger account of that particular note is debited with the same and the Chief Cashier's signature is torn off and the note is further defaced by the amount of the note in the left hand corner being cancelled. These notes are put up in bundles of from 300 to 1,500 in each bundle and are deposited in the Accountant's library. Each note has a memorandum placed upon it showing from whom the note was received and the date of its redemption. About 50,000 notes daily are redeemed by the Bank, and notes which have been redeemed are kept for five years in the Accountant's library before being destroyed, when they are burned upon the premises. So systematic is the way of keeping these notes that any one of them may be readily found within a few minutes, notwithstanding the fact that eighty millions of them are generally on hand in the Accountant's library.

As the Bank of England pays two hundred thousand pounds a year to the Government for this note issuing privilege, the profit on the same will probably not amount to more than one-half that amount.

The most interesting feature of the Bank of England is contained in what is called the gold weighing room. There are sixteen gold weighing machines in this room, the invention of a Mr. Cotton, a former Governor of the Bank. Each machine weighs thirty-three coins a minute and is quite automatic in its action, simply having to be fed with sovereigns or half sovereigns as the case may be. Each machine has a tube in a semi-circular form which is capable of holding two hundred coins edgewise at a time and is adjusted to such an angle that the weight of the coins in the tube will gradually shove forward the first coin, which drops on a little table which acts as a scale. At a corner of this table two hammers are fastened and these hammers automatically work backwards and forwards at different elevations. If the table receives a coin of standard weight it will sink far enough to escape the higher hammer from striking it and will then be struck by the lower hammer which tosses the coin into a receptacle to the left, where all standard coins are accumulated. If the next coin in the tube happens to be of light weight the table will not be able to escape the higher hammer and will consequently be struck by it and the contents of the table thrown to the right. As has already been shown, the whole coin of the Realm is deposited with the Bank of England and passes through this weighing machine room and thus a constant re-adjustment of the coin of the Realm is going on. The light weight coins are cut in half by a machine and sent to the mint for re-coinage. The Bank or party depositing a coin of light weight is debited with the shortage in weight and thus the gold coin of England is kept up to its present high standard. The judgment of this machine is most unerring and it is through this ingenious device that the coin in circulation is kept so perfect.

One hundred and seventy-five persons are engaged to manage the national debt account in the Bank. The Bank derives an income of two hundred thousand pounds a year for keeping the Government account.

Although the active opposition to the Bank which it encountered in its earlier days has died away, still there is no institution which is so severely criticised as the "Old Lady of Threadneedle Street." This, however, is natural, considering the arduous and peculiar responsibilities attaching to the management of the Bank.

As a private corporation, the Bank has to look after its own interests, while, at the same time, as a result of the importance of this institution in carrying practically the only reserve of the country, it has to take upon itself the responsibility of a public office. Moreover, as it enjoys the confidence of the Government its course may seem objectionable to others who do not see behind the scenes, and the consciousness that the Bank of England enjoys this privilege makes the less fortunate institutions rather critical in the judgment of the action of its directors. If the Bank rate is advanced the public immediately cry out that the Bank is a nervous old thing, a mere child, enemy of trade, etc. On the other hand, if the Bank rate is not advanced, the public often express themselves to the effect that the directors surely cannot appreciate their responsibilities. By this time the Bank should be free from this kind of cheap abuse, but like the Government of the day, it always has unkind critics.

As regards the business of the Bank—there was a time when it just took the business that came to it and then it was assailed in a good humored way as a "soft head," but recently, however, it has been reaching out and extending its branches, and thus competing with its neighbors for business; and recently a new phrase was created by a Chairman, of one of its competitors, who, feeling the keenness of its competition, coined the expression of "the new woman," stating that the "Old Lady of Threadneedle Street" should now be styled the "new woman" of the money market.

The power of the Bank of England is enormous throughout the world. Its weekly statement is eagerly scanned by financiers of all of the commercial centres, and, while the reserve it holds is comparatively so insignificant to the tremendous credit it sustains, so great is the lever it possesses over the market that only twice in twenty years has its rate risen to six per cent., notwithstanding the tremendous upheavels that have occurred throughout Europe during that time. The reserves held by foreign nations aggregate very many times the amount held by the Bank of England, but the reserve is ample, notwithstanding the enormous trade of the country, on account of its being able to attract deposits from abroad when it is necessary to increase its reserve.

The stock of the Bank at the present time sells at about 325 per cent. premium. In 1696 it dropped as low as a discount of 83 per cent.

The good-will of the Bank represents some twenty-nine million pounds sterling, notwithstanding its reserve or surplus fund only amounts to a little over three million pounds sterling.

No account in its statement is taken of Bank premises, notwithstanding it owns almost four acres of land in the centre of London, with several branches in the country.

Part of the present Bank Building was constructed in 1734 and has been added to from time to time. The architecture within the courts of the Bank is very beautiful, and the building as it at presents stands is worthy of its wonderful history.

NOTED OBSERVATORIES.

By G. Parry Jenkins.

Delivered Nov. 14, 1904,

In the course of a review of his personal visits to some noted Observatories, Mr. Jenkins said Greenwich was to an astronomer what Mecca was to a Mohammedan. Often as a boy he had watched the big ball drop from the pole on the tower at mid-day, but the notice on the door of the Observatory "No admittance except on business" had barred his entrance until the summer of 1889, when an opportunity came through the introduction of a dear old friend of his, the late Mr. G. H. With, of silver-on-glass specula fame, to Mr. William Ellis, F. R. S., then head of the Magnetic Department.

Greenwich Observatory was founded on August 10th, 1673, by King Charles II., with the express object of watching the Moon's motions; but the present Astronomer Royal said slight errors in the position of our satellite still existed, after two hundred years of constant observations. The illustrious personages who had filled the important office of Astronomer Royal were Flamsteed, Halley, Bradley, Bliss, Maskelyne, Airy and Christie. Each had been famous and their various discoveries were enumerated in detail. All the modern equipment at Greenwich Observatory was practically due to Sir. W. Christie, the present Astronomer Royal. The largest instrument there was the magnificent refractor of 28 inches aperture, made by Sir Howard Grubb. Mr. Jenkins said it was with more than ordinary interest that he handled this telescope and had a peep through it in Greenwich, because two years previously he had the honor of seeing the lens made at the Rathmines Astronomical Works in Dublin, and having the process of manufacture explained by the world-famed optician who figured it. To give some idea of the difficulty involved in producing a disc of glass 28 inches in diameter perfectly homogeneous and without any flaw or blemishes whatsoever, Sir Howard Grubb said he had to discard no less than eighteen pieces of glass, all specially prepared for him, before he selected the one whose optical qualities were considered good enough for him to retain and grind into the lens which now rests in the National Observatory of Great Britain. The important instruments used in the transit room for determining time at the prime meridian were marvels of accuracy and skill. Mention was also made of the astrographic twin telescope, the 30 inch reflector, and the 26 inch and 9 inch Thompson photographic refractors—everyone superb instruments—while the whole routine work was carried on by a staff of about sixty experts.

During the period Sir Robert Ball was Astronomer Royal of Ireland, Mr. Jenkins received an invitation to visit Dunsink Observatory, near Dublin, and those who were acquainted with that delightful book, "The Story of the Heavens," were familiar with the building and its outfit. The principal telescope there was 12 inches aperture, the lenses of which were presented to the Board of Trinity College, Dublin, by Sir James South, and the telescope was known as the South Equatorial. The Observatory also contained a very good 6 inch Transit instrument by Repsold. The transits of the celestial bodies over the meridian of Dunsink were recorded by electrical contact on a chronograph, and a photograph of the latter instrument given to Mr. Jenkins as a souvenir was exhibited.

Two Observatories were located in the ancient city of Oxford, and visits to both were described. The Radcliffe Observatory contained many fine instruments, while the University Observatory was one of the institutions engaged in the International Photographic Survey of the Heavens, which was without doubt the most gigantic astronomical work of modern times. In the year 1887 a congress of astronomers was held in Paris, and they decided to prepare a photographic chart of the whole sky, which is now nearing completion. The following Observatories were engaged in the task, viz.: Helsingfors, Potsdam, Oxford, Greenwich, Paris, Vienna, Bordeaux, Toulouse, Catane, Algiers, San Fernando, Chapultepec, Tacubaya, Rio de Janeiro, Santiago, Sydney, Cape of Good Hope, La Plata, and Melbourne. In order to obtain uniform results from all parts and Melbourne. In order to obtain uniform results from all parts of the globe the telescopes employed were all refractors of 11 inches aperture and 11 feet focal length, giving a field of view of 2 degrees square. The necessary instruments have been provided at the expense of the Governments represented, and cost about $7,000 each. Mr. Jenkins here traced the progress of celestial photography from the time Dr. J. W. Draper first photographed the moon in the year 1840 to the products of the leading Observatories of to-day.

A visit to the Toronto Observatory brought the address to a close. This institution was principally known for the valuable magnetic observations which had been conducted there for the last 65 years. The first Observatory was constructed of logs, but for many years the work had been carried on in a suitable stone building in Queen's Park. It contained a fine 6-inch telescope by Cooke, of York. This instrument was most substantially mounted on a clock driven equatorial, and daily observations of the sun were made by the same. Owing to the advent of the electric cars into Toronto in the year 1892, the magnetic instruments had to be removed to the village of Agincourt, 18 miles away. The Dominion Government had now erected a handsome Observatory in Ottawa and installed a large 15-inch telescope by Brashear. It was under the direction of Dr. W. F. King, Chief Astronomer of Canada, and the whole of the Toronto equipment was being transferred to Ottawa.

In conclusion, Mr. Jenkins said, lest the size of the telescopes in these great public Observatories should deter anyone from the thought of taking up the study of astronomy, and perhaps even of joining a body like the Hamilton Astronomical Society, he would remind them of Sir Robert Ball's words: "The student of the heavens who uses a good refracting telescope having an object glass not less than 3 inches in diameter (within the reach of all), will find ample and delightful occupation for many a fine evening."

THE SUN AND FAMILY.

BY REV. H. G. LIVINGSTON, B. A.

A Synopsis of Paper read before Astronomical Section, May 9th, 1905.

The Sun and the Sun's children and grand-children constitute a very interesting and popular family to which we all sustain an important relationship. There is no one body in the universe which to us is so distinctly pre-eminent and which stands for so much as the Sun. It is probable that the Sun is a specimen of other bodies and that there are stars which are suns and which are centres of other systems. But to the ordinary individual the Sun is largely the hub of the universe. It is the pivot and centre of the various heavenly bodies, whose movements are known to man and whose study constitutes the science of Astronomy. The orderly movements of the various members of the solar family is effected mainly by gravitation. Loosely stated, the planets revolve around the Sun. What really takes place is that they revolve around the centre of gravity, common to him and them, and this point, though not in the centre of the Sun, is within the Sun's mass. The solar system constitutes a part of this galaxy and is moving to a point in the constellation of Hercules. The Sun may be taken to be about 93,000,000 of miles from the earth, this distance being the unit by which most other long celestial distances are reckoned. The diameter of the Sun is about 866,000 miles. Its volume is more than one million times greater than the earth, while its mass or weight is 332,000 times that of our planet, or about 700 times that of all the planets put together. The Sun throws out light and heat to the utmost confines of the solar system. How the light and heat are produced we cannot positively affirm. It is considered that the following elements, among others, are present in the Sun: Sodium, iron, calcium, magnesium, nickel, barium, copper, zinc, hydrogen, chromium, cobalt, manganese, titanium, radium and helium. How the Sun maintains its heat is a problem as yet unsolved. The theory that it is kept from dying by the meteors that fall into it is untenable. Its heat may be partially maintained by the contraction of its volume. Our knowledge of the sun has greatly increased during the past generation, due to the faithful observations that have been made and to the extensive application of the spectroscope. As a result many former conclusions have been revolutionized and have had to be restated. The Sun's family consists of planets, comets and asteroids. The planets derive their nourishment, light and heat from the Sun. Jupiter may be to some extent an exception to this, having some inherent light. The comets are supposed to shine largely with their own light.

The members of the Sun's family are divided into primary and secondary. By a primary we mean one which directly circulates around the Sun. By a secondary is meant one which in the first instance circles around a primary, and therefore only in a secondary sense circulates around the Sun. Omitting asteroids, comets and meteoric rings, eight primary planets are now known viz.: Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Of these, the first four are comparatively small, while the last four are the giants of the group. The distance of the planets from the Sun, the centre of the solar system, differs enormously. The speed of motion in their respective orbits differs correspondingly. The difference in speed is in strict harmony with the law of gravitation, the planets nearer the Sun being exposed to greater solar attractions and needing a correspondingly greater rapidity of motion to overcome the energy of their attraction and maintain their orbital distances. The space given to us for this digest will not allow us to make any reference to the comets and asteroids. We shall close by saying that our study of this subject has greatly strengthened our faith in the thought that these wondrous orbs could not have come into existence nor have been maintained in their allotted places for so long a period of time except as the result of design emanating from an all powerful and all wise Creator.

PAPER READ BY PROF. W. A. PARKS, Ph. D.

April 13th, 1905.

Professor W. A. Parks, Ph. D., was called upon to give his paper on "Formation of Coal Beds and Life of the Coal Forming Age." In discussing the different theories as to the origin of coal beds, the lecturer showed that they could not have been formed by alluvial deposits at the mouths of rivers. By means of slides he proved that the plants must have fallen where they grew, as erect trunks of trees, and roots penetrating the soil beneath are distinctly visible. He favored the theory of coast lagoons, and showed maps of the North American Continent before coal was formed. The location of the coal fields correspond to the lagoons or coast swamps of that early time. Many views were given, showing the plant life, and also the animal life of those early times. The lecture was fully illustrated and most interesting and instructive.

NOTES ON THE LATE COLLECTING SEASON.

BY COL. C. C. GRANT.

The writer had merely examined a portion of an Indian cornfield (which had in former years produced many Sponges and Sections) after the crop was removed, when a severe attack of inflammation of the eyes rendered further examination or collecting impossible, and he reluctantly abandoned the field of research, consoling himself with the expectation that a few weeks' rest would set them all right; however, in this he was mistaken; the matter proved much more tedious than was supposed. In the early spring, when he proceeded to complete the examination, he ascertained his sight was so imperfect that he was unable to distinguish a single specimen, owing to short-sightedness—a second attempt subsequently proved a little more successful. An entire restoration of the eyes to their original condition may not be attainable—but perhaps, unless a gradual improvement has taken place since spending a short time at Winona, I fear the recent collecting season may have proved a complete failure as regards results. Any considerable falling off in the numbers of "Cambro-Silurian Drift Fossils," collected at Winona (lake shore) is not apparent, and probably a larger number of specimens were obtained than in any year previously. We cannot say that many new forms rewarded investigation of the lake shingle or "Glacial Clay" overlying, but at least some few rare ones were secured. The writer thinks the term "Erie Clay" of Sir W. Dawson was not happily chosen. You may recollect the late Mr. A. E. Walker when Chairman of "the Geological Section" (a Geologist of considerable experience), in one of the papers published in our proceedings, expressed the opinion that he could not understand why the name was applied. I fully agreed with him that it was rather misleading, and in conversation subsequently, pointed out that

"Glacial, or Boulder Clay," used for this deposit in Europe, was far more expressive and required no explanation as far as I could see.

The great storm of the previous year on the Lake buried under sand much of the shingle along the lake shore; but in some places it had swept off this material which hitherto had concealed Fossiliferous Drift, not open to examination hitherto. Very likely I should credit this circumstance with the discovery of many specimens and not attribute it to any marked improvement in eyesight..

Early in September, when I supposed the crops had been removed, I paid a visit to the field adjoining the Corporation Drain which in former years furnished members of the Section, and others, a large number of glaciated "flint-flake fossils;" too late for examination, for unfortunately I found it freshly ploughed; however, the adjacent field on the McVitty farm afforded me some few Brachiopods and Bryozoons, which led me to imagine after all, I was enabled to detect specimens, even when colorless and partaking of the nature of the matrix itself. The flint-flake fossils are always difficult to distinguish unless the chert surrounding is decayed. The field in question merely presented an odd bare patch here and there, being almost completely overgrown with clover and grasses, which rendered it exceedingly difficult to distinguish anything there.

In order to ascertain the crops on the brow of the Escarpment towards the Albion Mills, the writer paid two visits to this locality about the middle of September and was pleased to find the large field beyond the orchard and bluff (his favorite ground for Niagara sponge sections) had been planted with beans, maize (in rows), potatoes, etc., this year. Now, all these crops are favorable for collecting purposes. The Indian corn, when broadcast, is by no means so, and, unfortunately, one of the best places for collecting complete Sponges near the city bears a flourishing one of this sort at present. A collector would suppose that where the sections are numerous the entire forms of these fossils would be most abundant. It is not so, however; the contrary seems the case, if one may judge from considerable experience, and I may frankly acknowledge, I am utterly unable to afford any satisfactory explanation, which for many years has been to me a puzzling matter.

While the well-known fields on the brow of the Escarpment, near the Corporation Drain, presented an exceedingly unfavorable appearance for collecting, contrary to expectations, they did not fail to produce some Bryozoons and other interesting organic "Silurian remains." On consulting Professor Miller's well-known work I found in "American Palæozoic Fossils" merely one Lichenalia named "L. Concentrica," and a variety "L. Parvula." This family (which, as far as I know, only is found in Niagara) is represented in our local chert beds probably by several undescribed species. The writer has seen Dr. Jas. Hall's "L. Concentrica" in the limestones. Rarely, however, the section may notice an exceedingly fine specimen of this Bryozoon in the case presented to the Hamilton Scientific Association by our former President, Mr. A. E. Walker. From Mr. McVittie's field, near the Drain, about the middle of September, I got a chert-flake containing the impression of the valve of a shell unlike any yet seen here. Its appearance may be deceptive; this is not uncommon when a portion of the shell has disappeared or is concealed in the matrix. There are indications of faint concentric marginal lines perceptible.

Some years back, the writer received from Dr. Head, of Chicago, specimens of the Niagara Sponges he collected in Tennessee. A few were placed in the Niagara Fossil Case, for comparison with our chert specimens. Not many seemingly are found to be common to the different localities. This, however, may be owing to the imperfect records; yet, I think. several families of "Hamilton Sponges" are unpresented in the Tennessee ones. Our collection here is incomplete, and as this class of fossils attracts (like the Niagara Graptolites) considerable attention outside Canada, it is absolutely necessary to present to visitors as complete a series of these organisms, this being looked upon as the headquarters for both. Some light additions to these have been made recently. Sections of Dr. Head's Genera Rusosignum (Wrinkle Sponge) are rarely found in a good state of preservation, as noticed by the late A. E. Walker. When found undecayed, or unweathered, they display, invariably, a peculiar deep blue color never found in other Sponge Sections, which renders them conspicuous when some considerable distance away.

The writer's first visit to the fields along the brow of the escarpment, towards the Albion Mills, was early in September. I was pleased to find, from the nature of the crops in my favorite hunting ground (the one beyond the reservoir, adjoining the young orchard), that it presented a fair prospect for collecting sponges and sponge sections, when the crops were harvested. Beans, potatoes, Indian corn (planted in rows) are favorable for collecting. On proceeding further, to have a look at another field, which has been under clover for some years, where several fine sponge sections were obtained some years ago, in the distance it appeared as if the maize had been broadcast there. On passing it, subsequently, on my way to the Mount Albion waterlime quarries, I ascertained I was mistaken, and managed to secure the unweathered sections of a species of Rusosignum (Head), retaining the peculiar dark blue color. This I have placed in a Museum case, with a few other sponges, and is the only one of the kind we possess, I believe. As far as I recollect, the late President of the Section, A. E. Walker, attributed the marked decay of Rusosignum sections to the looseness of the spicules. They are exceedingly dense, he remarked, in the numerous and well preserved sections of our plain, globular sponges.

The Albion Mills waterlime quarry was visited nearly at the end of September, chiefly with the view to secure a second specimen of the large Favosites, similar to the one placed a few years back in our upper sidecase. I pointed out its position to one of the men employed there, who mentioned he would put aside for me any large round lumps found in the soft shale bed. On arrival I discovered the quarries had not been worked, apparently, for some time. The old workings were covered with weeds and grasses, rendering it difficult to discover any organic remains. I succeeded, however, in securing a few specimens of a minute Alga, which, I am inclined to believe, may prove to be a new species. Many years ago, slabs were found containing this fossil, rather poorly preserved, in the shale. On submitting them for examination to a geological friend, he remarked, "It is a matter difficult to determine—corals, perhaps." I rather imagined it represented generations of small Silurian Sea Plants of the Niagara age, as no hard portion remained, as would be the case in corals.

On returning from the Albion Mills waterlime beds, I noticed a farming friend of mine busily engaged in cutting down his Indian corn crop, near the outlet of the corporation drain. The field in question presented some clear spaces, where I may obtain at least a few sponge sections, perhaps. I thought the result exceeded my expectations. In addition to several fine sections, I brought back two or three complete sponges. All, however, were known to me previously. Among the sections discovered were some few rare ones, now difficult to obtain nearer Hamilton.

I am perfectly satisfied we have not yet secured a complete series of the Niagara sponges, which are only found in this locality. I did not see the collection the late President sent to professors in Germany. I remember he was in possession of examples of the Spreading Aulocopina, one of several species of the family. I pointed out a field to him which furnished me with sections, pointing to a number which possessed a large circular osculum, encircled in a regular ring of smaller ones. Neither of us, I think, discovered the entire sponge.

When the corporation handed back the Webber and Hancock quarries, there remained in the former a portion of the blue building beds held by the proprietor. As these were not far from the brow of the escarpment (which was found to have many Graptolites there in former years), I considered I could count on obtaining some more when the workmen reached the part in question, which they were fast approaching. In this I was greatly disappointed. However, a considerable amount of building material was removed during my absence at Winona, and, as many of the Graptolites are small and not easily recognized by the quarrymen employed, it is possible not a few may have escaped observation. My collection there was limited to a few which had been acquired previously. It may be noticed, as regards this particular quarry, the underlying shales were found to be quite as barren of these organisms as the Niagara limestones or the chert beds themselves.

THE CITY QUARRIES.

The writer was glad to find that the corporation intended to open another quarry near the Mountain View Hotel, when they ceased work on the Webber property. This new quarry, close to the Strongman road, proved very disappointing. When stripped of the surface soil, there was not the slightest appearance of glacial clay—nothing but decayed or badly weathered chert beneath it, which certainly was unfavorable for fossil preservation. There are places in the quarry where the beds have not suffered much from water-soakage, but the complete absence of Bryozoon shells, etc., there, also seems difficult to explanation. One may notice an unusual number of deposits called "Dendrites." Perhaps the manganese oxide may account for this utter barrenness apparent. A few Graptolites were found in part of the Webber quarry not handed over to the corporation, but it produced much less than what was expected.

The Hancock quarry was reopened recently, I understand, to obtain road metal from the chert beds for the county. On looking over a portion of the material excavated, I was greatly pleased to discover a rare Cephalopod for the Niagara rocks—a Gomphoceras. It may be the one already named by the late Dr. James Hall, which I have not seen figured. It is not unlike one found in still older rocks in Ohio—Gomphoceras "eos"—the class is not so uncommon in later Palaeozoic times. The specimen is an interesting addition to local organic remains. Very recently, also, my old friend and fellow-worker, Mr. Nichol, produced for acceptance a "Dendrograptus" (new to me) from a decayed upper chert bed, which the centre fortunately preserved unweathered, almost miracuously. Still later, from a lower chert bed, the writer secured a straight, trumpet shaped (not curved) Graptolite. The branches are so close that with the naked eye it is difficult to determine its classification. In an upper blue building limestone bed, one of the quarrymen obtained a portion of the shattered material, revealing the surface, covered with apparently detached branches of a Graptolite, scattered irregularly around. This singular specimen is the third seen from the same horizon, under precisely similar conditions. Probably it was furnished, like "Graptolithus Pristis," and its family, with a floating disc, and the branches represent the arms. This disc, a soft, leathery material, must be very rarely preserved fossilized. In Anticosti, the writer found a limestone layer in which the arms of "G. Pristis," generation after generation, were embedded by thousands; but this particular part was never observed there.

The Webber quarry quite recently furnished me with a very large specimen of "Dictyonema Retiformis." It occurred in the upper blue building bed. Only a small portion presented itself, but the hammer fortunately revealed the entire form.

NOTES GENERAL AND GEOLOGICAL.

On several occasions recently, visitors at the Museum expressed regret that we did not see a way here in Hamilton to unite the two apparently distinct Museums of the city.

When the McInnes property (Dundurn Park) was purchased, several members of the Association were in favor of removing there, while others held it may be advantageous to possess a few rooms in the so called Castle itself for the display of duplicates of the various scientific sections of the far older institution, which to-day has been recognized, as one may perceive, from the numerous publications we receive from every part of the civilized world.

The distance from the city itself must prove how unsuitable Dundurn is for a public museum. In the winter months the building is shut up altogether, and in summer many of the city families leave for the Beach and various other places.

In all countries museums are looked upon as of very great importance in public education. In an address before the American Historical Association, Professor Goode, of the Smithsonian Institute, remarked: "Public institutions are not intended for the few, but for the enlightenment of the masses." During the past and preceding winter seasons, I think much valuable information was conveyed to all of us by the able lectures of the men selected by the Council to impart some knowledge of scientific matters, etc., to the public generally. As far as the writer is concerned, he believes one would learn more from such addresses as he heard during the past few months than from the study of books on the various subjects for a much longer period. In every case, both language used, and illustration, were calculated to produce a lasting impression.

A visitor from British Columbia recently informed me, on his arrival at Hamilton, he enquired regarding the direction of the City Museum. "I need not say," he added, "I was misinformed, for on arrival at the Castle on the cars, I found the Dundurn establishment closed, and I had, in my journey there, lo t time."

It is evident, from the foregoing remarks, that the visitor was misinformed by some person unconnected with Dundurn, for it is clear that every one interested in it is fully aware that it is closed in winter. The matter, insignificant in itself, may pass unnoticed, but, on another occasion, a city visitor referred to Dundurn as "The Hamilton Museum." I do not think any member of our Association would care to recognize it by such a title as this. The directors may not have usurped a name which belongs solely to the older institution, but perhaps the circumstance may be recorded to prevent mistakes of the kind in future.

Among a few things recently acquired by the Hamilton Museum, is a full dress of a native of the Andamans; the conclusion your curator arrived at was, it may be a suitable one for an Indian climate, but it is certainly somewhat deficient as an article of clothing, their forests obligingly furnishing all they require in the fashionable dress line. The bows and arrows of the natives are very peculiar; the former are of great strength and bulk; hand and foot must be used in propelling the latter—deeply notched, but not feathered. The writer was much pleased to see a lady teacher from Fruitland bringing recently, by appointment, a numerous body of her pupils, on two occasions, to see the Museum, and on pointing out a few things from the Andamans and elsewhere, Miss, or Mrs., MacKenzie gave the boys and girls considerable information on the geographical position of the places mentioned, which, no doubt, was more deeply impressed on the memory of the scholars than if the remarks had been made to the classes elsewhere.

The matter recalled an anecdote of a naval officer, related many years ago: The captain of an English war-ship visited an island in the South Pacific, then little known. On his return to England he published an interesting account of the place itself and its savage inhabitants. It attracted the notice of the Royal Geographical Society, London, which was pleased to make him a member of their scientific society. He must have felt grateful for the honor conferred. When he obtained promotion, he became one of the Lords of the Admiralty, and, wishing to do something in return for the society's kindness, he caused instructions to be given that whenever visits were paid to lands little known the manners and customs of the natives should be recorded under the printed heads of the accompanying forms. In due course of time, intelligence reached him of the arrival of a ship which had been employed for some years on special duty in eastern waters. As soon as the reports were received the Admiral enquired at the office for Captain B——'s particularly, and as he was much interested in the manners and customs of the natives of Andam, or Borneo, we can fancy his disappointment when he found in the hand-writing of the worthy skipper the blank columns filled with this recorded opinion: Manners—"They have none;" Customs, "Very beastly."

When the snow disappeared, the writer visited the ploughed fields near the city and along the brow of the escarpment, for some distance beyond the reservoir. The frost penetrated but little during the past winter, into the ground; however, I got a few sponges and sections. One of the former (incomplete, unfortunately) displays the pores of, perhaps, a plain globular form (flattened by pressure). The pores and their arrangement differ from all seen previously.

NOTES ON A FEW DEEP SEA DREDGINGS, ETC., FROM THE EAST.

In the Manuel of the Mollusca, by Woodward, published many years ago, the author states that out of 408 shells collected up to that time in the Red Sea, 70 were Mediterranean and 40 Atlantic ones, which had migrated into it in early pliocene times, while others represented Indo-Pacific ones that extended their range into the Mediterranean at an early age. He does not say whether any shells are peculiar to the sea itself, but since the publication of the Manual, the writer noticed, on the part of Malachologists, expressions of regret that dredging in the sea had been greatly neglected.

I have recently received, through the post-office, from India, a small parcel. One of the specimens, a Rostellaria of the Strombidæ family, appears to the writer to be of considerable geological importance, as it may tend to modify our views regarding the depth of ancient seas, judging from the organic remains discovered on the now elevated sea bottoms. In one of the early papers read to the Geological Section, I pointed out that one of the leading Geologists in Great Britain (Professor E. Forbes) had arrived at the conclusion that as sunlight was only known to penetrate to a certain depth in modern seas, we had positive proof where color was found in fossils extracted from the primeval sea in which the mountain limestone rocks were deposited, that the seas in question could hardly have exceeded 50 fathoms. How erroneous was this opinion was fully demonstrated by the deep sea dredging of the Challenger Expedition. Scientific men sent from Great Britain; the many dispatched from the United States of this continent for a similar purpose;

France, Germany, Italy, etc., all contributed to the knowledge we possess to-day regarding a Fauna, which a previous generation never suspected could have possibly, in such abysses, have ever existed. Yet a new world of life has been there revealed—rivalling in color and brilliancy anything we can find in tropical land vegetation. The members of the Geological Section of the Hamilton Scientific Association are well aware that the naturalists of a past generation universally held the opinion that it was impossible for Fauna to exist at certain depths indicated, owing to the pressure of the overlying weight of the vast body of water. I beg to submit for your examination a few of the most fragile sea shells the writer has ever seen; yet you notice from the remark on the envelope in which they are enclosed, they were brought up alive in the dredge, off Muskat, Gulf of Oman, from 261 fathoms. Does it not seem almost impossible to account for such a fact as this?

The next specimen submitted for consideration is a specimen of Rostellaria (Lamark), one of the Strombidæ (wing shells), probably R. Curta—five species are found, it is said, in the Red Sea, India, Borneo and China, with a range of thirty fathoms. In the present instance, you may notice it was brought up alive in the dredge, with the operculum in place, from 230 fathoms. Woodward states some seventy species have been discovered in a fossilized state in the cretaceous and overlying deposits. Would it not be rather a rash proceeding to declare that the rocks in which any individual fossil was found must have been deposited in either a deep or shallow sea? We may reasonably conclude, since "the Strombs" are animal, not vegetable, feeders, that Nature has amply provided for the food they require, however deep may be the sea bottom they inhabit.

Since the remaining shells contained in the parcel were dead ones, brought up by the dredge, they convey no information regarding the zone inhabited, and dead shells frequently washed ashore may also be carried away by currents and deposited in water of very great depth. The type of the Muricidæ is the well known "Murex tenuispina" Lamark (slender spine). The specimen now presented was brought up dead, in the Persian Gulf, at 27 fathoms. There is nothing unusual in this, since the range of the Muricidæ is from low water to 25 fathoms, according to the naturalists of a past generation.

"The Imperator," dredged at 47 fathoms, in the Persian Gulf (brought up dead), is one of the Turbinidæ vegetable (Alga) feeders, restricted to the Laminarian Zone. Some little time ago, it was stated, an American collector had found in a shallow pool inside a coral reef, no less than five specimens of the Conus Gloria Maris. I quite forget in what sea. It is not very many years since a single specimen was sold for 50 guineas. The rarest shell in existence, however, is a cone in the British Museum, named "The Cone of the Holy Mary," valued at £500 sterling.

Ever since Mrs. Carey removed from the Museum to Dundurn her fine collection of modern sea shells, we have been attempting gradually to replace it. These cannot be properly arranged and correctly named except we can consult a work of established repute on the subject. The number of species formerly put down as 29,000, have, of recent years, been considerably increased. The cones alone number over 300.

We all know the assistance afforded Palæontologists by the study of modern sea and fresh water shells. A work on Conchology in the Public Library here is of very little use to us, since the colors are not shown. The cost of Tyron's Works on Malachology is considerable. We cannot expect the Hamilton Scientific Association (situated as we are at present) to incur the heavy expense of the purchase. It is a work of permanent value. I am told each family of the Mollusca has been given a separate volume. The complete books may not be required. If the Library Board could be induced to obtain a volume or two on "The Strombidæ," Muricidæ, say this year, leaving "The Bucinidæ," Conidæ, or Volutidæ to the next, it would considerably assist us in properly arranging and naming the specimens in the cases. Our collection of modern shells certainly requires some few additions, types, etc. The writer recalls a lecture on "Museums," by a famous

Smithsonian professor. One of his audience remarked, a certain city in the United States possessed a complete museum. "A complete museum, sir, that means a dead one!"

ADDITIONAL NOTES.

LICHENALEA HALL.

Some years before he died, the late Dr. James Hall furnished the writer with the figures of "Lichenalea Concentrica" and the fragment of a parasite attached to Strophostylus he had named "Var. L. Parvula." The former is not at all uncommon in the Niagara chert here; the latter represents, perhaps, a distinct species which is frequently discovered fixed on one of the plain globular Niagara sponges. I cannot remember finding it attached to either "Aulocopinas" or the more numerous "Rusosignum." In searching for flint-flake fossils in glaciated drift-chert and also in a layer in the Hamilton quarries, I occasionally found what I considered a distinct and well marked species of the Bryozoon. I therefore concluded during the past collecting season to carefully examine the eight feet of upper Niagara chert which remains unremoved by glacial action. A little beyond the railway rock cutting, the writer had not been very long at work when he discovered three or more members of the family which, he thinks, may be new species. They are not confined to a single bed, and the section of a sponge was obtained in one of the layers; the weathered chert in which they were embedded was very brittle near the edges and some were destroyed in extracting, but three in good preservation were secured. In describing the type of the Genera Lichenalea Concentrica, it appears to me Dr. James Hall himself entertained doubts of his own correctness in assigning one or more fragments in his possession to the Bryozoon in question. I would call your attention to his own remarks on the subject: "The variations in expression, in the many forms of this species (Lichenalea Concentrica), size, proportion and arrangement of the cellules upon the surface, and the aspect produced by weathering or maceration, are so great as often to induce a reference to distinct species."

It is evident from the foregoing that the paleontologist entertained misgivings regarding the position he assigned to some small fragments which he supposed to be broken portions of "Lichenalea Concentrica." The specimens recently obtained in the Niagara chert beds here, no doubt, may throw additional light on this interesting genera. It is not an easy matter to detect the fossil (especially in situ), since colorless, like the white weathered chert itself. Probably five or more species (new to science) are represented in the neighborhood of Hamilton. The writer may be mistaken in thinking the parasite Lichenalea of the globular sponge represents merely a single species. There are two other families of Bryozoons discovered in New York state—Niagara "Ceramopora" (Berenica) and "Paleschara"—which have not been found yet either here or in the Grimsby shales. The latter hold scarred Bryozoons, which I have never seen figured. This class of organisms has been rather neglected here. Many of its minute forms are not calculated (to attract attention.

When the epitheca of Lichenalea has been removed by weathering (or in some unknown manner) the broad surface of the fan-like expansion is densely covered by minute ring-like markings, representing the openings of the cellules. This feature of the Bryozoons seems rare in the Niagara chert.

The Clinton (May Hill) series: One visit alone was paid to the only portion of these rocks open to the members of our section now, viz., the small reservoir near the Jolley cut. The few slabs found there (although fairly preserved) contained merely the common, well-known Clinton Brachiopods and fragmentary plant remains. If we may rely on what is stated in a daily paper, that a railroad company intends to lay a track shortly to Ancaster, this would afford us a capital opportunity of gaining some additional knowledge regarding the Clinton and other rocks to the west of the city. Let us hope the directors of the new company will not feel inclined to follow the churlish and currish example of the Grand Trunk of Canada, which prohibits scientific investigation, not only on the track, but inside its fences.

In one of the city quarries at the head of the Jolley cut, one may now notice in Niagara shale a good display of a band of "iron pyrites." Since the quarry was abandoned, the weathering process, rain-water, etc., has converted the iron of the mineral into rust, and deposited beneath it a fair quantity of "Sulphur," its other ingredient. This band in the shale, together with the "iron pyrites" in Pentamerus limestone bed, we may look upon as the source of the sulphur springs, and the small quantity of the sulphur gas found at the Albion Mills, near Hamilton.

When we remember how limited in thickness are the limestone layers here, we reasonably conclude "caverns" can hardly exist which would permit the accumulation of gas. I have secured some specimens of the sulphur from the quarry to place in the case containing a few other Hamilton minerals.

At the opening meeting of the Geological Section we decided to ascertain whether a medium-sized "coral," obtained late last year at water-lime Barton beds at "Rosseaux creek," was a distinct species or not. A more fully developed one, corresponding with the "Favosites," was placed in the upper side case. This could only be ascertained by examining the interior. Our President intends to see what he can do in revealing the walls of the cellules. I intended to bring to the notice of the section last year a well-preserved specimen of another Barton Niagara coral from the same water-lime band; it was unfortunately mislaid and turned up quite recently. The writer has not seen the Niagara "Astrocerium" figured and described by the late Dr. James Hall, but remembers Sir W. Dawson considered the general appearance of the cells fully justified the separation from "Favosites." Dr. Nicholson, in Paleontology of Ontario, holds quite a different opinion. On reference to Miller's "American Paleozoic Fossils," you will find he places "Astrocerium" in the order "Zoantheria," a sub-order of the family Favositidæ. We may view this as a sort of compromise. I am perfectly satisfied that many so-called distinct species are merely "varieties." This reminds me that I placed in the case containing Niagara Fossils an "Atrypa reticularis," presenting a marked difference to three or four others lying beside it in situ—the ventral valve being more puffed out. It recalled a still more gibbous and enlarged one of the same family, which I extracted from Devonian shale formerly, in Canada west, near London. which may be still in one of the upper side cases in which I placed it. No injury was perceptible in either instances, so perhaps we may conclude they represented merely accidental varieties of the Brachiopod in question.

The Niagara fossils, which first attracted the attention of some of the leading geologists in the States to Hamilton, were the "Graptolites" and "Sponges" discovered here. Barrande, the chief authority on the former in Europe, described, I think, thirty forms of the family found there. This is about the number of new ones described and figured by Dr. J. Spencer, F.G.S., many years ago as occurring at Hamilton, Ont. Since then great numbers have been obtained, in remarkable preservation, which are calculated to cast light upon and increase our knowledge of Silurian Zoophytes. A gentlemen the writer met at the new city quarry informed me he had visited it several times and got nothing. I explained to him the absence of glacial clay there was not favorable to the preservation of organic remains. Despite that, four new forms were discovered subsequently by Mr. Nichol and the writer (very unexpectedly on my part, I may add).

Dr. Head, of Chicago, stated that Professor Lapworth, Birmingham, a leading authority on Hydrozoons, was anxious to obtain any specimens we could spare. At the time in question the small collection in my own possession had been promised to the Smithsonian Institute for description, by Dr. Gurley. His sight failed, I have heard, unfortunately. Probably the ones forwarded to the British Museum since then, if new to science, will receive attention from this well-known paleontologist.

SPONGES.

A large number of chert sponges, sections and Niagara common Brachiopods, were presented to young lads who evidently are taking an increasing interest in such things here of late. One of these remarked, when I pointed out where he was likely to find others, "The fields there have been searched already so often there may not be many left." Now, such is not exactly correct. The plough and frost, etc., every year are bringing fresh material to the surface.

The last collection I made along the corporation drain was, I think, early in November. In a field there that had been closely examined for years, and several times also during the collecting season, I discovered a complete "Aulocopina" and a dark blue section of a Rusosignum sponge, which I had been looking for for many years. Only single specimens of our Niagara sponges were found in many cases, which we are unable to place in the museum cases just now. Detached sections of others indicate the existence of forms unknown yet. Many years ago the late A. E. Walker, who was greatly interested in our local chert sponges, expressed to the writer his deep regret that neither of us had succeeded in securing a complete form of the "spreading Aulocopina." This was a name suggested by sections in our possession. Another member of this family, which Prof. Rauff states has been only found in Hamilton, Ontario, also is not represented among our sponges. It presents a central osculium, encircled by quite a number of smaller ones. A third species (frequently seen) is exceedingly flat, with an oval osculium. It is not Dr. Head's "Aulocopina Walkeri." Like Aulocopina, another genera of chert sponges, I understand, has never been found outside this district—Rusosignum, the wrinkled one of Dr. Head, of Chicago. We have a number of others in our cases undescribed as yet. Independent of the expense of illustration, the writer already pointed out a rule of Geological societies not to recognize any fossils, unless described in works solely devoted to "geology." Mr. Schuler informed me that when the Botanical Section ascertained that some low forms of animal life were mixed up in the collection received from the relatives of my old friend and fellow-worker, the late Professor Wright, they handed them over to us. It is unnecessary to say they are exquisitely displayed with the old skill which some of us may remember.

PLATE NO. 1.

This well-marked Dendrograptus was discovered by Mr. Nichol in the new Corporation quarry. It comes from a thin upper chert layer, much weathered all round the edges, but the center in which it appears fortunately escaped decay.

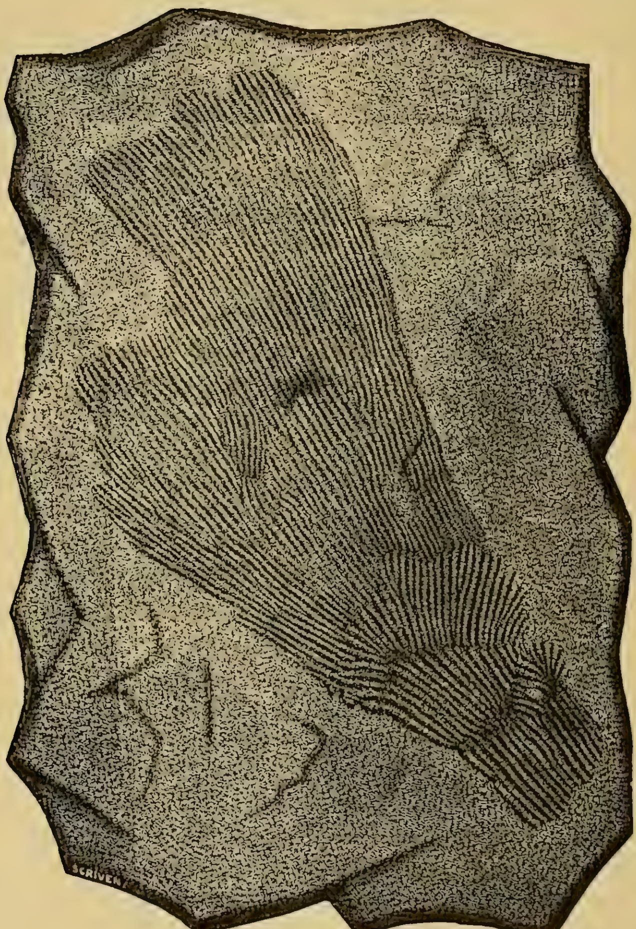

PLATE NO. 2.

This is one of the few fossils discovered in the new quarry. The branches are close. I am unable to detect the connecting bars of Dictyonema. The cellules are unknown. It seems a new species, and belongs to a new genera, perhaps.

THE PROBABLE COURSE OF EVOLUTION IN PLANTS.

J. B. Turner, B.A., *Vice-Principal Hamilton Coll. Institute.*

[Illustrated by numerous lantern slides.]

The hypothesis of evolution in the organic world has had for its chief support the phenomena of animal structure and life. These phenomena have been studied so carefully and comprehensively that there are but few who have given the subject any attention that have not accepted the hypothesis in one form or another as affording a fairly reasonable explanation of the origin of the different forms found in the animal world. There may be wide divergences of opinion as to the details, but on the great general principle there is a wonderful unanimity.

For plants, however, there has not been the same working out of details. The general acceptance of the hypothesis in so far as plants are concerned seems to have come about to some extent by analogy. As a consequence the course along which the complex higher plants have been evolved from the lower forms is not clearly defined, nor has any one course been generally accepted as the most probable one. It is my present purpose to offer a few suggestions on this very important matter, not so much with the view of giving a complete statement of what I believe to be the course of the evolution of plant forms as to indicate some of the most conspicuous landmarks in the long pathway from the lower to the higher forms.

In dealing with this progress from one form to another it is necessary that it be made clear at the outset what structures or organs are of importance in marking out the way, so that there may be no misunderstanding of the relative values of the different structures and organs in such a discussion.

Students of plant forms who, in recent years, have in any way given expression to their views on the question of relationship of the different forms to one another have invariably based their opinions upon the variations and progression in the mode of reproduction of new individuals and the organs which take part in this function. This selection is doubtless a wise one, for the influence of environment, in the broadest sense of that term, will most readily affect the organs that are to the greatest degree connected with the perpetuation of the species. If this view be correct, then the variations and progression observable in these organs will fairly well indicate the line along which the evolution of plants has taken place.

The simplest plant form consists of one cell, and increase in the number of the individuals in such a case takes place by the division of this original cell—first into two, and when these new individuals have reached a certain stage division again occurs. This process of division, continued as long as conditions are favorable, will eventually result in the production of an almost indefinite number of individuals from the original one. The The Glœocapsa, or Chroococcus, will serve to illustrate this mode of reproduction.

In the foregoing process only one cell takes part, and the individual at any time consists of but a single cell. In the course of time the individual, by two or more cells failing to separate from one another, becomes a more complex structure, the simplest form of which is a thread of cells. With this increase of complexity of structure there arises a differentiation in the mode of reproduction, and very soon we find two cells taking part in this function.

In the Spirogyra, which consists of threads of cells floating in water, the cells of adjacent threads put out processes in such a way that those of the cells in the different threads meet one another and the contents of one cell pass into the other, and the contents of the two fuse together and a new individual is formed, which passes into a resting condition. In this simple operation we have the beginning of sexual reproduction. In external appearance the two cells whose contents fuse together are not dissimilar, so that structurally there is no apparent differentiation.

It is important, however, to remember that the contents of all the cells of any given thread in the Spirogyra pass in one direction. That is, if the contents of one cell of a given thread pass over into a cell of an adjacent thread, then the contents of each cell in the first thread will pass in the same direction. It is obvious, then, that while there is no structural differentiation apparent, there must be a potential differentiation. It is worth noting, too, that the contents of one of the cells has acquired the power of moving from one place to another.

In the Ulothrix zonata, a filamentous alga, reproduction is effected in two ways, the former of which resembles somewhat the reproduction of the unicellular plants; the latter is a simple form of sexual reproduction, and this method is the more important of the two from the evolutionist's standpoint. Asexual reproduction is effected by means of swarm-spores which have four cilia, and are formed by division of any cell in the filament. These, after escaping from the cell in which they are formed, give rise to new filaments or plants. These swarm-spores, by reason of their cilia, have the power of motion. The sexual swarm-cells are formed in a similar manner, but in much greater numbers. They are smaller than the swarm-spores and possess only two cilia. By conjugation of two swarm-cells a structure is formed which passes some time in a resting condition, after which a new filament is formed. The excess in number of swarm-cells over swarm-spores indicates an increasing tendency towards sexual reproduction. The cilia spoken of are effective organs of locomotion, the importance of which will appear later. The fact remains, however, that as in the case of the Spirogyra, conjugating cells are apparently the same structurally.

The modes of reproduction just described persist through a large number of the lower green plants, usually known as Algæ. In the sexual mode of reproduction, important modifications take place, however, in the direction of differentiation, structurally, of the conjugating cells. This differentation in a highly developed condition is well exemplified in the Fucus platycarpus, where one of the conjugating cells, the egg-cell, has become large relatively and merely floats in the water, while the other, the sperm-cell, has become reduced in size and has become exceedingly active, the cilia, with which each is provided, being effective organs of locomotion. A careful consideration of these facts will make it evident that a great advance has taken place in a particular direction in this method of reproduction. Coincident with this there has arisen a tendency towards the disappearance of the asexual mode of reproduction.

Before leaving the Algæ, reference should be made to the Chara, a very common fresh water form. In this plant the organs of reproduction have attained a high degree of perfection. So far as these organs are concerned, the Characeæ are not less highly specialized than are many of the so-called higher plants. The completeness of the organs of reproduction make it somewhat difficult to assign this order of plants to its proper place in the course of plant evolution.

Up to this point attention has been directed to the Algæ, or lower green plants, only. There is, however, a large number of lower plants not included in this division known as the Fungi. These plants are either parasitic or saprophytic, and on that account are modified in such a way as to present almost insuperable difficulties to the evolutionist. From physiological considerations it may at once be conceded that they are of later origin than the Algæ, and hence must be treated as a branch which came from the parent stem at a later period than the Algæ. Among the Fungi there occurs a mode of reproduction essentially similar to that found in the unicellular Algæ. The cell multiplication by budding occurring in the Yeast plant is an example of this simple mode of reproduction.

When, however, the attempt is made to trace the progress of the evolution of these plants by an examination of their reproductive organs we are able to go only a very short distance until we reach a point where these organs disappear. In the Mucor mucedo, one of the common moulds, a conjugation occurs very similar to that occurring in the Spirogyra, indicating that the evolution in these two classes of plants has taken place along similar lines. In the fungous part of the lichens, at least in some of them, there are found organs of reproduction that have reached a fairly high degree of perfection, the two conjugating cells being well differentiated.

In those fungi which are structurally most complex, no organs of reproduction have so far been observed, and consequently the pathway of their evolution has been lost. The absence of reproductive organs is most probably due to a process of degeneration that has resulted in the entire disappearance of these organs, and the plants have reverted to the more primitive mode, namely, asexual reproduction.

Leaving the Algæ and Fungi, the plants next in the ascending scale are those included in the Bryophyta. In these plants the organs of reproduction are highly specialized. The conjugating cells are of two kinds, a non-motile one, which does not become detached from the parent plant, and a motile one, which becomes detached and moves about readily. We have also in these plants, for the first time, an alternation of generations. The gametophyte generation is the larger and more important, while the sporophyte generation is very much smaller, and in some cases not observable except with a magnifying glass. Within the group Bryophyta the evolution appears to have taken place along the line from the very small sporophyte, on a relatively large gametophyte, to a much larger sporophyte on a relatively smaller gametophyte.

It is also worthy of note that the sporophyte never becomes independent of the gametophyte, consequently the former depends upon the latter for its nourishment.

The Pteridophytes, including the ferns, equisetums, club-mosses and allied plants, have a reproductive system similar in a general way to that of the Bryophyta. Nevertheless, there are some very important respects in which these plants are an advance upon the mosses. Referring again to the Bryophyta, it will be recalled that the gametophyte is the more important generation of the two, and that the sporophyte never exists except in connection with the gametophyte.

In the Pteridophytes, important differences in both these respects occur. The gametophyte is very much reduced, so much so, indeed, that in some cases it is but microscopic in size, while even the largest are minute compared with the sporophyte. The connection between the sporophyte and gametophyte is only of short duration, and in the early stages of the life of the sporophyte. Very soon this structure takes root in the soil, and from that time forth carries on an independent existence, while the gametophyte withers away and dies. The internal structure of the sporophyte has also become complex, and the different systems of tissue well differentiated. True roots also for the first time make their appearance. Within the group the course of evolution appears fairly well defined. In the fern both kinds of reproductive organs are on the same gametophyte; while in the other divisions of the group the tendency appears to be to have the reproductive organs of different kinds on separate gametophytes. This fact would seem to indicate that there is a potential difference in the spores. This possible differentiation of the spores becomes an accomplished fact in some of the members of the group that are closely allied to the club mosses. In the Selaginella, and some others, there occur two kinds of spores, large and small ones, known respectively as macrospores and microspores. With the differentiation of the spores there occurs a marked diminution in the size of the gametophytes. The gametophyte from the macrospore bears the female organ, and is so reduced in size as not to become independent of the spore. The gametophyte from the microspore bears the male organ, the autherozoids from which escape and fertilize the oosphere of the female organ. It will thus be seen that there is a constant tendency to a decrease in size of the gametophyte, accompanied by a corresponding relative increase in the size and importance of the sporophyte. The conjugating cells continue very similar to the corresponding cells of the Bryophyta.

The conditions outlined, as found in the heterosporous Pteridophytes, continue with only very slight modifications among the Phanerogams. The macrospore of the preceding plants is the equivalent to the embryo-sac in the flowering plants.

One important difference exists, however, between the macrospore and the embryo-sac. The former becomes detached from the sporophyte which produced it, while the latter always remains in conjunction with the sporophyte producing it. The microspore of the heterosporous plants is the equivalent of the pollen grain in the flowering plant.

Previous to fertilization in the flowering plants important changes take place within both the embryo-sac and the pollen grain, resulting in the reproduction of structures, which must be considered gametophytes. The reproductive organs, if they can be called such, found in connection with these gametophytes are somewhat rudimentary. The germ cell is not contained in an Archegonium, as in the preceding plants, while structures resembling the autherozoids have been found in only one or two cases in the Phanerogams, and that in plants very closely allied to the heterosporous pteridophytes.

A great deal of work remains to be done before it can be authoritatively stated that evolution among plants has taken place along any one line. Much has been done in this field in recent years. Many readjustments have been made as new light has been thrown on points that were somewhat obscure. Additional workers are constantly taking their place in the ranks of the great army of patient and painstaking investigators, so that while the past has been productive of good results, the future holds out promise of still greater achievement.

ANNUAL REPORT OF THE ASTRONOMICAL SECTION.

For 1904-5 Session. E. H. Darling, *Sec.*

The year 1904-5 has been one of success and prosperity for the section. To its membership have been added the names of several prominent citizens of Hamilton and one member from Meaford, Ont. (the Vice-President of the Meaford Astronomical Society), bringing the total number to 55, including two honorary members. The attendance on the whole has been good, frequently over-taxing the capacity of the hall, and a long list of papers and lectures given before the Society have been interesting and instructive.

The following is the programme for the session just closing, and it is a source of satisfaction to note that of the thirteen lectures, ten were given by members of the Society.

Oct. 18, 1904—Reception by President—Aberdeen Observatory.

Nov. 1—"Meteorites," Rev. Dr. Marsh, Sc. D.

Nov. 15—"Some Noted Observatories I Have Visited," G. P. Jenkins, F. R. A. S.

Nov. 29—Gravitation and Its Law," E. H. Darling, Assoc. M. Can. Soc. C. E.

Dec. 13—"Eclipses," Prof. A. T. DeLury, M. A., Ph. D., Toronto University.

Jan. 17, 1905—"The Pole Star," Rev. D. B. Marsh, Sc. D., F. R. A. S.

Jan. 31—"Star Names," G. Parry Jenkins, F. R. A. S.

Feb. 14—"Electricity Applied to Mechanics," Mr. Alex. Campbell.

Feb. 28—"The Panama Canal," W. R. Warner, F. R. A. S., Cleveland, Ohio.

March 14—"The Astronomy of the Bible," Rev. F. E. Howitt.

March 28—"The Sun," Rev. D. B. Marsh, Sc. D., F. R. A. S.

April 11—"The Eye—The Medium of Observation," Chas. I. Kelly, M. D.

April 25—"A Voyage Around a Planet," Wm. Bruce, Esq.

May 9—"The Sun and His Family," Rev. H. G. Livingston, B. A.

May 30—Election of Officers.

Special note must be made of the great privilege enjoyed by the section in having Mr. Warner, F.R.A.S., of Cleveland, to lecture on the "Panama Canal." Advantage was taken of the opportunity to invite the Association and the public to the lecture, and the result was that an audience of upwards of a thousand people availed themselves of the treat.

The Section records with much pride the election of their President to the distinguished position of Fellow of the Royal Astronomical Society of Great Britain, and especially so when brought forward and supported by such notable men as Prof. John A. Brashear, of Allegheny, P. A., Prof. Rambaut, of Oxford, and Sir Robert Ball, of Cambridge; and also his election as honorary member of the Astronomical Society of Belgium.

Apart from the regular work of the Society there are two items of interest worth mentioning, which go to show that the Society, principally through the work of its President, is becoming known and recognized.

The first is the invitation of the Naval Observatory at Washington to exchange time by telegraph on New Year's Eve, which was accepted and participated in by the officers of the Society, a report of which is given in the minutes of Jan. 17th, 1905, and the results proved very satisfactory. The flashes being virtually identical. A similar greeting was exchanged with the Toronto Observatory. The part the Society took in these greetings is mentioned in the Official Report of the Naval Observatory.

The second item is the recognition of the Society by the Dominion Government in granting the request for a representative
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on the Eclipse Expedition to Labrador in August, in the person of G. Parry Jenkins, F.R.A.S.

As the Royal Society of Canada has chosen our President, Dr. Marsh, as one of its representatives, the Society in this way is fortunate enough to have two of its members on the Expedition.

The Society has now got fairly under way, and all that is necessary to enable it to take its place among the Astronomical Societies of the world is the continued support of its members in attendance and study.

ANNUAL REPORT OF THE CAMERA SECTION.

Hamilton, Ont., May 8, 1905.

The Camera Section has experienced a comparatively quiet year, probably due, for the most part, to the older members not taking a very active part in the work, but leaving the year's work to be carried on by the younger members of the Section. The younger members put forth their best efforts to do all possible for the success of the Section and have done very well, the work exhibited at the annual print exhibition being of a high artistic merit, though the number of exhibitors and number of prints on exhibition were considerably less than former years. We are glad to note, however, that the older as well as the younger members are now awake to the fact that if the Section is to make progress in the Photographic art, the members must all work together, and already many of those who, during the past year did not take any active part in the affairs of the Section, have put their shoulders to the wheel, and the present indications are that the year before us is going to be the best yet.

The Section decided to again enter the American Lantern Slide Interchange for the year 1904-5, and last fall about 100 slides were sent to New York, from which the judges chose the set for the Interchange circuit.

During the season many lantern slide exhibitions were given and much enjoyed by the members and their friends.

We did not have any photographic demonstrations or papers during the year, as in former years, and it is to be hoped that the programme committee for the coming year will try and arrange for as many papers and demonstrations of an interesting and instructive nature as is possible.

A number of important improvements have been made to the dark room, such as improving the enlarging and reducing lantern, a new condenser being added to it; new shelving, etc.

There was but one outing, that on Victoria Day, to Credit Forks. There was a large attendance of members, and a very enjoyable day was spent in that vicinity, some good views being secured.

The Annual Print Exhibition was held on March 23, 24 and 25, and was visited by a large number of citizens. The successful exhibitors were as follows:

A. G. Alexander, first trophy and gold medal.
Aubrey M. Hamilton, 2nd trophy and medal.
Miss Dixon, landscape, medal.
A. C. Blake, genre, medal.
George Barton, flower studies, medal.
Walter Hill, marine, medal.

Eight new members were added to the roll during the year. In conclusion, I desire to thank all who have in any way helped me to perform the duties of office, and ask for my successor the same hearty support that I have received. Respectfully submitted,

WALTER E. HILL, Secretary.

ANNUAL REPORT OF THE GEOLOGICAL SECTION.

For the Year Ending May 11, 1905.

The Section, in submitting this, the annual report, wishes to place on record that although composed of few members the usual interest has been maintained throughout the term just ended, and that the work of collecting fossils has been diligently and successfully carried on. Many specimens new to science have been placed in our Museum and many have been sent away to different Museums of the world, to wit, the British Museum, the Washington Museum, the Dublin Museum, the Albany Museum, the Ottawa Museum. Other specimens have been sent to such eminent men as Prof. Rupert Jones, of England, Prof. Clark, of the State of New York, Prof. Gurley, of Washington, and also to others interested in Palæontology. Some of these specimens have been sent away for identification. The Graptolites found here represent a great many varieties not yet figured, so far as known by the members of the Section. Some new forms of Stromatopora have been found, also some Fossil Sponges, showing that the rocks south of us and the shingle on our beach contain many new varieties heretofore unknown, only waiting for the diligent student to bring them to light. The result of these discoveries have been made known to eminent Palæontologists. Col. Grant received a communication from Prof. Lapworth, of Birmingham, one of the leading authorities on the Hydrozoa, expressing a desire to obtain some specimens from the neighborhood of Hamilton, and Prof. Clark has signified his intention to come over and bring with him the President of the American Geological Society, and Prof. Parks, of the Toronto University has expressed his intention of visiting Hamilton this summer. These gentlemen are coming to examine the rich palæontological field which has yielded so many rare specimens, some of which are to be found in some of the principal museums of the world. It is indeed gratifying to the members to know that largely through the instrumentality of one of its number, I mean Col. C. C. Grant, this locality and the Geological Section of the Hamilton Scientific Association has gained such a world wide reputation. The thanks of the Section are due to him for his untiring efforts on its behalf.

A number of meetings were held, at four of which papers of Geological interest were read by Col. C. C. Grant. Following are the dates of meeting and the subjects of papers read:

Dec. 30, 1904: "Notes on the Late Collecting Season."

Jan. 28, 1905, "Additional Notes During the Past Collecting Season."

Feb. 27, 1905, "Notes on a Few Deep Sea Dredgings, Etc., from the East."

April 29, 1905, "Notes General and Geological."

All of which is respectfully submitted.

A. T. NEILL, Chairman.

BIOLOGICAL NOTES.

The following plants have been added to the local list since the last report was issued :

Erythronium albidum Nutt.
Jeffersonia diphylla (L) Pers.
Viola rotundifolia Michaux.
Mertensia Virginica (L) D.C.
Galinsoga parviflora Cav.

Specimens of Pterospora Andromedea Nutt. and Hypopitys Hypopitys (L) Small, reported by Judge Logie in 1860, but not observed by any workers during the interval, have been collected. Several violets are reserved for complete identification.

J. M. DICKSON.

CURATOR'S REPORT.

I have the honor to report that some few things have been added to our collection. The Misses Unsworth presented the Museum with a very fine specimen of a modern Madrepore Coral, and also some minerals. The skin of a large python, from Africa, was presented to us through ex-President Alexander. The donor's name is perhaps in one of the cases, which at present is dimcult to reach.

We are gradually replacing the collection of modern sea shells removed by Mrs. Carey to Dundurn. These cannot be properly arranged until something is settled regarding Museum definitely.

A few specimens were added to the geological cases. but the now unworked Hancock quarry furnished your Curator with the best preserved Fucoid he has ever seen represented in a limestone layer. Plants are rarely well preserved in such material, remarks Dana, if ever.

CHAS. COOTE GRANT, Curator.

HAMILTON SCIENTIFIC ASSOCIATION

TREASURER'S STATEMENT

RECEIPTS.

Balance from 1904	$ 18
Government Grant	400 00
Members' Fees (regular)	39 00
Members' Fees (Astronomical Section)	50 00
Members' Fees (Photographic Section)	51 00
Horticultural Society (rent)	7 50
	$547 68

EXPENDITURE.

Rent of Museum	$150 00
Rent of Dark Room	18 00
Caretaker	70 35
Gas Account	7 10
Printing Annual Report (on acct.)	100 00
Printing and Engraving	57 00
Postage and Stationery	30 80
Lectures	12 75
Photographic Section Expenses	35 00
Insurance	14 00
Sundry Accounts	13 25
	$508 25
Balance on hand	39 43
	$547 68

P. L. SCRIVEN, Treasurer

This is to certify that we have examined the vouchers and found them correct.

ALF. H. BAKER,
E. H. DARLING,
Auditors

May 18, 1905.

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
Natural History 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 Assoc. for the 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 Microscopal 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.
Soc. 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.
Colorada 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 Leads . . . . 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 Antiquaries du Nord .... Copenhagen

(5) France.

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

(6) Germany.

Naturwissenschaftlicher Verin .... 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 .... Tokio

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

LIST OF MEMBERS

OF THE HAMILTON SCIENTIFIC ASSOCIATION

HONORARY

Grant, Lt.-Col. C. C., 93 Bay street south, Hamilton
Macoun, John, M.A., Ottawa
Fleming, Sanford, C.E., C.M.G., Ottawa
Farmer, Wm., C.E., New York
Small, H. B., Ottawa
Dee, Robert, M.D., New York
Charlton, Mrs. B. E., 280 Bay street south, Hamilton
Keefer, Thos. C., C.E., Ottawa
Burgess, T. J. W., M.D., F.R.S.C., Montreal
Carry, Mrs. S. E., 29 Caroline south, Hamilton
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Bull, Rev. Geo. A., M.A., Niagara Falls
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Kennedy, Wm., Austin, Tex.
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Ami, Dr. H. M., Ottawa

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Acheson, Wm., 165 Queen south
Acheson, Percy, 164 Emerald north
Adam, John, 55 Victoria ave. south
Alexander, A., F. S. Sc., 182 Wentworth south
Alexander, A. G., 182 Wentworth south
Anderson, John, 111 Locke north
Anderson, Miss, 299 Main
Arnott, Mrs. H., 1 Emerald south
Appleton, L. G.
Asman, H. O., B. A., 150 Victoria ave. south
Aylatt, Fred, 187 Caroline south
Bale, G. S., B. A.
Bailey, W., Ontario Normal College

Baker, Hugh C., Bell Telephone Co.
Baker, A. H., 99 King east
Ballard, J. F., 116 King west
Bale, F. J., 217 Victoria ave. north
Baldwin, T. O., 294 Hannah east
Bartlett, H. F., 168 Market
Barton, Geo., 274 Hannah west
Beasley, Thos., 421 Main east
Beasley, Mrs. Thos., 421 Main east
Beemer, A. T., 134 Rebecca
Biggar, S. D., Mayor, King east
Bertram, Jas. B., Dundas, Ont.
Black, Geo., 70 East ave. south
Blake, A. C., P. O. Dept., 17 Morden
Blatz, Adam, 187 Hannah east
Brennan, Jas., 196 Jackson west
Brown, Hillhouse, Alma street
Brown, Adam
Brown, Mrs. Anna H., 20 Hannah west
Broughton, Benj., 18 Inchbury
Broughton, B., John north, near King
Brady, Rev. R. E. M., 475 Mary
Braithwaite, A. D., mgr. Bank of Montreal
Bradwin, F. W., 204 Catharine south
Brass, Peter J. B., 109 Bay south
Bruce, Wm., 17½ King east
Buchanan, Robt. J., Auchmar House, Mountain
Burnside, J. W.
Cann, H. V., mgr. Bank of Nova Scotia
Campbell, Robt., 222 Main west
Campbell, Mrs. Robt., 222 Main west
Fallis, Rev. S. W., B. A., Gore street Methodist Church
Fearman, F. W., 90 Stinson
Fearman, R. C., 17 Macnab north
Fox, Chas. B., B. A., cor. Main and Wellington
Findlay, W. F., 47 James south
Findlay, W. M., 387 Aberdeen ave.
French, Thos. E., 114 Maria
Gadsby, J., 314 Caroline south
Gaviller, E. A., M. D., 70 Main west
Geohes, —, 5 James north
Gibson, Hon. J. M.
Gibson, Hon. Wm., Beamsville
Gill, Jas., B. A., 45 Maria
Glassco, Frank S., mgr Imperial Bank of Canada
Gorden, John, 132 Peter
Graham, C. W., 53 Markland
Grant, W. J., 137 East ave. south
Grant, A. R., 144 Erie ave.
Grant, A. H., 50 Alanson
Greene, J. J., Sanford Mfg. Co.
Greening, S. O., Greening Wire Co.
Harley, Miss H.
Hall, Chas. F., Jr., Locomotive
Hall, Chas., 361 Victoria ave north
Hansel, Franklin, D.D.S., 40 East ave. north
Hamilton, Aubery M., 276 Hannah west
Harper, J. F., 11 King west
Hendrie, Hon. J. S., 254 James south
Hendrie, Wm., Holmstead
Henry, Rev. E. A., M.A., 122 Hannah west
Henby, Mrs. H.
Herald, Chas. A., 91 Queen south
Herald, Wm. C., 91 Queen south
Hardy, Capt., 129 Erie ave
Hogarth, E. S., B. A.
Hill, R. J., 56 Erie ave.
Hill, W. E., 6 James south
Hope, Geo., 43 Duke
Hore, J. G., 249 Victoria ave. north
Howitt, Rev. F., 108 George
Hoyle, R., 75 Catharine south
Hunt, Fred., Turnbull's Bookstore
James, W. A., 86 Bay south
Jamieson, Miss
Jones, Seneca, Hughson south

Jenkins, G. P., F.R.A.S., Hamilton, south
Johnston, Geo. L., B.A., 11 Walnut south
Kelley, Chas. T., M.D., 225 King west
Kelly, C. E., Barton school
Kemp, Geo. B., 198 Herkimer
King, Jos., 313 Main
Kitchen, Rev. Wm., 90 Hunter west
Knott, Thos. O., 20 Blyth
Lazier, S. F., K. C., 131 Charles
Lee, Lyman, B.A., 15 West ave. south
Lees, Geo., 5 James north
Lees, W. A., Poplar ave.
Leggat, Mathew, 23 Duke
Little, Hector J., 59 East ave. north
Livingstone, Rev. H. J., 18 William
Lougheed, W. J., Collegiate
Locheed, Dr., D. S., King west
Lucas, E. H., 309 King east
Lucas, Com. R. A., 63 Duke
Luxton, James, 5 Nightingale
Luxton, Harry
Lyle, Rev. Dr.
Lyon, Anthony, Screw Factory
Marsden, Miss, Main west
Manley, Mrs. H., Meaford
Marsh, Rev. D. B., Sc. D., 322 Herkimer
Marsh, Mrs., 322 Herkimer
Millard, J. W., Meriden Britannia Co.
Milne, C. G., Hamilton Bridge Co., 167 Bay south
Morrow, J. A. C., 79 King east
Moodie, J. R., Main and Macnab
Moodie, Jas., Main and Macnab
Moore, H. S., 23 Grant
Moran, J.
Morgan, Ernest, 185 East ave. north
Morgan, S. A., B.A., D. Paed, Ont. Normal College
Morris, Thos., Wellington north
Morton, Jas., Markland street
Morton, Dr. J. P., 148 James south
Morton, Rev. J. J., 39 Park south
Mulvaney, W., 20 Stinson
Murray, Wm., Athol, Bank of Hamilton
McCullough, —, 364 Queen south
McCullough, J. O.
MacPherson, F. F., B.A., 104 Wellington south
McGee, Miss M., 196 McNab north
McHaffie, W., City Hall
McKenzie, A. M., 134 Erie ave.
McIlwraith, T., coal merchant
McNair, W. G., 52 Rebecca
McMillan, Miss M. G., c/o Greening Wire Co.
Myles, W. H., coal merchant
Neill, A. T., City Hall, 346 Oakland ave.
Noyes, E. Finch, 150 Herkimer
Nix, Chas., King east
Orr, Thos., 166½ Main east
O'Reilly, M. J., Hughson south
Patterson, Jessie, 176 Victoria ave. north
Patterson, Ida, 176 Victoria ave. north
Pearce, Henry, Dundas, Ont.
Peene, Miss W. M., Blyth street
Pennington, E. D., Dundas
Powis, A., 64 King east
Presnail, H., 74 George
Preston, Rev. F., 175 Main west
Ptolemy, R. A., 209 Macnab south
Penson, S .R. G.
Quance, Francis, cor. Hess and Hunter
Reid, Miss Louisa, 220 Hunter east
Richardson, E. J., 643 Bay south
Robinson, W. A., 34 Hannah east
Rodgers, Mrs. E., 444 Main east
Roger, Thos. A.

Ross, Chas. M., Prov. and Loan Bldg.
Rutherford, Geo., Winer & Co.
Routliffe, C. H., Spectator Bldg., flat 3
Seager, W., 104 King west
Scriven, P. L., 13 King William
Semmens, Arthur, 39 Stanley ave.
Seymour, A. J., Box 264, City
Shannon, E., Bank of Montreal
Shea, John, 25 King east
Shee, W., Poplar ave.
Shepherd, Hon. James, American Consul
Sintzel, John, 63 Victoria ave. north
Sommerville, Wm., 118 Duke
Souter, D. A., 15 Hess south
Steele, R. T., 64 Hannah west
Stoney, Mrs., 120 Markland
Strathy, Stuart, Traders Bank
Strong, —, 33 Emerald north
Sutherland, J. W., Herkimer
Sweet, J. C., 33 Bay south
Tansley, Harry, 170 East ave. north
Taylor, A. J., 130 Markland
Thompson, Alex., Bay and York
Tilden, John H., 45 Victoria ave. south
Tilley, Leonard F., 103 Wellington south
Turner, J. B., B.A., Collegiate
Turner, Alex., 151 Hughson south

Bernier, Capt. J. E., Hon. Member of Astronomical
Campbell, C. C., 38 Queen south
Campbell, Mrs. C. C., 38 Queen south
Caswell, Rev. W. B., 139 Herkimer
Child, W. A., M.A., 377 Hess south
Clark, D., D.D.S., 54 King west
Cloke, J. G., King west
Coburn, H. P., 262 James south
Crawford, A. B., King west

Turnbull, J, mgr. Bank of Hamilton
Twohy, Miss H., 198 Macnab north
Tyrrel, J. W., C. E., 7 Hughson south
Unsworth, Miss C., 20 Hannah west
Vallance, Geo., 160 Hughson
Vallance, Wm., 42 Herkimer
Wagener, —, 25 York
Wallace, R. S., Wood, Vallance & Co.
Walker, Miss I. M., 116 George
Walton, Miss Kate, 148 Catharine north
White, Miss F, c/o D. Moore Co.
White, Wm., 9 James north
White, J. G., Hamilton Prov. Bldg.
Whitney, H. A., room 2, T., H. & B. Railway
Whitton, F. H., 353 Bay south
Witton, H. B., 16 Murray west
Witton, W., 24 James south
Wilcox, W. E., Stoney Creek
Wilson, Wm., 78 Victoria ave. south
Williams, J. M., 8 Devenport
Winfield, H., 99 Peter
Wodell, J. E., 123 Emerald north
Wolverton, A., M.D., 149 James south
Wuntz, Frederick, 176 Bay north
Young, J. M., 194 Park south
Zimmerman, J. A., 7 King east
Zimmerman, Adam, M.P., 132 Bold

Crossley, Miss M. E., 182 Herkimer
Darling, E. H., 109 Hughson north
Davenport, T. J., 170 Young
Dickson, J. M., 22 Bruce
Dixon, Miss J. B., 61 East ave. south
Duffield, Miss E., 123 Duke
Easter, A. W., Main west
Eastwood, John M., Times Ptg. Co.
Evel, J. J., 51 Stanley ave
Richardson, S. G., Traders' Bk. Bldg.

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NOTE ON A PALÆOZOIC CYPRIDINA FROM CANADA.

By Professor T. RUPERT JONES, F.R.S., F.G.S.

IN the Annals and Magazine of Natural History, ser. vii, vol. i (1898), pp. 333-334, pl. xxvii, a numerous series of fossil Ostracoda, with bivalved carapaces, having more or less resemblance to those of *Cypridina*, were described and figured. The specimens selected had been collected by various observers in different regions, and comprised two from the Tertiary of France, two from the Cretaceous of Belgium, one from the Permian of Durham, seven from the Carboniferous of Britain, three from the Devonian of Devon, three from the Upper Silurian and two from the Lower Silurian (Ordovician) of distant regions. References were made to several allied Palæozoic forms; and one other species from the Carboniferous of North America (Ulrich) and two from the Upper Silurian of Scania (Moberg) ought to have been mentioned.

We have now to notice another old Cypridinal form (the internal cast of a left valve), probably of Ordovician age. It has come to hand from Col. C. C. Grant, of Hamilton, Ontario, Canada, who exposed it in breaking up some blocks of limestone, probably belonging to the Trenton series, from a "glacial drift" at Winona, on the shore of Lake Ontario, not far from Hamilton.

This limestone is largely composed of a small gregarious variety of *Isochilina Ottawa*, Jones (see GEOL. MAG., July, 1903, pp. 300-304); and in this condition it resembles other specimens collected by Colonel Grant. and sent by him to the British Museum.

The particular specimen under notice approaches in lateral outline to *Cypridina brevimentum*, Jones, Kirkby, and Brady (Foss. Entom. Carbonif., pt. i, 1874, p. 16, pl. ii, figs. 15-19, especially fig. 15*a*). It differs, however, from that species in the following particulars:

It is more definitely oblong; straight on the back, with its postero-dorsal angle, and not the postero-ventral part, projecting. The hook or hood is narrower and sharper than in *C. brevimentum ;* attenuated partly by loss of substance.

The notch below is deeper than in the figures quoted, and it has a bold outline with an ogee curve. The cast itself has suffered a slight damage by having lost some of its convex surface, and the middle part of both its ventral and its dorsal edge, when it was being detached from the block. With the above-mentioned distinctive characters we may regard it provisionally as a separate species, with the name of *Cypridina antiqua,* sp. nov.

This internal mould of a left valve is somewhat decorticated across the middle of its convexity. The cast consists of dark-grey, fine-grained, and slightly micaceous mudstone, distinct from the limestone to which it is attached. It measures 15 millimetres in length and 10 in height (from dorsal to ventral edge).

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