JOURNAL AND PROCEEDINGS

OF THE

Hamilton Association

FOR SESSION 1891-92.

NUMBER VIII.

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

[illegible]

OFFICERS FOR 1891-92.

President.

A. ALEXANDER, F. S. Sc., Lon., Eng.

Vice-Presidents.

A. T. NEILL. S. BRIGGS.

Secretaries.

THOMAS MORRIS, Jr. A. W. STRATTON, B. A.

Treasurer.

RICHARD BULL.

Curator and Librarian.

ALEX. GAVILLER.

Asst. Secretary and Curator.

GEO. M. LESLIE.

Council.

COL. C. C. GRANT. W. A. ROBINSON. WM. TURNBULL.
J. F. McLAUGHLIN, B. A. T. W. REYNOLDS, M. D.

Museum.

PUBLIC LIBRARY BUILDING,
Main Street West.

A Small [illegible] to Ottawa

OFFICE-

	President.	1st Vice-Pres.	2nd Vice-Pres.
1857	Rev. W. Ormiston, D.D.	John Rae, M. D., F. R. G. S.	J. B. Hurlburt, M. A., LL.D.
1858	John Rae, M. D., F. R. G. S.	Rev. W. Ormiston, D.D.	J. B. Hurlburt, M. A., LL.D.
1859	Rev. W. Ormiston, D.D.	J. B. Hurlburt, M. A., LL.D.	Chas. Robb........
1860	Rev. W. Inglis, D. D...	T. McIlwraith	Rev. W. Ormiston, D. D.
1861	Rev. W. Ormiston, D.D.	J. B. Hurlburt, M. A., LL.D.	Rev. W. Inglis, D. D.
1871	W. Proudfoot.........	Judge Logie	Richard Bull ....
1872	Judge Logie	H. B. Witton, M. P....	Richard Bull ....
1873	H. B. Witton, M. P....	J. M. Buchan, M. A....	A. T. Freed..........
1874	H. B. Witton, M. P....	J. M. Buchan, M. A....	A. T. Freed..........
1875	H. B. Witton	J. M. Buchan, M. A....	W. H. Mills ....
1880	T. McIlwraith	Rev. W. P. Wright, M. A.	H. B. Witton.........
1881	J. D. Macdonald, M. D.	R. B. Hare, Ph. D.....	B. E. Charlton.......
1882	J. D. Macdonald, M. D.	B. E. Charlton........	J. A. Mullin, M. D....
1883	J. D. Macdonald, M. D.	B. E. Charlton........	H. B. Witton ....
1884	J. D. Macdonald, M. D.	H. B. Witton	Rev. C. H. Mockridge, M. A., D. D.
1885	Rev. C. H. Mockridge, M. A., D. D.	Rev. S. Lyle..........	W. Kennedy........
1886	Rev. C. H. Mockridge, M. A., D. D.	Rev. S. Lyle..........	Matthew Leggat .....
1887	Rev. S. Lyle, B. D.....	B. E. Charlton........	W. A. Childs, M. A.
1888	Rev. S. Lyle, B. D.....	T. J. W. Burgess, M.B., F. R. S. C.	W. A. Childs, M. A...
1889	B. E. Charlton.......	T. J. W. Burgess, M.B., F. R. S. C.	J. Alston Moffat .....
1890	B. E. Charlton........	J. Alston Moffat.......	A. T. Neill..........
1891	A. Alexander, F. S. Sc.	A. T. Neill	S. Briggs............

BEARERS.

Cor. Sec.	Rec. Sec.	Treas.	Libr. and Cur.
T. C. Keefer, C. E.	Wm. Craigie, M.D.	W. H. Park.......	A. Harvey.
T. C. Keefer, C. E.	Wm. Craigie, M.D.	W. H. Park.......	A. Harvey.
T. C. Keefer, C. E.	Wm. Craigie, M.D.	W. H. Park.......	A. Harvey.
Wm. Craigie, M.D.	Wm. Craigie, M.D.	W. H. Park.......	Chas. Robb.
Wm. Craigie, M.D.	Wm. Craigie, M.D.	W. H. Park.......	T. McIlwraith.
J. M. Buchan, M.A.	I. B. McQuesten, M. A.	W. G. Crawford...	T. McIlwraith.
J. M. Buchan, M.A.	I. B. McQuesten, M. A.	W. G. Crawford...	T. McIlwraith.
Geo. Dickson, M.A.	Geo. Dickson, M.A.	Richard Bull	T. McIlwraith.
Geo. Dickson, M.A.	Geo. Dickson, M.A.	Richard Bull	T. McIlwraith.
Geo. Dickson, M.A.	Geo. Dickson, M.A.	A. Macallum, M.A.	T. McIlwraith.
R. B. Hare, Ph. D.	Geo. Dickson, M.A.	Richard Bull	A. T. Freed.
Geo. Dickson, M.A.	A. Robinson, M. D.	Richard Bull	W. H. Ballard, M. A.
Geo. Dickson, M.A	Wm. Kennedy....	Richard Bull	W. H. Ballard, M. A.
Geo. Dickson, M.A.	Wm. Kennedy....	Richard Bull	W. H. Ballard, M. A.
Geo. Dickson, M.A.	A. Alexander	Richard Bull	Wm. Turnbull.
Geo. Dickson, M.A.	A. Alexander	Richard Bull	A. Gaviller.
Geo. Dickson, M.A.	A. Alexander .... F. S. Sc.	Richard Bull	A. Gaviller.
H. B. Witton, B.A.	A. Alexander ..... F. S. Sc.	Richard Bull	A. Gaviller.
H. B. Witton, B.A.	A. Alexander ..... F. S. Sc.	Richard Bull	A. Gaviller.
H. B. Witton, B.A.	A. Alexander ..... F. S. Sc.	Richard Bull	A. Gaviller.
H. B. Witton, B.A.	A. Alexander .... F. S. Sc.	Richard Bull	A. Gaviller.
Thos. Morris, Jr..	A. W. Stratton, B.A.	Richard Bull	A. Gaviller, and G. M. Leslie.

MEMBERS OF COUNCIL.

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

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

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

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

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

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

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

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

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

1880—M. Leggatt; I. B. McQuesten, M. A.; A. Alexander; Rev. A. Burns, M. A., L. L. 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. Hinchliffe.

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; Lt.-Col. Grant.

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

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

CONSTITUTION AND BY-LAWS

As amended by resolution passed April 14th and May 12th, 1892.

NAME AND OBJECTS.

1. The main objects of the Hamilton Association shall be the cultivation of Science, Literature and Art, the formation of a Museum, Library, and Art Gallery, and the illustration of the Physical Characteristics, Natural History and Antiquities of the country.

MEMBERS.

2. Members shall be of three classes, Ordinary, Corresponding, and Honorary. Both ladies and gentlemen shall be eligible for membership.

3. Ordinary members are those who pay an annual contribution of two dollars; a payment of twenty dollars shall entitle to ordinary membership for life.

4. Corresponding members are those who reside at a distance from the city and contribute to the objects of the Association. They shall have all the privileges of ordinary members, with the exception of being eligible for office. They may at any time become ordinary members by the payment of ordinary membership fees.

5. Honorary members must be men eminent for their literary or scientific attainments. They shall be exempt from payment of fees; they may attend the meetings of the Association, and shall be furnished with copies of the Journal and Proceedings, but shall not hold office.

6. Proposals for the admission of members may be made at any regular meeting, and decided by vote at the next regular meeting.

OFFICE-BEARERS.

7. The Officers shall be a President, two Vice-Presidents, a Corresponding Secretary, Recording Secretary, Treasurer, Librarian and Curator of the Museum, and Assistant Secretary and Curator, who, together with the Past Presidents resident in the city, the

chairmen of all working sections and five elected members, shall form the Council.

8. The Office-bearers and five members of the Council shall be elected at the regular meeting in April of each year. They shall enter upon their duties at the annual meeting in May, and shall continue in office for one year or until their successors are appointed. They may be re-elected to the same or any other office.

MODE OF ELECTION.

9. The Office-bearers and the Committee shall be elected in the following manner, after *viva voce* nomination: Each member shall write the name of the person he selects for the office, and put the paper, without signature, in the ballot box. The Secretaries, or two Scrutineers, specially appointed, shall report the number of votes for each nominee, and the person having the majority of votes shall be elected. In case there are more than two nominees for one office, and no one has a majority of the total nnmber of votes, the one having the smallest number of votes shall be struck off the list and a fresh ballot taken.

MEETINGS.

10. The Association shall meet on the second Thursday of every month, from November to May inclusive, at eight o'clock p.m., unless otherwise ordered by the Council—five members to constitute a quorum.

11. Special meetings may be held at any time, on the call of the President, in his own right, or on the requisition of three members, for the transaction of any stated business.

12. A majority of votes cast shall determine every question.

13. The President, or chairman of the meeting, shall have a casting vote in addition to the ordinary vote.

SECTIONS.

14. To allow those members of the Association, who devote attention to particular branches of science, fuller opportunities of meeting and working together with fewer formal restrictions than are necessary at the general meetings of the Association, Sections may be established in connection with any of the branches of learning coming within the scope of the Association. There shall be for each section a Chairman to preside at the meeting, and a Secretary who shall prepare for the last meeting in May in each year, a report of

the proceedings of the section during the year. Meetings of the sections may be called at any time by the Chairman. No person who is not a member of the Association shall have the privilege of joining any of the sections.

ALTERATIONS.

15. No alteration or addition to the Constitution or By-laws of the Association shall be made unless carried by a two-thirds vote at two successive regular meetings.

16. No alteration in the Constitution can be considered, except on the written motion of three members.

17. Should the Association at any time become inactive, the Library and Museum shall be preserved entire and deposited with some scientific or educational institution in the city.

PAYMENTS.

18. The membership fee of two dollars shall be payable within one month after the election of each member, and annually thereafter.

19. No ordinary member, in arrears for one year, shall be entitled to vote, or be eligible for office, and if, after two years, his annual fees remain unpaid, he shall, *ipso facto*, cease to be a member.

OFFICE-BEARERS.

PRESIDENT.

20. The President, when in the chair, shall inform the Association of the proceedings of the Council since the last report, receive and read motions and cause the sense of the meeting to be taken on them, preserve order, and direct the proceedings of the meeting in the regular course. An appeal may be made from any of his decisions to the meeting.

21. A Vice-President, in the absence of the President, shall preside, perform his duties and have his privileges.

22. In the absence of the President and both Vice-Presidents, a Chairman for the meeting shall be chosen by those present.

SECRETARIES.

23. The Corresponding Secretary shall conduct all the general correspondence, preserve letters received and copies of letters written by him, announce the receipt of all letters and papers, and read such as the Council or Association may require.

24. The Recording Secretary shall take minutes of the proceedings at the meetings of the Association and the Council, which, when read at the next meeting, and approved, shall be entered in separate minute books. He shall issue notices of the meetings of the Association and Council, in the former case, two days, in the latter, one day before the meeting, and shall notify members of their election.

25. The two Secretaries shall edit the Journal and Proceedings of the Association at the close of each session.

TREASURER.

26. The Treasurer shall have charge of the funds, under the direction of the Council. He shall collect annual membership fees, pay accounts approved of by the Council, make correct entries of income and expenditure, and submit a statement thereof to the Annual Meeting.

AUDITORS.

27. Two Auditors shall be appointed at the meeting, on the second Thursday in April, to examine the Treasurer's books and vouchers, and report to the annual meeting.

LIBRARIAN AND CURATOR.

28. The Librarian and Curator shall have charge of the Library and Museum, under the direction of the Council. He shall make a catalogue of the books, for circulation and reference, in the Library, and of the specimens in the Museum, naming the donors.

29. Any member may obtain from the Librarian any book, not a book of reference, and may retain it for two weeks, when, if no other member has applied for it, he may retain it for another fortnight.

30. Members shall have access to the Library to consult books of reference, at such times as may be specified by the Council.

31. Special donations to the Library or Museum may be accepted on special conditions.

32. Duplicate specimens in the Museum may be exchanged by order of the Council for equivalents.

33. Every member shall have access to the Museum, at the times specified by the Council, and any member may introduce visitors.

34. No case shall be opened without the sanction and presence of the Curator.

COUNCIL.

35. The Council shall have the management of the funds and property of the Association. The shall keep minutes of their proceedings, and report regularly to the Association; at the annual meeting they shall present a report of the year's work.

36. The Chairman, in his own right, or at the request of any two members, may call a meeting, aad four members shall constitute a quorum.

37. The Council shall arrange the order in which papers, or other subjects for consideration, may be brought before the meetings of the Association.

PAPERS.

38. Any paper read before the Association and deemed worthy of preservation or publication shall become the property of the Association.

ORDER OF BUSINESS.

At the ordinary meetings the President shall take the chair at the appointed hour, or as soon thereafter as five members are present, and the following order of business shall be observed:—

1. Reading, amending if necessary, and confirming the minutes of last meeting.
2. Transaction of business arising out of the minutes, or lying over from the last meeting.
3. Announcement by the Corresponding Secretary of letters, papers, or other documents received since last meeting—and reading of such of them as may be desired.
4. Report by the Curator and Librarian of donations to the Library or Museum.
5. Giving notice of motions and general business.
6. Balloting for admission of new members.
7. Proposals of members.
8. Introduction of visitors (by any member).
9. Reading and remarks on essays and papers.
10. Announcing, as far as practicable, the business of next meeting.

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF THE

HAMILTON ASSOCIATION

DURING

THE SESSION 1891-92.

THURSDAY, SEPTEMBER 24th, 1891.

SPECIAL MEETING.

Mr. B. E. Charlton, in taking the chair, announced that the custom followed in former years, according to which the newly-elected officers did not enter upon their work until November, was not sanctioned by the constitution, and that it was through the courtesy of the new President, Mr. Alexander, that he was then presiding. This, he added, was the first of a number of special meetings arranged for by the Corresponding Secretary. The Association would during this session meet on the second and fourth Thursdays of each month.

Professor Ramsay Wright, of the University of Toronto, who had kindly consented to be present, then addressed the meeting on "Microbes—their Life and Work." He referred to the wonderful advances made in microscopical research within the last ten years, and then proceeded to describe the minute beings to which it had introduced us. They are exceedingly small (hence the term *microbe*), the unit of measurement applied to them being contained 25,000 times in an inch; in form they are quite simple, some linear, others globular. They feed on any form of dead animal or vegetable matter, and greatly assist the processes of decomposition; but sometimes establishing themselves in the living organism they cause disorders of various kinds. Under favorable conditions they multiply with amazing rapidity.

Professor Wright then described the best modes of propagating and studying microbes, and by the aid of models and illustrations with the lime light pointed out the characteristics of the varieties associated with cholera, tuberculosis, fevers and other diseases.

Dr. J. D. Macdonald, in moving a vote of thanks to Professor Wright, referred to the many subjects of dispute between the schools which had been settled by the revelations of the microscope. The motion was seconded by Thos. McIlwraith, and carried.

The chairman having announced the subject of the next paper, the meeting adjourned.

THURSDAY, OCTOBER 8th, 1891.

SPECIAL MEETING.

B. E. Charlton in the chair.

The Council recommended that applications for membership be received at special as well as regular meetings. No objection being made, four applications were read.

Col. C. C. Grant read the paper of the evening, entitled "Notes on Fossil Silurian Plants." The paper was illustrated by a number of specimens from the Museum.

Thos. McIlwraith, delegate of the Association to the meeting of the Royal Society of Canada, in Montreal, last May, then gave an account of that meeting.

After the usual announcements the meeting adjourned.

THURSDAY, OCTOBER 22nd, 1891.

SPECIAL MEETING.

A. T. Neill, First Vice-President, in the chair.

As there was no other business before the meeting, W. H. Ballard, M. A., proceeded at once with the reading of his paper, "How We Measure." In a paper read before the Association some time since; Mr. Ballard dealt somewhat fully with the origin of our units of measurement of time, length and weight. His purpose in this was to show that our other measurements are all reducible to these three. The units of surface and volume are derived directly from that of length; the units of capacity, density and specific gravity from those of weight and volume. The measurement of uniform or accelerated velocity implies a consideration of time and length;

the measurement of work, weight and length; while the measurement of momentum implies all three. Force is measured by a reference to the units of time and momentum; energy may be expressed in terms of mass and velocity, or of force and space; and the various units for measuring heat, light, magnetism, electricity, and the like, are only more complex combinations of the same simple elements.

After an interesting discussion the meeting adjourned.

TUESDAY, NOVEMBER 10th, 1891.

REGULAR MEETING.

B. E. Charlton in the chair.

The minutes of the regular meeting in May and of the three special meetings in September and October were read and confirmed.

The Corresponding Secretary announced the receipt of twenty-nine exchanges and twenty-one Government reports since the last regular meeting.

C. C. Arthur, M. A., H. Carpenter, B. A., W. Chapman and J. W. Tyrrell were elected ordinary members of the Association.

Six applications for membership were received.

Messrs. Turnbull and Witton then escorted the newly-elected President, Mr. Alexander, to the chair, to which he was welcomed by Mr. Charlton in a few appropriate words. Mr. Alexander's inaugural address dealt chiefly with the study of Biology.

After the address, the Museum was thrown open for inspection; a number of microscopes were placed in the Art School rooms, and experiments were made in Pneumatics and Electricity. Mr. Aldous provided a short musical programme.

The meeting was closed by the singing of the National Anthem.

THURSDAY, NOVEMBER 26th, 1891.

SPECIAL MEETING.

S. Briggs, Second Vice-President, in the chair.

No business was transacted.

Rev. Dr. Burns read a paper entitled "A Criticism of our School System." He called attention especially to the rigidity of the system, the disregard of the individual pupil's nature, and the restrictions placed upon the teacher. Fewer subjects, he thought, should be studied at a time, and there should be no attempt in our public school grades to exhaust all the difficulties of one subject before passing to another. The pupil's promotion should be determined by the teacher's opinion of his fitness for higher work, and no attempt made by persons otherwise unacquainted with the pupils to grade them according to their ability to answer a few questions, as at present. [The paper has since appeared in the form of a series of letters to the Toronto *Globe.*]

Considerable discussion followed, for the most part concerning the qualifications of teachers and the methods of examination.

The chairman announced the formation of two sections, one for the study of Physics and Chemistry, the other for the discussion of questions in Philosophy.

The meeting then adjourned.

WEDNESDAY, DECEMBER 9th, 1891.

REGULAR MEETING.

The President, Mr. Alexander, in the chair.

The minutes of the last regular meeting, and of the special meeting of November 26th, were read and confirmed.

John M. Eastwood, W. Sanford Evans, A. E. Manning, Wm. Mole, M. R. C. V. S., Wm. Myles and A. C. Turnbull were elected ordinary members of the Association.

Two applications for membership were received.

A paper entitled "Canada: Its Canals and Waterways," was then read by H. B. Witton. The first part of the paper contained an interesting narrative of the discoveries of Cartier, Champlain, La Salle, and the Jesuit fathers in the watercourses tributary to the St. Lawrence. Next followed a brief account of the methods of trade in Canada in the early days; then of the construction of our various canals. The first of the series was constructed at the Cascades in the years 1779-83; the survey for the Sault Ste. Marie canal was made in 1797; the Lachine rapids were overcome in 1825; and the first Welland canal was opened by private owners in 1829. All these works have since been improved, some of them many times, and to them have been added the Chambly, Ottawa River, Rideau, and Trent Valley canals. The paper closed with a statement of the character and annual amount of the trade on the several canals, and of the percentages of freight carried in different years by water and land. Mr. Witton also showed a number of slides prepared by an officer of the Canals department.

On motion of B. E. Charlton, the Corresponding Secretary was instructed to convey the thanks of the Association to the Minister of Railways and Canals for the loan of the lantern slides illustrating the paper.

Mr. Alexander was asked to represent the Association at the approaching meeting of the Fruit Growers' Association of Ontario.

The meeting then adjourned.

THURSDAY, JANUARY 14th, 1892.

REGULAR MEETING.

The President, Mr. Alexander, in the chair.

The minutes of the meeting of December 9th were read and confirmed.

Mr. Alexander gave a brief account of the meeting of the Fruit Growers' Association.

Thos. H. Smith and R. A. Thompson, B. A., were elected ordinary members of the Association.

Three applications for membership were received.

The Corresponding Secretary reported the receipt of twenty-eight exchanges.

The Curator reported a number of donations to the Museum, for which, on motion of W. A. Robinson, seconded by Richard Bull, the thanks of the Association were returned to the donors.

A resolution concurring in the recommendations of the late Prison Reform Conference in Toronto was moved by Mr. Briggs, seconded by Mr. Bull, and carried.

On the recommendation of the Council, L. Woolverton, M. A., of Grimsby, was elected a corresponding member of the Association.

S. B. Sinclair, M. A., then read his paper on "Memory." In the first part he analyzed the process of remembering, and explained the various theories held in regard to the mechanism of retention; in the second part he dealt with the practical question, how best to remember, discussing the value of mnemonics, the necessity of attention, the question of long and short hours of study, and the best methods of presenting subjects to young pupils.

Some discussion followed the reading of the paper, and after the usual announcements the meeting adjourned.

THURSDAY, JANUARY 28th, 1892.

SPECIAL MEETING.

The President, Mr. Alexander, in the chair.

The Corresponding Secretary reported the receipt of thirty exchanges.

One application for membership was received.

J. Alston Moffat then read a paper entitled "Man Scientifically Considered," seeking to show what is, what can be, and what cannot be learned by the scientific method concerning the origin of man, and what support the scientific principle gives to the assumption of an intelligent Creator manifesting himseif in nature.

After some discussion of the points raised in the paper, the meeting adjourned.

THURSDAY, FEBRUARY 11th, 1892.

REGULAR MEETING.

The President, Mr. Alexander, in the chair.

The minutes of the meetings of January 14th and 28th were read and confirmed.

Miss M. A. Buckley, John Holliday, M. A., A. King, M. A., and Wm. Wilson, were elected ordinary members of the Association.

A resolution of the Council recommending to the Association the hearty support of Mr. Beckett's scheme for a Mountain Drive, was announced and concurred in.

J. B. Turner, B.A., then read a paper entitled "The Chemistry ot the Bleaching Processes," illustrating it by several experiments.

After the usual announcements the meeting adjourned.

THURSDAY, FEBRUARY 25th, 1892.

SPECIAL MEETING.

The President, Mr. Alexander, in the chair.

The Curator reported several additions to the Museum.

The President then read a paper on meteors, contributed by

H. B. Small, of Ottawa, and entitled "Messengers from the Skies." An interesting discussion followed. On motion the thanks of the Association were tendered to Mr. Small.

Mr. Beckett then outlined his plan for a drive along the face of the mountain. The following resolution, moved by F. W. Fearman, seconded by A. E. Walker, was carried:

"That this Association, after hearing Mr. Beckett's description of the proposed Mountain Drive, do approve of the scheme, and recommend its adoption by the city."

The meeting then adjourned.

THURSDAY, MARCH 10th, 1892.

REGULAR MEETING.

The President, Mr. Alexander, in the chair.

The minutes of the meetings of February 11th and 25th were read and confirmed.

The Secretary gave notice that at the meeting on the second Thursday of April he would move that certain changes be made in the Constitution. A copy of the motion was ordered to be placed in the Museum.

Mr. Bull moved, seconded by Mr. Walker, that the Secretary be instructed to communicate with the families of the late T. C. Mewburn and Charles Robertson, expressing the sympathy of the Association with them in their loss.

The receipt of twenty-six exchanges was announced.

L. Woolverton, M. A., of Grimsby, then read a paper entitled "Fungi Affecting Fruits." After the reading of the paper, a number of questions relating to diseases of fruits were asked. Reference was made to the unsatisfactory character of the present law for the inspection of diseased fruit trees. It was moved by B. E. Charlton, seconded by Thos. Littlehales, and carried, That in view of the great loss to fruit growers from the prevalence of the "Black Knot" in plums and cherries, and the "Yellows" in peaches, the Legislature of the Province of Ontario be requested to make the statute in relation to these diseases more stringent, so that the two most formidable enemies of the fruit growers of Ontario may be speedily stamped out.

The meeting then adjourned.

THURSDAY, MARCH 24th, 1892.

SPECIAL MEETING.

The President, Mr. Alexander, in the chair.

The Corresponding Secretary announced the receipt of thirty three exchanges and six Government reports.

The President referred to the proposed establishment of a Photographic Section of the Association.

C. R. McCullough then read a paper setting forth the advantages of a reformed spelling, and answering the objections most commonly urged against it. An interesting discussion followed.

After the usual announcements the meeting adjourned.

THURSDAY, APRIL 14th, 1892.

REGULAR MEETING.

The President, Mr. Alexander, in the chair.

The minutes of the meetings of March 10th and 24th were read and confirmed.

The Corresponding Secretary announced the receipt of nine exchanges and a number of Government reports.

The Curator reported some donations to the Museum made by Mrs. Charlton, to whom the thanks of the Association were expressed.

In accordance with notice given at the meeting of March 10th, the Secretary then moved that certain changes, suggested by the Council, be made in the Constitution of the Association. The motion was supported by Messrs. Walker, Forbes and Gaviller, and carried.

Twenty-eight applications for membership were received.

The President reported the progress made in fitting up the dark room for the Photographic Section, and announced that a meeting for the organization of the Section would be held in the Museum on Monday, the 18th inst., at 8 p.m.

W. H. Schofield, B. A., then read a paper on "The Jews and the Persecutions in Russia." After tracing the succession of persecutions attending the Jews in various parts of Europe, he described the measures that have been adopted against them in Russia, especially within the last eighteen months. That the persecutions are due chiefly to religious feeling, was shown, the writer held, by the restrictions placed upon non-conforming Christians. Considerable discussion concerning the extent and cause of the present movement followed, and sympathy was expressed with the subjects of persecution.

The President directed attention to the ferns from Jamaica (the gift of Mr. Adam Brown) which were on view, and said that the remainder of the collection, together with some plants collected by Mr. Wm. Hussey in the south of England, would be ready for the next meeting.

The meeting then adjourned.

THURSDAY, APRIL 28th, 1892.

SPECIAL MEETING.

The President, Mr. Alexander, in the chair.

Five applications for membership were received.

The President then read a page by T. J. W. Burgess, M. B., F. R. S. C., of Montreal, entitled "Notes on the Genus Rhus," and dealing especially with the poisonous varieties to be found in Canada.

In the course of the discussion which followed the reading of the paper, Mr. Fearman said that in Muskoka Wild Balsam *(Impatiens Flava)* was used as a remedy for ivy poisoning.

The President announced that the next would be the annual meeting.

The meeting then adjourned.

THURSDAY, MAY 12th, 1892.

REGULAR MEETING.

The President, Mr. Alexander in the chair.

The minutes of the meetings of April 14th and 28th were read and confirmed.

The Corresponding Secretary announced the receipt of twelve exchanges and a number of Government reports.

The following, from whom applications had been received in April, were elected ordinary members of the Association: Alex. E. Adam, Jas. R. Adam, Ernest Alexander, Alf. H. Baker, J. W. Bowman, J. G. Y. Burkholder, Chas. E. Cameron, Alf. C. Crisp, Geo.

H. Cuttriss, A. L. DeVine, W. J. Grant, Geo. Lees, R. A. Mathesius, Edwin Mills, Jas. R. Moodie, Arthur Morgan, M. J. Overell, R. A. Robertson, Lucien G. Ross, Richard Southam, Robert Stark, David Sweet, Harry Sweet, J. D. Turnbull, W. R. Turnbull, W. J. Turner, Wm. White, Julius M. Williams, Jas. Gill, B. A., J. C. Hore, R. A. Hutchison, Rev. J. H. Long, M. A., and S. A. Moore.

An application for membership was received from A. D. Garrett, and on a motion of Thos. Morris, Jr., he was at once elected.

Wm. Mole, M. R. C. V. S., then read a paper, illustrated by specimens, photographs and diagrams, on the "Origin and Development of the Horse," tracing the stages of its rock-recorded evolution, and comparing its limbs with those of man. A number of questions bearing on the subject, asked by those present, were answered by Dr. Mole.

The annual meeting was then held. Reports were read as follows:

Report of the	Council, by the Secretary.			
"	"	Geological Section,	by	A. T. Neill.
"	"	Biological	" "	Henry Moore.
"	"	Philological	" "	A. W. Stratton, B. A.
"	"	Physical	" "	Geo. Black.
"	"	Philosophical	" "	S. A. Morgan, B. A.
"	"	Photographic	" "	Wm. White.
"	"	Treasurer,	"	Richard Bull.

Officers for the ensuing year were elected as follows:

President, - - - - -	A. Alexander, F. S. Sc.
First Vice-President, - -	A. T. Neill.
Second Vice-President, -	S. Briggs.
Corresponding Secretary, -	Thomas Morris, Jr.
Recording Secretary, - -	C. R. McCullough.
Treasurer, - - - - -	Richard Bull.
Curator, - - - - - -	Alex. Gaviller.
Ass't Secretary and Curator, -	Geo. M. Leslie.

Elected Members of Council—T. W. Reynolds, M. D., W. A. Robinson, P. L. Scriven, Wm. Turnbull and Wm. White.

After a vote of thanks to the retiring Secretary the meeting adjourned.

PRESIDENT'S ADDRESS,

At the Inaugural Meeting held November 10th, 1891.

A. ALEXANDER.

Biology—The Use of the Word—How it Came to be Used—Its Scope, and a Few of the Advantages of Biological Study.

LADIES AND GENTLEMEN:

I have to thank you for the great honor you have conferred upon me by electing me to the position of President of this Association; and while I feel that I can never fill the chair so efficiently as my predecessor, Mr. Charlton, has done for the last two years, the kindly words he has spoken in introducing me, and the intense interest I feel in the progress and work of the Association, encourage me in the hope that I may be able to help, in some feeble measure, the work to which we have set ourselves.

In looking about for a text around which I might cluster a few things I should like to say to-night, I was helped to a decision by remembering that there is an increasing number, of young people especially, who are interested in the love and study of nature. This is evidenced by the crowds that issue, in the spring and summer, from the city to the woods and fields, to look at and gather and study the flowers and insects and birds. I have been a keen observer of this daily exodus each year for at least twenty years, and I have been much gratified with the marked increase in the numbers. This, then, and the casual remark of a friend respecting the Biological Section of our Association, are responsible for the choice of the theme of my address to-night.

Since the re-organization of the Sections a few years ago, I have had occasion to speak of the Biological Section in particular, and have often urged its claims upon individual members of the Association, and asked them to attend its meetings. On more than one occasion I have been told that the word *Biological* frightened some, and that if we should call it the "Natural History" Section more would attend it.

Of course, as a matter of fact, all the members of our Association know exactly what is covered by the title "Biological Section;" they know the *derivation* of the word, and the position Biological studies occupy among the other physical sciences. Therefore in what follows I am not inferring that it is necessary to throw more light on these, but rather, that we may look historically at the various steps leading to the use of the word Biology, and how it actually grew out of the term Natural History which my friend wished substituted for Biological.

What is Biology then? The word itself came into use about ninety years ago. That is, it was first mentioned about ninety years ago, and may be said to be the expression of the growth of science during the last two centuries and a half.

At the dawn of learning, after what we call the dark ages, all knowledge was divided into two kinds. These were, the knowledge of nature, and the knowledge of man; for it seems to have been the current idea then, that there was a sort of antagonism between man and nature, in fact, that the one had not very much to do with the other, except that the one was pretty often rather troublesome to the other.

And though we find on reading the writings of some of the great thinkers of the seventeenth century, that they recognized but one scientific method, applicable both to man and to nature, we also find that some of them had a notion of the existence of a broad distinction between nature and man.

One of the writers of that period was Thomas Hobbes, whose wonderful book "Leviathan" was published in 1651. I cannot do better than quote his own terse statement in relation to the division of human knowledge at this period. He says, "The register of the knowledge of facts is called history, whereof there be two sorts, one called *Natural* History, which is the history of such facts, or effects of nature, as have no dependence on man's will; such as are the histories of metals, plants, animals, regions and the like. The other is *Civil* History, which is the history of the voluntary actions of man in the commonwealth."

So that we see, all history of fact was divided into these two groups of *natural* and *civil* history.

It will be seen from this that if our Association had existed in the time of Hobbes we should have needed only two Sections to include all we at present undertake. The Geological and Biological Sections would have met as *one* Section.

It is a very interesting fact to remember that about this time the Royal Society of England, whose monthly issue of their proceedings is regularly sent to enrich the library of this Association, was founded about the time the writer above referred to published his book. It was then called a "Society for the Improvement of Natural Knowledge," which is nearly the same thing as a "Society for the Improvement of Natural History."

Of course, as time went on, and the various branches of knowledge more distinctly developed and separated from one another, it was found that some were more susceptible of precise mathematical treatment than others.

The publication of Newton's "Principia," which I suppose gave a greater impulse to the physical sciences than any book ever published before or since, or, it might be said, any book likely to be published in the future, showed that these precise mathematical methods were applicable to those branches of science such as astronomy, and what we now call physics, which occupy a large portion of the ground of what the older writers understood by Natural History. Then chemistry was wrested from the hands of necromancers and fortune-tellers and took definite shape, which helped to lead to a distinction being made between the experimental and the observational branches (excuse the term) of Natural History.

It is evident, I think, that the term "Natural History" came to be used about the middle of the last century for those phenomena which were not at that time susceptible of mathematical or experimental treatment. That would include those phenomena which come under the general heads of physical geography (Hobbes' "regions"), geology, mineralogy, the history of plants and the history of animals.

About this time appeared several great naturalists. Among others the great Linnæus, whose work, "Systema Naturæ," is in our Public Library. The subjects these men dealt with were spoken of as Natural History, and they were called, and called themselves, naturalists. But you will notice that this was not the original meaning of the term Natural History.

I think in some of the Scotch Universities there are still, or there were at least some thirty years ago, chairs of Civil and Natural

History. Just think of such a chair as that of Natural History in the Toronto University, where the unfortunate occupant would have to travel over the whole ground of Geology, Mineralogy, Zoology, Botany and Physical Geography?

In course of time, however, it was noticed by thinking men, that under this title of Natural History there were included heterogenous constituents—that Geology and Mineralogy were very different from Botany and Zoology, and consequently that a person might obtain a somewhat extensive knowledge of the structure and functions of plants and animals without the necessity of entering upon the study of geology and mineralogy, and *vice versa*. We also find that as knowledge advanced it became evident that there was a great analogy and a very close alliance between the two sciences of Botany and Zoology which dealt with living things, while they are much more widely separated from all other branches of science. Therefore we are not surprised that at the beginning of the present century, in at least two different countries, two or three famous men clearly conceived the idea of uniting the sciences which deal with living matter into one. Lamarck, of France, as far as I can find, was the first to use the term "Biology" (from two Greek words, meaning a discourse upon life or living things.) His work was published in 1801. In the following year a German, Treviranus, published the first volume of a work called "Biologie." When completed the work extended to six volumes, on which he spent twenty years of his life. He seems to have been the only one who really worked out the idea of the oneness of all life. He contended that all those sciences which deal with living matter are essentially and fundamentally one, and ought to be treated as a whole. That is, therefore, the origin and the history of the development of the word, and that is how it came about, that all clear thinkers and lovers of consistent nomenclature came to use the term instead of the old confusing name of "Natural History," which, as we have seen, conveyed so *many* meanings, and that also is why the Hamilton Association prefer to call the section dealing with life, whether animal or vegetable, the *Biological* Section and not the *Natural History* Section.

Before we leave the subject, just a few words about the general scope of our studies in Biology. In the strict technical sense of the word it takes in all the phenomena exhibited by living things as distinguished from those that are not living. This would be all very well, so long as we confined ourselves to plants and the lower animals, but you will at once see that we should be landed in considerable difficulties when we reached the higher forms of living things.

For whatever view we may entertain about the nature of man, one thing is perfectly certain, that he is a living creature. Hence, if our definition is to be interpreted strictly, we must include man, and all his ways and works too, for that matter, under the head of Biology, in which case we should find psychology, politics and political economy, all absorbed into the province of Biology.

We should consider, for instance, our friend Mr. McIlwraith to be quite inside the Biological fence if he were to refer, as he often does, to bird calls and bird notes, or bird music, when he discourses to us about his feathered favorites—in fact, a paper from *him* on that particular subject, so very interesting, would be quite within the scope of the work of the Section under review—but, if any member were to introduce the subject of human language, or *man's music*, we should at once have the Philological Section, led by our worthy Secretary, telling us that we were on foreign soil in meddling with this subject; and no doubt Mr. Aldous would hint that in introducing such a subject as *man's music* into the Biological Section we were at least not in harmony with modern scientific usage, but would also suggest that the place for it was in the music department of the Art Section, a section as yet unrepresented in our Society.

In strict logic it may be hard to object, for have not the lower animals their economy and their polity?—and if, as is always admitted, the polity of bees and the commonwealth of wolves fall within the scope of the biologist proper, it surely becomes hard to say why we should not include therein human affairs, which in so many cases resemble the bees in zealous getting, and are not without a slight likeness to the proceedings of the wolves.

However, there has been a sort of practical understanding by which biologists give up to a different branch of science what Bacon or Hobbes would have called *Civil* History. This self-sacrifice can well be afforded, inasmuch as, on a moderate estimate, there are over a quarter of a million of different species of animals and plants to know all about, so that you see this section has territory more than enough for the next century or two, at least.

If we had not come together this evening to have a sort of field night among the physical sciences, and by means of microscope, and botanical specimens, electrical and pneumatic apparatus, to come near to and hold converse with the minute and wonderful in nature, and to see the effects of some of the hidden but mighty forces of nature, I should have made a further demand upon your patience, that I might speak of what is to be gained by the study of Biology.

We generally judge of the value of human pursuits by their bearing upon human interests, that is, by their utility. Knowledge of every kind is useful in proportion as it tends to give people right ideas which are necessary as a foundation for right practice, and to remove wrong ideas which, as we all know, are the fruitful mothers of error in practice. And after all, our world seems to be largely if not absolutely governed by ideas, and very often by the wildest ideas, therefore it must be a matter of the very greatest importance that our theories of things, and even of things that may seem a great way from our daily lives, should be as far as possible true, and as far as possible removed from error. It would be in this higher and broader sense of utility that I would measure the value of the study of Biology. At many of the turns of this life of ours we feel the need of some knowledge of this science.

Those of us who had the great privilege and pleasure of hearing Prof. Ramsay Wright's lecture on Microbes do not require any argument to convince us how intimately the theory of infectious diseases is connected with biological knowledge. And surely this is of interest to all of us. This theory is being rapidly made clear by this study, and it surely behooves the general public, as well as the professional Biologist, to get a sufficient knowledge of these truths so as to be able to take an intelligent interest in the discussion of problems relating to measures for the dealing with these diseases.

I might point you to the fact that the theory of agriculture has been almost revolutionized during the last fifty or sixty years. The importance of this cannot be over-estimated, and the whole of these new views have grown out of the better explanation of certain processes which go on in plants, and which, of course, form a part of the subject matter of Biology.

I might go on multiplying examples of the many benefits, direct and indirect, derived from this branch of study, but time forbids.

And the pleasure of the study! Well, I dare not trust myself to describe it.

To make the subject complete I ought to speak of the best way of studying Biology, but I cannot now; suffice it to say, that the physical sciences can never be mastered as literary accomplishments are. They can never be mastered by merely reading books or listening to lectures on the subjects, any more than a boy could learn the business of a tea merchant by reading books about China and Japan, or India, or about tea. He has to go into a tea-merchant's office, where he can have the handling and the smelling and the tasting of the tea.

I am very much tempted here to go on and speak of our Section work in general, to tell you, among other things, that I believe the most important work done by the Association, next to the private and personal researches and field work of the individual members, is done in the Sections. I have found it so myself. I will just name one instance. At a meeting of the Biological Section held in the spring, Mr. Turner gave us a homely yet strictly scientific talk about the anatomy of birds. There we sat around the table, and he, with the skeleton and bones of his bird, made the marvellous mechanism of a bird's wing and other parts so plain to us, that I learned more in half an hour on that particular subject than I could possibly have learned from hours of reading, or from many learned lectures or papers on the subject. There the objects themselves forming the subject before us, are handed round, and the words, which are mere symbols, become real because they are linked with the object symbolized.

What I should like to see in our various sections dealing with the physical sciences is, that there should be such a true idea of the best mode of pursuing them, and such an enthusiasm in the pursuit, that out of our Association there might arise some who would pursue research into "regions beyond," for in all these fields, and, I might say, in fields that have been partially traversed, there are innumerable truths beyond the most advanced truth yet known. The why and the wherefore of most things have yet to be discovered. Let us all keep in view the objects of our Association, so that every active member may contribute something to the accumulating sum of human knowledge, and thus add to the sum of human power and happiness.

NOTES ON FOSSIL SILURIAN PLANTS, HAMILTON, ONT.

Read before the Hamilton Association, October 8th, 1891.

BY COL. C. C. GRANT.

As a general rule the fossil plants called fucoids of Silurian seas have attracted little attention. I suppose it arises from their being so seldom found even in a tolerable state of preservation. Many of them on this continent are concealed in the interior of the flags or limestone layers, and consequently are not calculated to attract attention. Accident rarely reveals the Buthotrephis of Hall in the inside of a Clinton slab. On one occasion I noted that a large projecting flag, which I was unable to reach, had at last given way through the action of frost on the underlying shales. The true Medina freestones below, as well as the "passage beds" of Dr. Spencer, had been previously quarried out and removed, leaving a perpendicular cliff on a small scale. Now it so happened that a hard block of an upper layer had lodged at the foot underneath, before its final plunge downwards. This it evidently struck edgewise. The result was the splitting of the flagstone, laying open a portion of the plant remains, or rather impressions, now contained in one of our side cases. Such a thing as this cannot often occur.

BUTHOTREPHIS, a Silurian fucoid, was named and described by the world-renowned palæontologist, Dr. Jas. Hall, of Albany, now Director General of the New York State Geological Survey, as occurring in the rocks in the United States, which are known to us Canadians now as Cambro-Silurians. The conical root, a portion of the main stem and a branch, were figured and described very accurately in an early report of the New York State Survey But I am not surprised that its claim to the title of a sea plant should be disputed at the earliest stage of its discovery, when only a short time since Dr. Nicholson, in the Palæontology of Ontario, remarked that Palæophycus Buthotrephis of Hall and Licrophycus of Billings belonged to a singular and obscure group of fossils which he indexed under the head *Incertæ Sedis.*

Perhaps in no other locality have been found more perfect specimens of Dr. Hall's Buthotrephis, than in our local Clinton rocks. From the conical root buried erect in an indurated limestone shale to the slender branch proceeding from the extremity of the main stem, it is almost as well defined as a specimen in a botanical case. The branches alternate, more robust near the base, and smaller towards the top. If only detached branches were obtained, they would probably be described and figured as distinct species, or at least varieties. It is evident that Dr. Nicholson and others have seen only mere fragments, that they have not made out where the plant bed can be found, where they were deposited *in situ.* In a layer little more than six inches thick I counted seven or eight generations, one lying above the other, with their partings of calcareous shale between.

A white colorless lingula (L. oblata) is frequently found in one of the plant beds. There are three or more; I think they are situated a little above the passage beds overlying the Grey Band of the Medina freestone. There are no indications on the surface that these Clinton flags contain fossils; an examination of the edges led to the discovery. If you carefully examine this portion you may notice short lines at regular intervals, interspersed through the matrix, differing slightly in color; note likewise that they appear to be confined to a certain part of the rock. Now if they were the burrows of *errant worms* named and figured in the Palæontology of Ontario under the name Planolites, one would expect them to present a more or less rounded shape, which they do not. I do not mean to say that Dr. Nicholson makes any mistake regarding the existence of an annelid in the muddy Clinton flats differing from other members of the family, Scolithus, Arenicolites, etc, whose burrows were vertical, not horizontal. The wisdom of this view admits of no dispute; but he adds, "The genus Planolites includes a large number of supposed *vegetable fossils* from the Palæozoic rocks which have been referred to the genera Palæophycus and Chondrites. . . . . They agree doubtless with some of the species described [as plants] by Hall and Billings from the Silurian rocks of North America." There, I think, he is quite mistaken. The error, I presume, originated, as in the former case, from his not having seen proper specimens, or from his being entirely unacquainted with their immediate surroundings.

PALÆOPHYCUS, a Silurian fucoid, was first named and described by Dr. Jas. Hall, of Albany, as occurring in the Cambro-Silurian rocks, I think, of New York, also. I first noticed it near Hamilton on the surface of a large block of Medina freestone which probably fell off a cart near the quarry and rolled down the hill. It completely covered the surface of the rock, and although a little flattened by pressure, it presented the appearance of *a soft succulent mass of sea weeds* that had been washed up on a sandy shore; some of the stems were two inches across. From a thin sandstone seam in the Grey Band I subsequently obtained a great number of specimens near the city in the old quarries below the escarpment,— perhaps young plants or varieties; they were of much smaller dimensions. Finer specimens of a Palæophycus were obtained in a freestone quarry near the Reservoir a few years ago. The most perfect one is now in the Redpath Museum, Montreal Another, too heavy to carry off, is still weathering out there, and as it is a remarkably fine one I think we ought to secure it for our collection. I feel assured if any one present had the opportunity of examining it, he would perceive in a moment the absurdity of calling such an organism a worm trail. The fucoid is ill preserved in our local Clintons and in the Niagara shale. But some years ago a cart, with a load of building stone from Lime Ridge, on the Hamilton and Caledonia road, about two miles south of the Mountain View Hotel, broke down on James street. The upper layer of Niagara limestone (glaciated) there holds many interesting species of Stromatoporæ. On examining the contents which had been dumped near the pathway, I was much surprised to find the surface of two of the largest rock masses completely covered with a Palæophycus, presenting a similar appearance to the *matted sea weeds of the Medina series*, the upper folding over the lower ones, and retaining faint traces of longitudinal striæ, even to the naked eye. Altogether, the plant from the Niagara bed was in a better state of preservation, and had attained a greater size, although clearly identical with the grey band fucoid. A middle portion of an upper stem was two and a half inches in diameter. I regret that the distinguished author of The Great Ice Age, Dr. Geikie, was apparently not aware of such a fact when he published his Class Book of Geology in 1886, and included our fucoid among trail impressions. I do not imagine he ever acquired a personal knowledge of our American Silurians, and he seems to have placed rather too much reliance on the views of others in this and a few more instances as well.

PALÆOCHORDA.—Under this name may be classified many of the fucoids Dana notes in the Manual of Geology as occurring in the Silurians of the United States. They are rounded branching stems, he adds, from the size of a thread to that of a finger. I obtained one of the intermediate forms from the Grey Band here, which many palæontologists would suppose to be a new species. I think it may prove, if not identical, at least a variety of a cord-like form of the lower Clinton green shales. The plant in question I found at the foot of the bluff, a little beyond the Reservoir, some twenty years ago. It is in the possession of the Canadian Geological Survey. I am unable to say whether it has ever been figured or described.

The late Dr. E. Billings, in a communication acknowledging the receipt of a box of organic remains from Hamilton, noticed particularly the Clinton fucoid, which was new to him also: "The rounded, matted, conical masses, with the tubes folding over each other." I was not able to afford him at that time the additional information he required regarding its position and surroundings *in situ*; in fact, all I knew about it then was that it must have fallen from one of the overlying green bands many years previously; otherwise it could not have been weathered out so well. It was not until I had examined, long after, nearly every layer of both bands, that I at length ascertained the actual position of the fossil. It occurs at intervals in a soft muddy band in the lower green shales. Strictly speaking, it is not exactly of a shaly nature, in the general acceptance of the term. Where the plant came into contact with its immediate surroundings, it evidently possessed the property of *indurating and converting the muddy sediment into a hard, stony substance.* Arthrophycus Harlani, another seaweed, as asserted by Credner recently, is found associated with it, and also a new species of the late Mr. Billings' genus, Licrophycus. I cannot suppose any ordinary annelid ever possessed the power of changing mud into stone. Hugh Miller records an instance where some weeds and vegetable refuse had been deposited on a heap of clay; the mass in a short time, although exposed to the air, become so hard that he was forced to use a pick to remove it. I am enabled to bring to your notice a few specimens of all three; some of them are in rather poor preservation.

Sir Wm. Dawson does not think Licrophycus represents a plant at all. He supposes it to be the trail of a crustacean or other creature to or from its burrow. There are a few other forms, possibly organic, but for the present it may be better to put them aside as doubtful.

In the meantime we may in ascending order pursue our investigations into the Upper Red Clinton Band, which probably is the equivalent of the Iron Band of the New York State Survey. However, if limestones there rest on the Iron Band, as stated perhaps incorrectly, our upper green shales must be absent altogether, or a second ferruginous bed, which is not seen at Hamilton, caps the series. Dr. Hall, of Albany, however, informs me that such is the case. The plants of the Clinton Iron Band, widely differ from *true fucoids.* They present no internal structure like land plants, but it is rather singular that they are frequently found *erect*, and it is necessary to break the flags across, not split them, in order to get good specimens. Indeed, they seem to be species of *marsh plants* that grew on the muddy soil, and the earthy iron ore itself is perhaps due to their presence. Dana remarks that "iron could never have been deposited in *an open sea*. Clayey iron deposits do not accumulate under such circumstances; they are proof of extensive marshes, therefore of land near the level."

That the tide had access occasionally is evident from the undoubted presence of such shells as Lingula and others, which buried themselves in muddy sediment between tides, perhaps like the modern Cardium (Cockle).

A few years ago it was found necessary to remove a large quantity of stone and shale which had fallen from the cliff behind the Reservoir, near the residence of Judge Robertson. On examining the material which had been emptied down the hill slope beneath the Jolley Cut road, I was surprised to find in the debris a fragment converted into iron, resembling in external appearance a coral Zaphrentis or Clisiophyllum. Sir Wm. Dawson, however, thought it bore a nearer resemblance to a plant. I have never known a case where a coral has been changed into *iron*, but I had in my possession a land plant from the English carboniferous rocks fossilized precisely in the same manner. I have no doubt our great fossil botanist was quite correct in his views respecting it.

Although it contains few fossils the succeeding Upper Green Clinton Band is of much interest. Evidently deposited in a shallow sea, the sandstones pointing to a shore line display the ripple marks left by the waves on the Silurian beach, and the burrows of an annelid closely related to a modern lob-worm; they are vertical and in pairs. Nicholson's Planolites or errant worm occurs here also. The few plants are ill preserved; one of them had a bulbous root. While the sea bottom was undergoing depression, previous to the deposition of the limestones, a fucoid, colored black in the green shales, put in an appearance. The stems are fluted like the Cambrian Eophyton, or a striated fucoid from the lower red sandstone, figured by Hugh Miller. The branches appear to be of the same thickness throughout. When the limestone rests on the shales, the base bed of the Niagara proper, according to all Canadian geologists, it has caught up and attached, scarcely incorporated, a portion of the clay underneath. On splitting this the plant is seen, but it survived the submergence of the clay deposit, for I have traced it even in the interior of the lower building block as well as in others superimposed.

So recently as the 6th of November last, I noticed in the quarry adjoining Mr. Colbeck's place, on a limestone block, the remains or impression of a sea weed differing from others found here. If I could succeed in extracting it uninjured for Sir Wm. Dawson it might prove of much interest. It is on such a massive layer that I think it may be rather difficult to do so. Dana remarks that limestones seldom contain *Plant Remains.* It is not so in Canada, however true it may be as regards the States. The limestones at Macdonald's Cove, on the north shore of Anticosti, contain detached branches, perhaps of a Buthotrephis. I obtained hundreds of specimens remarkably well preserved but never found even a fragment of the main stem or conical root. Whether they were distinct species or mere immaturities of the vegetable kingdom I was unable to determine for my part. It was in the waterlime beds at Rousseau's Creek above the Albion Mills that I discovered the beautiful fucoid represented in Sir Wm. Dawson's work on Fossil Plants as an undoubted Silurian sea plant. The layers in question hold others also, which for the present must remain undetermined. They vary considerably as regards the thickness of the stems or branches as well as in lesser particulars. I think it probable that the specimens obtained from the bed of the stream had the carbonaceous portion removed by acidulated water flowing over them—the corneous substance of the Niagara graptolites is not always preserved. The absence of the bituminous matter in fossil plants has frequently caused them to be mistaken for *worm-casts formed by the ejecta of a marine annelid*, while, on the other hand, the roots of modern grasses penetrating between the layers of shale, stamp impressions often erroneously regarded as fossilized plant remains.

It may be thought that I am rather aggressive in my notes on some of the disputed plants of the district. That reminds me of a story I once heard at our mess. An Irish guardsman was on sentry in London. Tired of walking up and down at his post, he halted and ordered arms just as a man approached accompanied by a bull dog. The latter considered the action nothing more or less than a hostile one, and went for the soldier, who immediately brought his musket to the charge and received his adversary on the point of his bayonet. "Why did you not use the butt end and beat him off with that?" indignantly exclaimed the owner. "Sure, man, I would have done that if he came at me tail foremost, but it was the fighting end that came first and so I couldn't help it."

Further evidence on the question is given by Col. Grant in a subsequent paper in this number.

MAN SCIENTIFICALLY CONSIDERED.

Read before the Hamilton Association, January 28th, 1892.

BY J. ALSTON MOFFAT.

Man, as a subject of study, has ever been considered a profitable one for men to engage in; and although it seems to be one that he is in a position to know more about than any other, and that more correctly, yet there are few subjects upon which a greater diversity of opinion has been expressed.

The subject is unquestionably complex, with many anomalies and seeming contradictions in it, and from the limitation of the human faculty, with its inability to grasp the whole of any subject at once, and its liability to dwell almost exclusively on the side which it prefers, a partial, distorted and consequently erroneous view of it is obtained, which has often led to much profitless disputation.

Science has on this, as on many other subjects in recent years, thrown a flood of light, but so many different conclusions have been drawn from the same facts, that one is often perplexed and bewildered by his reading upon it rather than enlightened. So I thought it would be a profitable occupation for my own mind to gather together the facts so far as I could obtain them, put them in order in plain language, and see just what was known with certainty, what might be known, and what could not be known about the whole subject, and this paper is the outcome of my effort.

Now as the subject is in extent and importance out of all proportion to the time allowable for one paper, I shall have to confine myself largely to a statement of principles, leaving each one to follow out and apply them for himself.

The scientific method of investigation is to take an object just as we find it; discover as far as possible its character, constitution and origin; how it acts, and is acted upon; its relation to its environment and other organisms; its resemblances and differences; that it may be properly placed in that portion of the system of nature to which it belongs. One of the most prominent and uncompromising principles on which scientific investigation rests, as on a foundation of adamant, is, that all the phenomena of nature, material or mental, result from the operation of fixed laws. Consequently, when we set about the investigation of any object in nature, the first step toward a right comprehension of it is a knowledge of the guiding and controlling principles or laws of its nature. For its being as it is, and its doing as it does, are the natural result of these, and the endless diversity we find in nature does not result so much from a multiplicity of laws, as from the inexpressibly diverse combinations of the materials through which they operate; for we know nothing whatever of the laws of nature except as they manifest themselves in action. Therefore, the authoritative dictum of science is, that every phenomenon in nature has an efficient cause, which utterly excludes any possibility of chance, that being merely a convenient term with which to cover our ignorance.

Causes are either immediate or with different degrees of remoteness. Each remove is as a link in a chain, each being the effect of the one preceding, and the cause of that succeeding it. We may be able to trace back quite a number of these links, whilst those more remote are wholly unknown to us. Yet science claims that there has been an unbroken continuity of these from its first origin to the present, and that there was an efficient cause for its origin; therefore it is a reasonable and desirable thing to try to discover it; hence the ever renewed and untiring efforts on the part of men to account for the origin of things.

When science takes up man as a subject of investigation, it finds him to be composed of matter, the chemical constituents of which are identical with the soil on which he treads, differing only in their combinations. He draws his sustenance more or less directly from the soil; and belonging to the animal kingdom, is subject to all the laws of animal matter, in his inception, development, maturity, decay, death and dissolution, returning again to the elements from which he came, being identical in these respects with all animal life around him. Again science finds man to be an organic being, constructed on a uniform principle; having a variety of organs, each adapted for the performance of a certain function, capable of combining and working in harmony for the good of the whole, making him a complete organization well adapted to all his requirements. But in this he does not stand alone, the organization of all animal forms being as perfectly adapted to their requirements as man's is for his; the term 'perfect' being conditional on purpose and use.

The plan of structure in animal forms is one, modified in detail for the various functions of each. It is also one of gradations, the lower forms having few organs, and these performing functions of the simplest kind. As we rise in the scale of being, the organs are more numerous, and capable of performing a greater number of operations, until we reach man, whom science places at the head of the list, because he has the most highly developed and complex organization, capable of performing the greatest diversity of operations of any animal form on the globe. Now, the gradations rising through so many forms, the differences are necessarily slight in each, but they are not arranged on a uniform cumulative principle; that is, the one above is not always in every part in advance of the one below.

Science gathers all animated organisms into groups, each group with some distinguishing characteristic; these groups are one higher than the other, but in passing from one to the other there is often a great descent from the highest of the one to the lowest of the next above. Thus they overlap one another, and in the groups there is often great difficulty found to assign each individual its proper place, from the fact that an individual that seems to be low down in the group has something in its organization that would rightly place it much higher in the scale. This is finely illustrated in the case of the apes. These run from an exact resemblance with some of the lower Mammalia to a striking resemblance to man. Now it has been demonstrated by the strictest scientific anatomy that some of the lower forms of the apes have in their skeleton bones more distinctively human than are to be found in some of the higher ones; that the peculiarly human portion in the lower is often dropped in the one above, and another equally human taken up, no cumulative advance being made; so that, although the entire human skeleton may be found in perfection in the ape family it is not found combined in any single portion of it. And it is this combination that secures to man his rightful pre-eminence in scientific classification.

Again, science finds man to have a mental faculty. Of mind, pure and simple, science knows nothing; it obtains evidence of its existence through the exercise of the mental organs, which are known to have their seat in the brain. Science pronounces all phenomena to be the result of matter in motion, and it defines mind to be the result of this particular kind of matter in motion, of which the brain is composed. Whether it can exist apart from matter, or manifest itself in any way except through matter, science knows not. When man is compared with the lower animals in this particular, science finds them possessed of similar faculties, manifesting themselves in similar ways, grading from mere sensitiveness up to a very high degree of intelligence, which it pronounces to be one in kind with man's differing only in degree. Indeed, in some of them, some of the faculties attain a far higher degree of development than the corresponding ones in man; but in this as in their anatomy, although all the mental faculties of man may be found scattered up and down amongst the lower animals they are not found combined in any one, so that it is impossible to say which of them is nearest to man, except in the one particular that is characteristic of them.

Science finds man to be a social being. Of this it is needless to speak, further than to say, that by means of it he attains to his highest point of excellence, and through it sinks to his lowest depths of degradation.

Science finds man endowed with powers of speech; that is, he is capable of expressing his thoughts in language that is intelligible to others. Whether he has the faculty of originating language to express his thoughts, without the aid of education, science has not yet demonstrated; but the experiments that have been made in that direction strongly favor the presumption that he has, and that children cut off from an opportunity of learning a language from others, would begin to exercise the faculty amongst themselves, and originate a language that they could understand, which might become the medium of intercourse for a nation. The lower animals have the power of communicating by sounds, with their fellows of the same kind, but these are of very limited range, and are principally connected with the preservation of their lives, and the continuance ot their kind. Animals in domestication can be educated into understanding man's order given in articulate speech, but how their minds receive and act on it, we learn only through their actions, and how liable they are to be misunderstood, we know from the oft mistaken judgments formed of the actions of our fellow men.

Again, science finds man to be a self-conscious being; that is, he is not only conscious, but he knows it; he is conscious of possessing certain faculties, and can compare them and ascertain their relative importance with one another, or with those of others, and discover whether they are greater or less than these; he reasons, and he reflects on his reasoning; he acts, or he refrains from acting, and is quite conscious that he is doing so. Yet science cannot prove the existence of this self-consciousness by any of its methods; its existence is its own demonstration, which each individual has the most convincing proof of in his own consciousness; but of its existence in others he can obtain a knowledge only by his communication with them. Human consciousness is divided into the universal and the individual, or that which has been discovered to belong to the race, and that which has been found to be restricted to individuals of it. A very slight glance around is sufficient to demonstrate that the race is not equally endowed; that although the race has all the faculties that belong to it, these are possessed in very different degrees by different individuals of it. In some a faculty may seem scarcely to exist at all, whilst in others it may be developed to such a degree that they may find themselves separated from their fellows by it, few if any being able to sympathize with them in it.

Self-consciousness is closely related to experience. Experience extends knowledge. The individual is conscious of the impression produced, and retains the knowledge obtained for his own advantage. Now, as each individual has an experience differing in some respects from all his fellows, arising from the circumstances of his life, such as the time and place in which he was born, the character of his parents, and his immediate associates, his position in the community and the advantages or disadvantages arising therefrom, his wider or narrower horizon of observation will to some extent mould his individuality and give to each a different view of life from the others, which, if communicated to them, might add much to the sum total of the profitable knowledge of the race.

Consciousness is that which gives unity to the individual life, through all the changes of time, scene and circumstances to which it may be subjected. Science can demonstrate that there is not a single molecule composing the body at five years of age, left at the age of fifty; yet the individual can, from his own consciousness, confidently assert that he is the same person. Just how much of all this is applicable to the lower animals is mere matter of conjecture, as information on the subject is not obtainable from them by articulate speech.

Again, science finds man to be a religious being. Professor Tyndall says, "The religious principle in man is as much a verity as any part of human consciousness, and against it the waves of science break in vain." Could anything be more truly or beautifully expressed? Nothing else will account for its universality and permanence. It is coeval with the human race, and co-extensive. Observe man in any time, place or condition, and we find that this inherent principle persists in manifesting itself in one way or another. Another says, "Systems and forms of religious expression are perishable, but the religious principle itself is eternal." But many confound the two, looking only at the external expression, forgetting the principle from which it springs. Hence the oft-repeated statement that religion is merely a matter of education; which may be quite true of the form, but wholly erroneous as to the principle. That this principle can be strengthened and expanded by cultivation, or weakened and dwarfed from want of exercise, is a fact in perfect accord with every other principle in man's nature; but the one did not originate it, nor can the other utterly extinguish it.

Others again contend that religion in the world is the result of a conspiracy on the part of the priestly or ecclesiastical class, to keep men in bondage for their own personal advantage. That is like a reversing of the order of nature; the ecclesiastical class is rather the natural result of the religious principle in man. That some men have adopted the ecclesiastical profession as a means of obtaining power, preferment and wealth, is a matter of history, but they were quite innocent of originating the principle; they merely took advantage of its existence, and used it to advance their own selfish ends. Let us examine this matter a little more closely. Man, in an untutored state, is almost wholly controlled by his feelings. Now it is one of the most permanent impressions in the consciousness of the race, that man has not entire control of his own destiny, but that there is a power above and beyond himself that is capable of affecting his destiny for good or for evil; and he has a strong suspicion that he is not in complete harmony with that power, of whose existence he is terribly conscious, but of which he knows nothing. This naturally keeps him in a state of uneasiness lest his person or possessions suffer, for it seems an instinct in the human mind, which education does not always eradicate, to erroneously regard all the unusual phenomena of nature as evidences of the pleasure or displeasure of that power, as these happen to be favorable or adverse to him. Now a man in perplexity how to act, in a matter which he is quite ignorant about, naturally seeks advice of his fellows. One, professing to be wiser than the others, recommends a course to follow; his advice is taken, and as in all cases where a person has performed what he regards as a duty, an amount of self-satisfaction naturally follows. He gets for the time a degree of relief, and concludes that the advice was good. The adviser consequently rises in his estimation as a man of wisdom, to be consulted in all times of trouble, and to be recommended to others in like cases. This gives him position and authority in the tribe. His services are found useful, then necessary, and so become permanent; and here we have the natural origin of the priestly class.

Now it is not in the power of the human mind to conceive of that of which it has no knowledge, and whenever it makes the attempt, it begins at once to form its conception of it by that which it does know; and when man tries to define that power of which he is so much in dread, he takes himself for the model as the highest being he knows of, and exaggerates upon that; and in this we get the natural origin of all the gods of all the world. For as each individual is, to some extent, diverse in character from every other, each will form his own estimate of what would be pleasing to that being of his imagination, by what would be most satisfactory to himself if he were in his place. In this we have the origin and explanation for what appears to be a standing source of bewilderment to many, the endless diversity we find in the world of the external manifestations of the internal religious principle. And when this comes to be controlled by the intelligent guidance of a a priestly class, we have the foundation laid for all the religious systems that man has ever invented to give expression to that principle within him, from the most primitive or debased to the most gorgeous and refined that the cultivated imagination and the wealth of the class can produce. Now we are in a position to see the cause of the tremendous influence that the priestly class has ever exercised over humanity. The fulcrum is in man's nature; and, given confiding ignorance on the one hand, and designing unscrupulousness on the other, we have the explanation for much that is deplorable in human history. Now we are in a position to estimate the influence of education. Children born into any set of customs and observances follow them as a matter of course, confiding in the wisdom of their fathers for their being right. Their religious observances come to them in the same way; so as a rule, they are accepted without question, and the longer they have been established the stronger do they become, and the less likelihood there is of their being changed. Of what vast importance then it is to man that his education should be correct; for no amount of religious observance will lead him to the performance of truth, justice and mercy. He will at times violate these in following out what he considers to be duty, or will even commit what he knows to be a crime and think by a scrupulous observance of religious rites to make amends for it, and often feel quite satisfied that he has done so; all the result of a false education and his native ignorance of moral rectitude; morals being in a man almost wholly a matter of education and quite separable from religion.

Science has found no evidence of such a principle in the lower animals. This is a distinguishing characteristic of man, which places him clearly and unmistakably beyond them.

The question instantly arises, what is its import and significance? The principle is imbedded in his nature, and he can no more escape from it than he can from his shadow; and no theory of man that does not take it into account, and provide scope for its exercise, can ever be wholly satisfactory to him. We have seen that there is an ever present consciousness in the race of an unseen power in the universe that holds him in its grasp, and of which he is more or less in constant dread, and which, through all his history, has urged him on to the performance of deeds, the object of which was to propitiate it if possible; that it is in fact natural for man to believe in the existence of the supernatural. Now in the very pronouncing of that term we have parted company with natural science. For this is a region into which science can neither lead nor follow, for it is not subject to any of its methods of investigation. And yet my subject is far from being completed, and the human mind refuses to rest in uncertainty on a matter involving such important consequences.

Science acknowledges the religious principle in man, and it ever has and ever will demand a satisfactory explanation; and if science fails us here and refuses its assistance, by the very constitution of our being we are compelled to look elsewhere for what will not.

When Darwin was pointing out to the Duke of Argyll some striking adaptations of parts to their uses, the Duke remarked that "it seemed impossible to look at them without seeing that they are the expression of mind." Darwin said: "That often comes over me with overwhelming force, but it passes away again." In that disclosure made by this eminent naturalist, we get a view of the natural operation of the human mind, in demanding an efficient cause to account for visible phenomena, which is one of the fundamental principles of modern science: that everything in nature has a cause, which, if known, would account for its existence. In this, then, I get a clue how to proceed with my subject. Leaving the scientific method, which will not here apply, I follow the scientific principle, which is of universal application, and so continue it.

You remember the expression used by Prof. Tyndall in his famous Belfast speech: "I have traced life to the utmost limits of the knowable, and looked beyond, and there was nothing." If he had said that he saw nothing, he would have been as scientifically correct as he was when he said, "of the origin of life, we know nothing." And yet science has taken many steps in advance of the position occupied by Prof. Tyndall when he used that expression, but is just as far from discovering the origin of life as ever. Now, this very subject has been under consideration for thousands of years, and many of the most powerful intellects of the race have been engaged in the effort to try to discover the cause of the visible phenomena of the universe, without a shadow of success, for, in Carlylian phraseology, "the farthing rushlight of the most brilliant human intellect will not illuminate to the depth of one-half inch that profound darkness which lies beyond."

Are we then left to the endless perplexity and vague uncertainty arising from the utter inability of the human mind to penetrate the invisible, and settle a doubt which it can neither solve nor let alone? There is an ancient document that professes to solve the mystery in the brief but majestic statement, "And He said, let it be, and it was." Now here we are at the starting point in an endless controversy. Reject this statement, and we are agnostics on the whole subject, not from any superior wisdom or intellectual ability, not even of choice, but from very necessity; accept it, and we get an efficient and satisfactory cause to account for the most profound and perplexing mysteries that meet us in our investigations of nature. Now, it does not require a cultivated intellect to accept the word of another. It is a well-known fact, that the ignorant and uncultivated are far more likely to accept a bare statement than those that are well informed. No matter what unfair use may be made of it in argument, it is an undeniable principle of human nature; all that can be reasonably demanded is an assurance that the speaker is honest, and that he knows that whereof he speaks; and on a matter beyond his reach, the most cultivated can demand no more. If we accept this particular statement as coming from the source it claims, we cannot doubt the one or question the other; if we accept it hypothetically, then the probability of its truth has to be learned from its merits.

Now it has been laid down as an axiom in scientific discussion, that a hypothesis, to be worthy of consideration, must be in harmony with all known facts, and be able to explain difficulties more satisfactorily than any other; let us then try that statement by this test and see how it works. At once we find that it conveys to us a piece of information, that the labors of thousands of generations have made plain to us can be obtained with certainty in no other way.

In the biography of the great naturalist, whose name is used to designate a particular system of scientific philosophy, and to whose life's labors the world is so much indebted for the vast increase to its knowledge of natural subjects, as well as for the immense impulse which he gave to a more correct method of studying them, we are told that he became so impressed with the idea of man's base origin, that he would not allow himself to indulge those lofty sentiments that inspire the mind when it is brought into contact with nature in some of its grander manifestations, and to which his nature was peculiarly susceptible, as it seemed to him like a mockery for a being of such an origin to indulge in aspirations not in keeping with it, and, he thought, not likely to be realized; until by their continued suppression, he tells us that he became as a dried leaf to everything except science, and that it was depriving him of the power to take pleasure in many of those engagements which had formerly added greatly to the joy of his life. We can all realize to some extent the tremendous loss that he sustained, in thus carrying to their natural conclusions his honest convictions. When he and the Duke of Argyll were contemplating the adaptation of parts to their uses, the natural object presented the same appearance to both, and the one was as capable of appreciating the perfection of its construction as the other; but the one accepted the above-mentioned statement as to its origin, with all that it implies, the other rejected it. This is the point of divergence between the two which leads to such opposite conclusions; for originating implies an intelligent purpose, a purpose successfully carried out; it implies wisdom and power, which again implies an interest taken by the originator in its accomplishment, that purpose being the disclosure, in some measure, of the mind and character of the originator to the intelligences of whatever grade with which the universe has been supplied, and this disclosure everything in the universe is in some way, and to some extent, actively or passively engaged in making; for everything that emanates from any mind necessarily bears the impress of that mind, and thereby in some measure discloses its character.

Now if Darwin had accepted that statement as to the origin of life, he would have been at once relieved from the depressing effects arising from the contemplation of man's animal connections; for his transient impressions would have been thereby made permanent, that intelligent mind presided over the universe, of which he was so profoundly impressed with being such an insignificant portion, as it would have convinced him that his origin was not from below, but from on high, and he could, without misgivings as to the possibility of his aspirations being realized, have thrown his mind open to every wave of joy that came in his way. Whether it was the rapturous delight in the first outburst of spring, when all nature seems to be celebrating its May-day of gladness, or under the vaulted dome of a midsummer forest, when the mind is awed as well as elevated by its grandeur, and all life seems engaged in chanting anthems of praise for the bliss of its existence, he, too, could have joined in the chorus with gratitude for eyes to see, and mind to comprehend in some measure the amazing beauty and wisdom, majesty and might, displayed in originating and guiding to beneficent ends such a stupendous and complicated system of things as is here to be seen, and when all language failed to voice the depth of his emotions, he could have bowed his head in speechless adoration. Thus we see how the acceptance of that statement as to the origin of life tends to dispel the doubts and perplexities surrounding man's complex and contradictory constitution, giving full scope for the exercise of every faculty of his mind, whilst it is in perfect harmony with every principle of his nature, and has a direct tendency to elevate and improve him, thereby indicating its superiority.

Let us take an historical example of how the scientific principle leads us onward and upward where the scientific method fails to apply. Over eighteen hundred years ago a man appeared on the earth, who claimed to have, by virtue of inheritance, supernatural powers. On one of his daily rounds, he met a man that was born blind. He spat on the ground, took the moistened dust, and put it on the blind eyes, and told their owner to wash in a particular place; the man obeyed and received his sight. Being fully conscious in himself that the means employed were wholly inadequate to produce such a result, he naturally, instinctively and unhesitatingly came to the conclusion that the man who did it must have the powers which he claimed, and there was but one source from whence such powers could be obtained. This deed being reported to the ecclesiastical rulers of the city, they set to work to investigate its truth. Having obtained all the evidence procurable on the case, they turned from the deed to the claims of the man, which they found to be antagonistic to their own, and announced that on these they could come to no conclusion; which gave occasion for the utterance of one of the most withering sarcasms ever voiced in any language. The deed they dare not deny, and it must have an efficient cause, so there was but one reasonable conclusion to come to about the claims of the doer, but that condemned themselves, and this men are slow to do. Now this man claimed to have supernatural knowledge, as well as supernatural power. He claimed that he was possessed of, and was competent to give, information on those very subjects which had harassed man during his whole history; that he knew what was beyond the visible, as he had in some sense come from there. He announced, once for all time, that there is a universe of invisible mind, as truly as there is one of visible matter; that mind can and does exist apart from matter; that there is one supreme intelligent mind, that originated and sustains all things for a purpose; that that purpose includes the greatest possible good for all his intelligent creatures; that that greatest good consists in their knowing as much about him as it is possible for their capacities to receive, and to be as much like him in character as it is possible for them to be, as the cause of all man's perplexity has ever been his ignorance of the one and the absence of the other; and that he had come for the express purpose of enlightening him on the one, and putting him in the way of obtaining the other, which would relieve him of that conscious dread of an invisible power, that had ever followed him as closely as his shadow; that it was not necessary for him to torture himself or make great personal sacrifices in order to obtain it, not even the performance of a ceremonial, simple or elaborate, for all that he required men to do was to believe what he told them, when they would be put in possession of a conscious knowledge that it was all true, a procedure directly at variance with the scientific method.

Now we have seen that it is natural for man to believe in the existence of the supernatural; indeed, it seems to require a laborious intellectual effort for a man to succeed in reasoning himself out of the belief in it; and when any individual has honestly arrived at the conclusion that there is no conscious existence beyond the visible, it is with a wail of regret that such splendid possibilities are to be so ruthlessly extinguished. Now, as it does not require superior intellectual powers to accept the statement of another, and there are some who profess to have put this man's promise to the test, and assert that they realize in their own consciousness that it is more than fulfilled. therefore, when we find a man who stands pre-eminent in the scientific world, who is gifted with as clear an intellect as ever appeared in this or any other age, and a mind stored with facts on all subjects relating to nature to an extent seldom equalled and never excelled, and endowed with the power to express his thoughts in the most exact and clearest of language, and that in copious flow, saying, "I believe myself to be possessed of all the senses which belong to the race; and when I find spiritualists making very positive assertions of knowing about matters of which I know nothing, and which I suspect they know just as little, I cannot help suspecting that they are but visionary enthusiasts," we are not required to consider it conclusive against such claims, as if it were a subject of natural science. The first thing we have to enquire is—has he complied with the one only condition upon which this kind of knowledge can be obtained? For we are distinctly informed that this kind of knowledge does not belong to the race; and his consciousness of its absence in himself, so clearly expressed, is a negative confirmation of its truth. Now this is a kind of knowledge that cannot be tested by any scientific methods, nor can anyone disclose it to another except by a verbal statement; so that when anyone comes to us asserting that he has it in possession, we have only his word for it. We are distinctly informed that the only evidence anyone can give to justify his right to the claim in the eyes of others, is a superior life; and by a natural and instantaneous action the human mind ever brings it to that test. Now here we are met by the objection, that in accepting this supernatural scheme of improvement and elevation for man, we are assigning to him a position and importance in the universe to which he has neither right nor claim; which is perfectly true, but the objection arises from an entire misconception of the principal design of the universe, which is not the exclusive advantage of it, or any portion of it, but as we have seen, to disclose, as much as possible, the mind and character of its designer to intelligent beings capable of appreciating it. That man has no claim to such consideration we do not require to be told, but that he is profoundly conscious of a terrible need of some such way of relief, the rivers of blood that have flowed from a myriad altars, and the smoke arising therefrom, which is traceable down through the whole course of his history, abundantly attest. But that such a scheme was originated for his exclusive benefit would be folly to suppose, even were we not positively informed to the contrary.

Now every individual of the human race is of the very first importance to himself; what he may be to the community is quite a different thing. We know that many persons obtain their importance in the world wholly from the position they occupy, and on account of it. Similar is man's position in the universe; nothing in himself but of the very first importance on account of the disclosures that are being made through him, of the mind and character of his originator. Now we know that nothing in the material universe stands apart and alone; that each and every part is in some way and to some extent dependent upon every other; that the well-being of every living thing on this globe is affected by influences emanating from others, whilst all are adjusted to the life and fitted for the conditions of the earth; that the earth and all the planets are moving in obedience to influences beyond themselves; that our solar system is moving in sweetest harmony with other systems, to influences of which we know nothing, and these again to others still in ever extending circles, whilst the whole material universe, having a common centre, is moving to influences emanating therefrom in inconceivably majestic grandeur. As it is thus in the universe of matter, so must it be in that of mind, and as we are informed that there are minds not associated with matter, whose interests have been considered in the design of the universe just as certainly as man's, and who are engaged in increasing their knowledge of their originator by observing the events that are transpiring in the realms of matter, as well as those of mind; and as we know by man's mind that there are thoughts that language cannot express, and expressions that cannot be understood from a want of a knowledge of the subject, and that there are subjects that can be far better comprehended by a visible illustration than by any amount of verbal communication, and as one illustration may not convey the full meaning of some subjects, so some minds may fail to get the full meaning that the illustrations are designed to convey, and different minds will draw different meanings from the same illustration, whilst none obtain the full meaning disclosed by any, but each increases his knowledge of it by an interchange of thought with his fellows, thereby getting a more full, clear and correct view of it than any could get alone; and as the whole visible universe is just so many object lessons projected in time and space, for the very purpose that therein may be read, according to the capacity and diligence of the reader, the mind and character of the designer, we see not only the necessity for a vast variety of illustrations to make the disclosure, but also for a great diversity of mind to investigate them, and discover their meaning; and as mind is ever expanding by exercise and capable of understanding a subject better the more it knows about it, and as the subject is infinite, and those engaged in investigating it are finite, we see the necessity for unlimited time to continue the investigation.

Now, as everything in the universe has for its ultimate end the disclosure, as far as possible, to the intelligences thereof, of the mind and character of their originator; and as the highest good of these consists in knowing as much about him as is possible for them to know, and thereby being made as like him in character as it is possible for them to be; for this one grand ultimate end was that amazing scheme for man's elevation, with all its tremendous consequences, originated and put in operation, which so far transcends man's most exalted powers to fully comprehend, and which is in so many respects contrary to the instincts of his nature, thereby calling forth the violent opposition of many; yet nothing else that has ever been proposed can fully meet the desperate needs, satisfy the aspirations and reconcile the contradictions of his nature at all comparably with it, thus indelibly stamping it with the imprint of its author. And although man must ever be the most directly and personally interested in the development of that scheme, so far-reaching and extended are the influences flowing from it, that the very loftiest intelligences of the universe are obtaining, by means of it, higher and yet higher conceptions of the author of their being, as the unlimited resources in the magnitude of the plan, and the wealth of beneficence in its execution are being gradually disclosed to their view, until man, the creature of the dust, and the close relation of the beasts that perish, is to them through his connection with it, an object of special interest, and this globe, so insignificant in itself amid the splendors of the celestial spheres, a centre of attraction on account of the events that are transpiring on it, by means of which they are obtaining such an insight into the character of its author as they have obtained in no other way. And as time rolls on they are ever and anon overwhelmed with new and astounding disclosures of that character, as the marvelous purposes involved in it are gradually unfolded before their wondering gaze, until all celestial language fails to give utterance to the depth of their emotions, and they are represented to us as endeavoring to find expression for them by veiled faces and prostrate forms before him, who is now to them a visible and measurably comprehensible manifestation in human form of the great invisible and incomprehensible originator of all things.

Such then is my condensation of the subject Man Scientifically Considered in so far as the language at my command has enabled me to express it.

THE CHEMICAL REACTIONS OF BLEACHING PROCESSES.

Read before the Hamilton Association, February 11th, 1892.
Illustrated by Experiments.

BY J. B. TURNER, B. A.

Bleaching is the process of depriving any substance of its coloring matter and thus rendering it white and clean.

In dealing with this subject I do not propose to take up the time of the meeting in discussing the history of the processes of bleaching, neither do I propose to occupy your time by entering into a discussion of these processes and their importance from a commercial or manufacturing standpoint, though either aspect of the subject might furnish a theme for a paper as interesting or perhaps more so than the one I am about to present. I might say, however, in passing, that bleaching is a matter of first importance to the manufacturer of textile fabrics, for unless the materials of which these fabrics are to be made are thoroughly cleaned and well bleached the process of dyeing the goods will be seriously interfered with.

A few words, too, on the knowledge of the processes possessed prior to the discovery of the more modern methods will not, I trust, be out of place.

There is a strong presumption that the process of bleaching was practised by the ancient Egyptians and Phœnicians ; in that they were able to manufacture and did manufacture some very beautifully colored goods. These colors, it is almost certain, could not be obtained without first thoroughly bleaching the material of which the fabrics were composed. We have no knowledge however, as to how this bleaching was effected and consequently we are unable to state whether they used chemical reagents or exposed the material to the action of the sun and atmosphere.

The earliest methods of bleaching of which we have positive knowledge consisted in exposing the colored material to the action of sunlight and the atmosphere. For a long time Holland was the centre of the bleaching industry, and this was the case to so great an extent that goods were sent from all parts of Europe to that country to be bleached.

The process there employed consisted in thoroughly cleaning the goods and then exposing them to the action of the atmosphere for a longer or shorter period as circumstances required. The time consumed in this process extended over from four to six and even eight months. The inconvenience of this delay was so great as to lead to the establishment of bleaching plots, as they were called, in Scotland and Ireland. The methods adopted by the managers of these plots were similar to those practised in Holland, but the time necessary for transportation from one country to the other was saved. These processes continued as the only ones in use until the discovery of the bleaching properties of chlorine, about the close of the last century. As a result of this discovery the time occupied in bleaching was very materially reduced, so that now the process of bleaching scarcely requires as many hours as it formerly did months.

The discovery of the bleaching properties of chlorine marks a decided advance in the art of bleaching; but although this is quite true, yet it was soon found that chlorine, while quite suitable for certain classes of materials, was wholly unsuitable for others on which it seemed to act in such a way as to destroy their texture and seriously impair their usefulness. In the bleaching of such materials as are injured by the action of chlorine, sulphur dioxide is now employed.

It is with these two bleaching agents, chlorine and sulphur dioxide, and the chemical reactions brought about by them, which result in bleaching that I propose to deal in this paper.

The source from which chlorine is obtained for bleaching purposes is bleaching powder, but as this is an artificial product it may be as well to give the original source of chlorine.

Chlorine, on account of its chemical activity, is never found free in nature, but in combination with some of the metals in the form of chlorides, of which the most plentiful is common salt, a compound of the metal sodium and this gas. The gas is obtained from the salt by mixing it with finely powdered manganese dioxide, and then adding sulphuric acid to the mixture. In the preparation of bleaching powder the gas thus obtained is brought in contact with slaked lime until no more of the chlorine is absorbed by it. The bleaching powder is then stored away for future use.

When sulphur dioxide is used as the bleaching agent, the necessary supply is obtained by burning sulphur, although in the chemical laboratory it is more frequently obtained by action of sulphuric acid on metallic copper.

The bleaching powder prepared in the manner above described is the source from which chlorine for bleaching purposes is obtained. The reactions by which the chlorine is liberated from the powder may be referred to at this point. There is some difference of opinion as to the exact composition of bleaching powder, and until this is positively settled it will be difficult, if not impossible, to give correctly the reactions which result in the liberation of chlorine from it.

On the one hand it is claimed that it is a mixture of two salts, calcic chloride and calcic hypochlorite, of which the formulas are $Ca\ Cl_2$ and $Ca\ (ClO)_2$ respectively. On the other hand it is claimed that it is a single chemical compound of the formula $Ca\ Cl_2O$, which it will be observed gives the same percentage of the elements present as the mixture in the first case. The argument usually advanced in support of the latter view does not hold in the case of the powder as we ordinarily know it, and as that is the form in which it is used, it may be assumed that it is of the composition first stated. Of the salts contained in the mixture, namely, calcic chloride and calcic hypochlorite, the former is a comparatively stable salt, while the latter is very unstable, decomposing in contact with the air, by reason of the influence of the carbon dioxide contained therein, yielding among other products hypochlorous acid and free chlorine; hence the peculiar smell of bleaching powder. This also explains how it is that bleaching will take place in an aqueous solution of the powder, although very slowly, since the decomposition goes on very slowly.

The decomposition of the powder may be effected rapidly by the addition of a small quantity of sulphuric acid to the solution of the powder. For the purpose of bleaching, however, this is not to be recommended, for although the process is more quickly completed, the action of the acid injures the material of the cloth to such an extent as to overcome the advantages of rapid bleaching.

The liberation of the chlorine may be readily explained by the use of chemical equations. Simultaneously two reactions take place between the sulphuric acid and the constituents of bleaching powder, and these reactions are represented as follows: That of sulphuric acid on calcic chioride by the equation $Ca\ Cl_2 + H_2\ SO_4 = Ca\ SO_4 + 2HCl$, and that on calcic hypochlorite by the equation $Ca\ (ClO)_2 + H_2SO_4 = Ca\ SO_4 + 2HClO$. Calcic sulphate is one of the products of each reaction, while the other product in the first case is hydrochloric acid, and in the second case is hypochlorous acid. This last material is very unstable, and is consequently readily acted upon by the hydrochloric acid, producing a result which is represented by the equation $H\ Cl + HClO = H_2O + Cl_2$; or we may represent the complete reaction by one equation, which will cover the ground of the other three, viz: $Ca\ Cl_2 + Ca\ (ClO)_2 + 2H_2SO_4 = 2Ca\ So_4 + 2H_2O + 2Cl_2$. We thus see that if the material to be bleached be immersed in an aqueous solution of the powder, or an aqueous solution which is afterwards acidulated, it will be brought in contact with the chlorine which is to effect the bleaching.

Without further experiment it is impossible to say what part the chlorine takes in the process. A few simple experiments will assist us in deciding the question. If a piece of colored calico, which has been well dried, be placed in a jar of chlorine from which the moisture has been removed by passing the gas over chloride of lime contained in tubes, and allowed to remain there for any length of time, it will be found that the color is not materially affected, but if the cloth be removed, moistened and returned to the jar, the color will in a short time disappear. Evidently then the water plays an important part in the process of bleaching by means of chlorine.

In this flask there remains material from an experiment which has been going on for several days. When the apparatus of this experiment was set up, the flask was completely filled with a solution of chlorine in water; the glass tube inserted in the cork is drawn out to a fine point, so that the liquid cannot fall out of its own weight; the whole was then exposed to sunlight for a number of days, with one evident result at least, namely, the formation of a large bubble of gas in the upper end of the flask. In this tube there is a solution of chlorine similar to that which was placed in the flask and exposed to the sunlight. Let us add a few drops of this solution to a solution of blue litmus: you observe the color is completely destroyed. In this tube there is a solution similar to that now contained in the flask; add some of it to some blue litmus solution and it becomes red. The difference between these substances can be further emphasized by adding some of each to a solution of potassic iodide and starch paste. The chlorine water will give a deep blue coloration, while that contained in the flask will produce no change. At once it becomes evident that some change has taken place in the solution contained in this flask:

From the fact that the blue litmus becomes red we infer that the solution now contains an acid. Further experiments serve to show that the acid formed is hydrochloric acid, a compound of hydrogen and chlorine in equal proportions. An additional fact to be noted is that the chlorine, as such, has disappeared from the solution during exposure to the sunlight. How then is the hydrochloric acid formed which is found in the solution. The chlorine which enters into its composition is easily accounted for, but no mention of the hydrogen has as yet been made. The only materials which were put into the flask were water and chlorine in solution in it. The only source then from which the hydrogen could be derived is the water, of which it is one of the constituents.

By the union of the hydrogen of the water with the chlorine to form hydrochloric acid, oxygen should be set free from the water. From purely theoretical considerations, then, we infer that oxygen must be set free by this reaction, and that the bubble in the upper end of the flask must contain it; this inference will be confirmed if some of the gas of the bubble be withdrawn and tested. Putting all these facts together a satisfactory explanation of bleaching by means of chlorine is obtained.

During the actual bleaching no oxygen is allowed to escape free into the air, so that the oxygen liberated by the action of chlorine on water must be consumed in the bleaching process. In this case, as in the case of every chemical reaction where elements are liberated from their compound, they are liberated in the form of atoms, and as atoms are for the most part incapable of an independent existence, they at once unite with the atoms present for which they have the greatest affinity, so that the oxygen atoms, as they are liberated from the water, at once seize upon the atoms of the coloring matter of the goods being bleached, as being the atoms for which they have the greatest affinity. If this explanation be the correct one, then, as a matter of fact, it is not the chlorine which does the bleaching, although that is the usual way of expressing it.

The function of chlorine is rather to bring the oxygen into the proper condition in which to effect the bleaching. If then the oxygen is the substance which does the bleaching, how then is it that exposure to the atmosphere does not bleach more rapidly than it does? I shall refer to this point again in connection with bleaching by exposure to the atmosphere.

Having discussed somewhat fully the process of bleaching by chlorine, I shall deal more briefly with bleaching by the agency of sulphur dioxide.

The dioxide, as I have already pointed out, is usually obtained by the burning of sulphur when it is required for the purpose of bleaching, and, as in the case of chlorine, the material which is to be bleached requires to be moistened with water, for if it is not so moistened the material may be left in the dry gas an indefinite period without any perceptible effect on its color, but when it is moistened the color begins to disappear in a very short time.

The function of the water in this instance is not so easily discovered as in the case of chlorine. A hint as to the kind of chemical action which results in the destruction of the color by the sulphur dioxide, may be obtained if we dip a bright colored rose or other flower in a vessel of the gas for a short time until its color begins to disappear, then if the flower be removed from the sulphur dioxide and exposed to the atmosphere its color will return again. The only element present in the atmosphere so chemically active as to produce such a result is oxygen, and therefore the return of the color to the flower is the result of oxidation. There is then a strong probability that the loss of color in the sulphur dioxide is the result of a deoxidation or reduction. The question then arises, what is the material produced by the interaction of sulphur dioxide and water upon each other, and does the substance so formed act as a reducing agent? It is easily shown that the product of the action of sulphur dioxide on water is sulphurous acid. By the addition of some permanganate of potash solution to a solution of the above acid, it is readily oxidized into sulphuric acid. The same fact may be stated as a reduction of the permanganate of potash of the solution. It follows then that while neither water nor sulphur dioxide are reducing agents yet the substance formed by their union has a strong affinity for oxygen. This fact serves, in my opinion, to explain the bleaching action of sulphur dioxide. Before proceeding with what seems to me the best explanation of this process, I shall state another view held by some good authorities, and which has the endorsation of such eminent chemists as Professors Roscoe and Schorlemmer, who, in their excellent treatise on chemistry give, on page 310, vol. 1, this statement of the explanation referred to. "The decolorizing action of sulphur dioxide depends upon its oxidation in presence of water with formation of sulphuric acid, the hydrogen which is liberated uniting with the coloring matter to form a colorless body thus :—$SO_2 + 2H_2O = H_2SO_4 + H_2$."

As I have already stated this view is that held by some chemists well qualified to speak on the subject, and I only quote from the above mentioned authors, as their treatise contains a concise statement of the explanation referred to.

I may be permitted to point out that in the absence of experimental evidence, it is difficult to believe that two substances as stable as water and sulphur dioxide are, can effect the liberation of hydrogen when they act upon each other; and further if the reaction takes place, which is represented by the above equation, what becomes of the hydrogen which is liberated if there is no coloring matter present? An experiment similar to that of the chlorine water in the sunlight ought to give us free hydrogen, but so far as I am aware such a result has never been obtained. This, I believe, is a serious, if not fatal, objection to the explanation given above.

I have, to some extent, already indicated what seems to me the correct explanation of the bleaching action of sulphur dioxide. It has been stated that water unites with sulphur dioxide to form sulphurous acid, and this acid was shown to act as a reducing agent, in that it readily deprives such a substance as permanganate of potash of its oxygen and becomes sulphuric acid. It is also well known that it is difficult to preserve sulphurous acid when exposed to the action of the atmosphere, as it is eventually oxidized into sulphuric acid when it is so exposed. This serves to still further demonstrate the fact that sulphurous acid is oxidizable into sulphuric acid and thus will act as a reducing ageut.

It is conceded by all authorities that bleaching by means of sulphur dioxide is a reducing process, and as the explanation I have ventured seems to be fully in accord with the results of the reactions between the materials present, and at the same time gives due prominence to reduction by means of sulphurous acid, I am forced to the conclusion that the last explanation is the correct one, namely, that the water which is necessary to the bleaching process unites with the sulphur dioxide to form sulphurous acid, and this acting as a reducing agent deprives the coloring matter of its oxygen and thus destroys its color.

It may be well in closing the subject of bleaching by these two agencies to contrast their action in this respect. In the first place it was pointed out that in the case of chlorine the bleaching was the result of the oxidation of the coloring matter, while in the second case the same result is effected by reduction. It will thus be seen that the one process is exactly the reverse of the other, although the same end is attained in both cases.

In dealing with the subject I have made no reference to the cases in which the chlorine and sulphur dioxide unite with the coloring matter and thus destroy it, although such is frequently the case.

Having shown how these two agents operate in the process of bleaching, I shall refer very briefly to the action of the atmosphere as a bleaching agent. Although the bleaching effect of the atmosphere was known and taken advantage of long before either chlorine or sulphur dioxide was discovered, yet there is much less known as to how it brings about these results than in the case of either of the other two. We have shown that in the bleaching by chlorine the action of oxygen brought about the final result. If in that case the oxygen actually does the bleaching, why might not the atmospheric oxygen do the same thing? It must be remembered that in chlorine bleaching the oxygen which effects the change is that which is liberated from the water by the chlorine. Now if we remember that every element is liberated from its compounds in the form of atoms, we shall perhaps see why oxygen, just as it is liberated from water, acts differently from atmospheric oxygen. The atoms of an element, if kept free to do so, will at once unite with each other to produce molecules of the element in which form the elements for the most part exist. These molecules must necessarily be decomposed again before the element can take part in a chemical reaction such as is necessary to effect bleaching. We thus see why it is that while nascent oxygen is capable of bleaching, it may be quite impossible for oxygen, in its ordinary form, to do so.

Since the atmospheric oxygen is in the form of molecules, it will be impossible for it to bleach any substance which is not capable of breaking up the molecule into its atoms; this, it appears, the coloring matter is not capable of doing, hence no bleaching of it is effected by atmospheric oxygen. We are thus forced to the conclusion that whatever the constituent of the air is, which causes materials to be bleached, it is not the oxygen contained in it. Nitrogen, water vapor and carbon dioxide, the other chief constituents of the atmosphere, from their very nature cannot be looked upon as bleaching agents.

Nitrogen is too chemically inactive, while water vapor and carbon dioxide are exceedingly stable, and thus will not readily lend themselves to the reactions necessary to effect the required changes.

There are a number of other materials, traces of which are present in the air, but of all these the only one which is likely to bring about the changes necessary to effect bleaching is ozone. Ozone is composed of oxygen atoms only, but since it presents properties different from those of oxygen, we must look for an explanation of this difference in the arrangement of the atoms.

For reasons, which it is unnecessary to give here, we consider the oxygen molecule as made up of two atoms, while the ozone molecule is made up of three. Further, while the oxygen molecule is difficult to decompose, the ozone molecule is quite unstable, so that its atoms readily separate and reunite themselves in molecules of two atoms each or as ordinary oxygen. While passing from one form to the other the oxygen is momentarily in the form of atoms, as it is when it is liberated by chlorine from water, at which time it effected the bleaching usually attributed to chlorine.

It is one of the principles upon which the science of chemistry is based, that whatever a material will effect at one time it will always effect under like conditions. Since, as we have shown, nascent oxygen will bleach when liberated from water by chlorine it will also do so when liberated from ozone, by whatever agency. The ozone of the air then may be considered as a bleaching agent. The only difficulty in the way of considering it as the substance which bleaches materials exposed to the air is the fact that it is present in such minute quantities that it is almost incredible that it can do all the work usually ascribed to it.

The sun's rays are also capable of bringing about chemical changes, as is shown by the photographic art, but as to the extent to which these enter into atmospheric bleaching I cannot at present say. I might perhaps speculate as to the part taken by the rays of light in the bleaching processes, but speculation in an experimental science, such as chemistry is, had better not be attempted. I therefore close with the suggestion that atmospheric bleaching is probably due in a measure to the action both of ozone and of the sun's rays.

MESSENGERS FROM THE SKIES.

Read before the Hamilton Association, February 25th, 1892.

BY H. B. SMALL.

There is an old Norse legend, still retained in parts of Europe, that when a child is born, the Goddess of Destiny spins a thread and hangs a star thereon, which continues to shine whilst life lasts, but at the approach of death the thread of destiny breaks, and the stars fall headlong to the earth, and is extinguished. To this legend may be traced the not uncommon remark amongst the country folk of the Mother country at the present day when they see a fallen star, that "A life is going out."

All sorts of superstitions have been attached to meteors in bygone days, and they have been regarded as omens of some great event or some dire calamity. We find in the Scriptures, associated with the calamities that were to befall Jerusalem, the expression, "The stars shall fall from heaven," and in Revelations, amidst all the fearful events described, are "The stars of heaven fell upon the earth," and "There fell a great star from heaven, burning, as it were a lamp."

In an old Latin chronicle, by Baldric, occurs the following passage, quoted in the Journal of the French Academy of Science, as adding testimony to the superstition regarding them. Baldric says, "Already, before the Council of Claremount, the stars had announced the progress of Christianity, for innumerable eyes in France saw them fall from Heaven, as thick as hail, on the 25th of April, 1095."

Ignorance is always the parent of superstition, and we have all probably read of the extreme terror the great November meteor shower of 1833 created amongst the Negroes of the South, who were convinced that it heralded the end of the world.

Virgil alluded to meteors as indicating storm, the passage translated by Dryden being as follows :—

"Oft shall thou see, 'ere brooding storms arise,
Star after star glide headlong down the skies;
And where they shot, long trails of lingering light
Sweep far behind, and gild the shades of night."

To this day we often hear it said, that the wind will blow to-morrow from a certain quarter, as the stars fall in that direction.

In some old volumes of the "Gentleman's Magazine," especially those of 1793 and 1776, are some curious notions respecting shooting stars, and quite a controversy on a gelatinous or jelly-like substance they were supposed to deposit on the grass or trees, where they fell, called by the writers "star shot" or "star jelly," and explained by Withering as "tramella nostoc."

One other anecdote of ignorance in this direction. The great November meteoric shower of 1833 was witnessed by a female servant, a new arrival from Erin, in South Carolina. Rising early to fodder cattle, she saw thousands of these meteors, till daylight stopped the display, but thought nothing remarkable of it, stating when talked to afterwards about it, that she paid no heed to it, as she thought that was perhaps the way the stars were put out every morning in this country."

The phenomenon of shooting or falling stars, or meteors, as they are more generally styled, is now acknowledged to have existed since the formation of the solar system, long anterior to the existence of man. On any clear evening, it is estimated a watchful observer may see on an average two shooting stars every five minutes, and at certain periods of the year in such abundance as to have obtained the name of "meteoric showers." These apparently emanate from a certain constellation, or from a point of space known as a "radiant" represented by some certain constellation, whilst single meteors appear to come from no particular point, but move in all directions, and from every part of the sky. These are styled "sporadic." In their normal condition these wandering bodies, before they reach our vision, are known as "meteoroids," and in their own proper orbit are never visible from the earth. They are then regular circumsolar bodies, obeying the laws of motion and gravitation as rigidly as the planets. Striking, or rather entering, our atmosphere at a speed of 48 miles per second, they at once become self-luminous from the heat engendered by friction with the tmospheric medium, and the arrested motion producing a sudden compression of the air. To illustrate this, I may mention that there is a little instrument called an air match, consisting of a piston and cylinder, somewhat like a syringe, in which a light can be struck by suddenly forcing down the piston upon the air below in the cylinder. As the air cannot escape it is suddenly compressed, and gives out a spark sufficient to ignite a piece of tinder at the bottom of the cylinder. Some idea from this may be formed of the heat evolved by the motion of a large body in the atmosphere with the velocity of a meteor. A combustible body, under such circumstances, would be speedily ignited, but could not burn freely till reaching air of greater density; thus, on entering the lower portion of the atmosphere, it would burn with great rapidity, and, accordance to its distance, be more or less, or entirely consumed before reaching the earth. It has been estimated that by the time they have traversed a space of 50 miles, the meteoroid, or meteor, as it has then become, is heated, melted, evaporated and extinguished in a period of not less than a second of time. The height from us at which they become heated to visibility is sometimes as much as 200 miles, but the average has been put down at 75 miles, and extinction about 50 miles above the earth. The length of the arc or course they describe in their visible path varies greatly, owing to the position of the observer. One may flash up, increasing in size and brilliancy, and disappear without seemingly describing any arc. The course of such a one is directly towards the observer, but to another person 30 or more miles apart, it would exhibit an arc of several degrees in length.

Different and varied views are held by philosophers as to the origin of meteoroids. One theory is, that they are fragments of an exploded or shattered planet filling interplanetary space, most of which, through holding orbits round the sun, will ultimately fall into that body, and serve as fuel for that central orb. To illustrate this, supposing our earth, through some gigantic convulsion became disintegrated, and burst into numerous portions, these would continue to move on becoming more or less erratic in their movements; the smaller portions would first feel the influence of disturbing agencies larger than the earth, and moving inward, would become entangled, as it were, in the resisting medium in space which is now acknowledged to exist. This resistence would change their orbits, and the lighter particles would form a more erratic orbit than the heavier or denser ones. They would grav[illegible] towards Venus, which lies inside our orbit, and be the first to fa[illegible] it, whilst the denser fragments, metalloids and metals, would be the last.

Dr. Brewster favors the theory of meteoroids being fragments of a large planet similarly as the asteroids, the previous existence of which was long ago suggested by the vast chasm between Mars and Jupiter, where only asteroids have as yet been observed. Dr. Olbers, the discoverer of three of the known asteroids, held the same idea, and that the lesser fragments, coming within the attractive power of a planet would fall towards it, and when entering its atmosphere would go through all the conditions referred to, fusion, luminosity, etc. Sir John Herschel, however, differs from this theory. The diameter of Jupiter, the largest known body in our planetary system, is 80,000 miles, whilst that of Clio, one of the smallest, is only 16 miles. Chladin, a philosopher, at the end of the last century, thought that bodies might exist as much smaller in comparison as Clio to Jupiter, having only 16 feet diameter, and in the same ratio we come down to 1-25th of an inch, mere cosmic dust. To this cosmic dust has been attributed that peculiar fleecy brightness known as the Zodiacal light. Any observer of the western sky at this season of the year (the early spring) for about an hour after sunset, may see a soft, faint cone-shaped glow light extending about 40 degrees, following nearly the sun's path in the heavens. Near the equator, where the elliptic rises high above the horizon, it can be seen nearly all the year round, and in a very clear atmosphere in the tropics has been traced all the way across the heavens from east to west, forming a complete ring. The theory that now prevails is that the light from the sun when below our horizon reflected on the cosmical atoms of floating star-dust and meteoroids, is the cause of the soft celestial glow that now lingers evening after evening in our western sky. An illustration of this is offered by a ray of light which finds its way into a darkened room through a small orifice, revealing as motes dancing in the sunbeam the particles of dust floating in the air of the room, but visible only where the entering ray of light falls athwart them.

In this connection, the recent deep sea soundings of the "Challenger" have brought to light a curious fact. Sir Wyville Thomson found that beds of sediment were being slowly formed on the deepest ocean floors, but so slow was the rate of deposition that it has been compared to a fall of dust in an unoccupied room. No better proof of this can be given than that an examination of the abyssal mud disclosed the presence of an appreciable proportion of meteoric iron, the product of those falling stars which dissipate themselves on entering our atmosphere. Professor Geikie says, in a recent geological lecture in Scotland :—" To learn that mud gathers there so slowly that the very star-dust forms an appreciable part of it brings home to us as hardly anything else could do, the idea of undisturbed and slow accumulation."

An interesting memoir by M. Tschermak, of the University of Wissenschaften, was published in 1875, on the source of meteoroids, and a paper on his memoir was, a few years ago, read before the Royal Irish Academy by Mr. Robert Ball. Tschermak claims a volcanic source in some celestial body. Mr. Ball follows the theory further, and by able reasoning shows that, if ejected from the planets or asteroids, there would only be a chance of one in 50,000 of them falling on the earth. In the early stage of our own earth's history, long anterior to life, when mighty convulsions were rending it, colossal volcanoes may have existed with explosive energy enough to drive missiles upwards with a velocity which would carry them far enough from the earth to a point where they would continue to move in orbits round the sun, crossing at each revolution the point of the earth's track from which they were originally discharged. If this were the case, there are now doubtless myriads of those projectiles moving through the solar system, the only common feature of whose orbit is that they all intersect the track of the earth, and, it and they now and then meeting, the point of intersection would be marked by the descent of a meteorite. This theory was hinted at by Dr. Phipson, in a work published by him in 1866, and Mr. Lawrence Smith, another later writer on the subject, inclines to the same view. No volcano now exists with explosive energy enongh to eject fragments that could constitute future meteoroids, and if such ever did exist, it could only be in the early stages of the earth's history.

Another, and an ingenious theory advanced by Professor Newton, of Yale College, and one meeting with general acceptance is, that meteoroids are fragments of or attendants on a comet, and in a lecture of his in 1879, he scientifically endeavors to prove this. Speaking of the recurring November meteoric showers which manifest themselves at their maximum every 33 years, he says: "Vast masses of these small bodies move in a long thin stream around the sun, and the earth at stated times plunges through them, taking with its atmosphere each time scores of millions of them. Their orbit is described in 33.1-4th years. They go out a little further than the planet Uranus, or about 20 times as far as the earth is from the sun. While they all describe the same orbit they are not collected in one compact group, but taking four to five years to pass a given point in the orbit, they may be likened to a train several hundred of millions of miles long, but only a few thousands in thickness. Along with this train travels a comet." Every August, about the 10th of the month, there is another star sprinkle, or slighter display of meteors (known among the common people as St. Lawrence's tears), and a comet, whose period is 125 years, moves in the plane with these meteors, and in a like orbit. Again, early in December there are star showers, the meteoroids composing them travelling in the orbit of Bielas' comet. In April slight showers again occur, connected with another comet's orbit. The sporadic meteors of nightly occurrence are but outlying stragglers of a number of meteoroid streams, and the leading problem of meteor science to-day is to find these streams and their attendant comet. Professor Newton says the known comets have been apparently growing smaller with their successive returns. Halley's comet was much brighter in its earlier than in its later recurrences. Bielas' comet has divided into two, if not more parts, and has perhaps gone altogether to pieces, as it could not be found in 1872, where it should have appeared. The question naturally arises, what causes a comet to break up? This is yet only a matter of speculation, but this much is known, that comets surely come from stellar space, in whose unimaginable degree of cold a condensing mass furnished heat for the making of a meteoroid. In cooling, or by some internal convulsion, the mass may break and enter the solar system, either as a mass of pebbles or as one huge body. Nearing the sun, new and strong forces act on it. The same heat and repulsion that develop and drive off from a comet in one direction a tail 100,000,000 miles long, may have worked off and scattered in another direction solid fragments to wander in their own orbit round the sun—an infinitesimal comet for millions of years—till entering the earth's atmosphere, one by one they crash through it either to fall on the ground or to be annihilated by friction before reaching it.

Professor Schiaparelli, an Italian authority on these questions, regards meteoroids as original inmates or portions of one of what he styles star drifts, and of whose existence decided proofs are given by Proctor, and composing with other stars of the same vast eddy attendant bodies accompanying in its journey through space the general drift or star family of which the sun forms part. On this assumption they are bodies from some more distant space than the star family of the sun, wanderers from more distant star drifts

The conflagration of a star through contact with meteoroid bodies is not an unknown occurrence. The first on record took place 2,000 years ago, and is described by Hipparchus. It was seen blazing in full daylight. A similar event is recorded in 945, in 1264 and in 1572. In 1596 Fabricius observed a similar occurrence, followed by another in 1604. In 1673 another made its appearance, remaining visible for two years, whilst as recently as 1848, a similar event was noticed, and a few years ago another appeared, which was ably written upon by Proctor in an article of his in 'Belgravia.' At the present time a burning star is apparent in the constellation Auriga, which is being watched with great interest. In 1859 two meteoric masses are recorded as having fallen into the sun and affected the whole frame of the earth. Vivid auroras were seen where they had never before been seen, accompanied by electro-magnetic disturbances all over the world. In many parts the telegraph lines refused to work, signal men received severe shocks, and at Boston and elsewhere, a flame of fire followed the pen of Baios' telegraph. This was the effect of two comparatively small meteors. What would be the effect of a comet, bearing in its flight many millions of these, falling into the sun, can hardly be understood. It would be only temporary, but no student of science would be left to record it. Proctor, however, reassures us by saying that all but one of the known star conflagrations have occurred in the zone of the Milky Way, and that one, in a region connected with the Milky Way by a stream of stars; and if among the comets in attendance on our sun there is one whose orbit intersects the sun's globe, it must already have struck it long before the era of man.

An interesting question has recently been put forward by the 'Lancet,' the well-known English medical publication, respecting the possible influence of meteoric matter on the animal life of the earth. Professor Herschel has succeeded in examining and analyzing by means of the spectroscope, the light of seventeen of these bodies, and he has succeeded in detecting the well-known yellow bands produced by sodium in combustion. "It is strange," says the 'Lancet,' "to consider what becomes of all the sodium thus dispersed throughout the upper regions of the air, as there can be no doubt that in some form or other it reaches the earth. The very air we breathe must at all times contain, in however minute proportion, the cosmical dust thus brought to us from the interplanetary spaces, and as the different meteoric systems are differently constituted, the air we breathe is constantly being impregnated with various forms of metallic dust. It is not certain that deleterious results do not occasionally flow from an excess of some of the elements contained in meteors. Professor Roscoe goes so far as to conjecture that the soda, which all accustomed to work with the spectroscope find present everywhere, may by its antiseptic properties, exert a considerable influence in maintaining the public health." Speculations and hypotheses of this kind are no doubt interesting, but, it seems to me, barren of utility till proved, and I merely quote from the 'Lancet' to show that the study of meteors is attracting other attention than that of astronomers.

Atmospheric electricity is now also being attributed to meteoric influence, and Professor Govi, in 1878, leans to the idea that a certain amount of heat is introduced into our atmosphere by the meteors that enter it, and Professor Everett attributes the sudden variations of the needle of the electrometer from no apparent assignable external cause, to the same influence. He adds, our great want at present is balloon observations, and says that he "feels convinced that friction of the air or of the solid particles contained in it is one cause of the generation of electricity in the air."

Scientific theories necessarily lack finality. Sufficient to-day to explain all the known facts, to-morrow discoveries may show their inadequacy, and lead to their modification or abandonment.

I will now devote a few minutes to meteorites and the historical records of some of the more celebrated that have fallen from time to time, on the earth.

Amongst all people, and in almost all ages, a general tradition has prevailed of the fall of solid bodies from the sky, under various denominations, and the meteorite has no doubt given rise to the miscalled thunderbolt.

In barbarous times, when *omne ignotum pro mirifico* prevailed, *i. e.*, when all that was unaccountable was looked on as a miracle, these missiles were ascribed to the anger of an offended Deity, and antiquarians even attribute to them the origin of the religious deference paid to the worship of stones amongst the nations of early days. The image of Diana mentioned in the Acts of the Apostles, as believed by the Ephesians to have fallen down from Jupiter, and the Palladium or sacred statue of Minerva, said to have fallen from heaven, and to have been preserved in Troy as a treasure, on the safety of which that of the city depended, had each, no doubt, this origin. It is only of late years that the attention of scientists has been given to ascertaining the origin of these falling bodies, philosophers having, up to 1802, regarded the idea of solid bodies being precipitated to the earth as entertained by the ancients, a vulgar error. In that year Mr. Howard submitted to the Royal Society a paper containing an accurate examination of testimony connected with such events, and a minute analysis of several of these substances which were said to have fallen in different parts of the globe. This excited an animated discussion, and led to a more careful study of the subject which in the last three or four years has had more light thrown on it than in all previous time, and there is now scarcely any scientific periodical which does not contain allusion more or less pointed, to meteors and meteorites.

Meteorites are divided into three groups, of which the distinguishing feature lies in the relative amounts and arrangement of the iron and stony material, or silicates, which they contain. All contain iron, almost invariably associated with nickel and cobalt. The three divisions are *aeorolites*, *aerosiderites*, and *aerosiderolites*. An *aerolite* is a meteorite composed chiefly of stony material, but containing nodules of nickeliferous iron. An *aerosiderite* is composed of solid nickeliferous iron, with little or no stony matter adhering, and an *aerosiderolite* is an intermediate variety of very rare occurrence in which the iron forming a skeleton is honey-combed in every direction by the stony portion. Meteorites are not found to contain any new elements, or rather, no elements not common to our earth are held by them; this leads to the conclusion that throughout the universe there is unity of design in physical constitution as well as in mechanical arrangement.

By the combined rotation and revolution of the earth, that portion of it where it is sunset moves from its zenith, whilst that portion where it is sunrise moves towards its zenith, or rather towards that portion of the zodiac nearest its zenith, and thus the latter has more chance of coming in contact with isolated flying masses. Those falling at sunset must overtake the earth in its course, and thus show by their velocity that it is other force than planetary attraction which propelled them. In this connection Proctor puts forward the idea that the destruction of Sodom and Gomorrah was occasioned by a meteoric down-fall, and this ingenious theory has been followed by Mr. E. L. Garbett, a well-known architect. Tempel's comet, in whose track the November meteors travel, is shown to have passed very near the earth about the time to which tradition assigns the destruction of these cities. Supposing that the meteors, composing or accompanying this comet, broke through the air, they would, if strewn with proportionate density, fall in a compact shower on whatever part of the earth's surface happened to be most fully exposed to them. Now it is distinctly stated, "The sun was risen upon the earth before Lot entered Zoar. *Then* the Lord rained brimstone and fire out of heaven;" so that at that time the destroyed cities lay almost centrally on that disk of the earth which was turned toward the radiant of the November meteors. Thus the earth at its full speed of 1100 miles a minute, or 18 miles a second, meeting the November meteors, which travel at a speed of from 24 to 40 miles, would cause just such a catastrophe. As a still further corroboration of this, we know that the whole plain, the site of these cities, is impregnated with salt, of which sodium is the chief component, and which has, as before shown, been detected by Sir Wm. Herschel in spectroscopic analysis in the yellow bands of meteoric light.

The discomfiture of the Amorites, mentioned in the Book of Joshua, may have been from a similar cause, the account furnished being that "the Lord cast down great stones from heaven upon them."

In the Acts of the Apostles, where the town clerk of Ephesus spoke of the image which fell down from Jupiter, the word "image" is not in the original, the reading there being "that which" fell down.

Amongst the earliest records of meteorites may be mentioned one spoken of by Pliny, which fell in Thrace, 467 B. C., and was still in existence in his time. This he describes as about the size of a wagon. The Chinese records go back 644 B. C. to 333 A. D. Anaxagoras, Diogenes and Plutarch, all agreed on meteorites, and though ignorant of the comet-lore of to-day, believed they were always rotating invisible to us. A large meteoric stone is recorded at Lucania 54 B. C. In Saxony (Annales Fuldenses) a great shower of stones in 823 A. D., destroyed men and cattle, and fired 35 villages; 921, 1010, 1164 and 1304, were remarkable for them. In 1492, one fell in Alsace weighing 260 lbs., and is still shown in the church at Ensisheim. In 1501, at Padua, 1200 stones fell, one weighing 160 lbs. and another 60 lbs. In 1511 a heavy fall occurred in Crema. In 1676 a large one burst over Leghorn, and the fragments fell into the sea. In 1790 a shower of stones fell at Aden. Later records are more detailed than earlier ones, where superstitious awe seems to have retarded investigation or description. In 1803, at L'Aigle, in France, a cloud appeared, out of which, during explosions lasting five or six minutes, and described as terrific thunder, a large number of stones fell. In 1807 an aerolite of 140 lbs. fell at Smolensk, in Russia, and in 1808, in Moravia, between 200 and 300 fell. At Brandenburg and Potsdam, and in England, a deposit of dust was noticed on the water, buildings, etc., after meteoric displays in 1818 and 1822, and in 1856 the decks of a vessel 240 miles off land, in the Indian Ocean, were covered with a fall of stones the size of shot, which microscopical examination proved were of true cosmical origin, and not volcanic, as was first suspected. In 1783 a bright meteor was seen from Greenwich Observatory, and noticed all over England, the diameter of which was estimated at one mile, and its speed at 1000 miles a minute. No fragments of it were known to have been found, but after its explosion the sound took ten minutes reaching the earth.

Speaking of the sound, I have no doubt that the "thunder in a cloudless sky" spoken of in the earliest records of Latium, and deemed such an ill omen by soothsayers, must have originated from meteoric concussion.

In 1807 a large shower of meteoric stones fell at Weston, in Connecticut, of which a full account was published by Professors Silliman and Kingsley, of Yale College. In the British Museum there are a very large number of specimens of meteoric stones, and the National Museum at Washington is not deficient in such specimens. In the Royal Academy at Stockholm are exhibited several, the largest weighing 25 tons, which were brought from Greenland by a Swedish Expedition of 1870, these being part of the "iron stones," of the existence of which the Esquimaux of Baffin's Bay had informed Captain Ross, the Arctic navigator.

To come down to recent years, in April, 1875, and May, 1879, two meteors of great size and brilliancy were observed in the Western States, illuminating the whole of Iowa, and parts of Missouri, Illinois and Wisconsin. Singularly enough both exploded over Iowa, scattering fragments of their mass over areas embracing six counties, accompanied with a noise like thunder. A full account is given in the Iowa State records, where it is stated that their chemical constitution differed from all meteorites analyzed elsewhere, these containing 7 per cent. of iron, a tenth of 1 per cent. of nickel, 17 per cent. of calcium, 47 per cent. of silica and 27 per cent. of ferrous oxide. The fragments of the meteor of 1879 fell chiefly in Emmett County, one of which, weighing 470 lbs., was sent to the British Museum, and another of 170 lbs. was sent to the State Museum of Minneapolis. At the time of its fall, some boys were herding cattle near a small lake five or six miles south-west of where the large masses fell, and they reported that just after the fireball passed over they saw and heard what seemed like a shower of hailstones falling on the water. Two large fragments of this meteor fell by the roadside, and a lawsuit was undertaken to decide whether they were the property of the finder, as wild game, or of the owner of the land, as being real estate; and it was decided in favor of the latter.

In 1878, near Covington, Indiana, a Mr. Grover, of Newton Fountain County, was killed in his bed by what was supposed to be lightning, but which further examination showed was a meteoric stone of pyramidal shape, weighing 20 lbs. This was unearthed in the cellar, some feet under the ground, traced there by the rent torn through floors and everything in its passage. The corpse was mangled as if by a cannon shot.

In 1879 near Bucyrus, Ohio, a similar death occured, the victim being a Mr. Meisenthaler, of Whitestone Township, a well-known cattle raiser of that district. As he was driving his cattle at daylight, he was struck by a meteorite and killed. This missile is reported as having apparently come from the west, at an angle of about 60 degrees, its obliquity being ascertained by its having in its passage cut through the limbs of a tall maple tree like a cannon ball. He was struck on or under the shoulder, whence it passed through him to above the left hip, and buried itself two feet in the soft black ground. The greater part of his body was crushed into the earth beneath the stone, which was described as of a rough, round form, and resembling iron pyrites. No doubt many similar deaths have occured but are unrecorded. I could cite numerous instances, which I have in my note-books, of meteorites falling close by parties who observed them, which are authenticated as reliable.

On December 15th, 1884, at 3 a.m., a large meteor passed over Quebec, and fell on the farm of Mr. LeFrancois, near Chateau Richer, 15 miles distant, burying itself to a depth of 5 or 6 feet, and measured, when excavated, five feet in circumference.

On January 27th, 1885, a large meteor passed over the Island of Guernsey, terrifying the inhabitants. and was seen by the crew of a steamer off the island, to fall into the sea, to the west.

On September 13th, 1885, a rumbling sound awakened the residents of Akron, Ohio, at 4 a.m., caused by a large meteor passing over the place, which illuminated the country for a great distance and was supposed to have struck the ground near the eastern part of that city.

In June, 1886, a large meteor fell into Spring Pond, near St. Regis Falls, New York State, scattering mud in every direction and killing numbers of fish.

On June 12th, 1887, a large meteoric stone fell near St. Joseph, Indiana, burying itself some 12 feet in the earth, and was estimated, before it broke, to have weighed nearly two tons.

On July 1st, 1888, a large meteor was seen passing over Montreal, and was noticed also during daylight at Appleton, Wisconsin, rivalling the sun in brightness. It was visible for half a minute, but was attended with no noise.

On February 4th, 1890, a large meteor fell near Granbury, Texas, striking the peak of one of the Comanche mountains, and knocking huge boulders into the valley, barely missing in their descent Major Torres' house.

On April 15th, 1890, a brilliant meteor passed over Glencoe, Illinois, about 10 p.m. with a loud report, and exploded a short distance east of the town. During the night the moon and stars were faintly obscured by a fine rain of ashes and minute cinders, sifting away to a light dust or gray powder.

On the same date a ball of fire passed over Levis, P. Q., at midnight, with a loud report, but no trace could be found on the ground.

On May 4th, 1890, a meteor was seen over Hancock, Kossuth, Palo Alto, Clay, Dickinson and Emmett counties, Iowa. It appeared like a large ball of fire at Angora, separating into two over that point, and then bursting into fragments, the sound of the explosion being heard three minutes afterwards. Buildings were shaken, windows broken, and a quaking of the earth was felt. A column of smoke rose, of dense appearance, as far as the eye could reach towards the zenith.

On February 24th, 1891, a large meteor passed over Portland, Maine, and was supposed to have fallen in Franklin County.

The London "Standard" of November 22nd, 1882, describing a large meteor which a few days previously passed over the northern sky, says an aurora was unusually bright at the time this strange torpedo-shaped luminous body passed majestically from east to west. It was described as resembling the glow produced by an electric current passing through a vacuum. Coincident with its appearance there was a magnetic storm of remarkable intensity. So violently were the telegraph and telephone wires deranged by the strong earth currents that their working was rendered impossible. American electricians equally experienced this interruption, and it was at the moment when the magnetic storm reached its intensity that the luminous body sailed across the sky. At Sidmouth the aurora was of an exquisite rose pink color. During the passage of the meteor the block signalling apparatus was greatly affected, two separate sections working at the same time, and the needle of the speaking instrument, instead of being read at vertical was obliged to be read at an angle of 45°. The block bells continued to ring during the passage of the object and for some seconds after its disappearance, and the signals were generally disarranged. At the same period very large spots existed on the sun's surface.

I believe the largest aerolite in any collection is in Brazil, weighing 14,000 lbs.

But time will not allow me to delay longer. I have been unable to hear of any meteoric stones existing in this section, and should be very glad to gain information of any such, if existing. It may be a new object for our Hamilton naturalists to look out for in their rambles, and of peculiar interest as leading to the study of a branch of physics only recently attracting attention.

SOME PROBLEMS IN HORTICULTURE.

I—FUNGI AFFECTING FRUITS.

Read before the Hamilton Association, March 10th, 1891.

BY L. WOOLVERTON, M. A.

How charming, to the inhabitant of the town, are the scenes of rural life; the rosy apples, the golden peaches and the various hued grapes—how attractive! His visits to the country are usually made during the summer season, during the time when the orchards are either clothed in rich abundance of pink and white blossoms, or else are laden down with their luscious fruits. The harvest time to him appears a time of joy, a time of festivity, and he thinks that, if he could exchange his life in the town for one upon the farm, he would reach the height of bliss. It is a mistaken notion to suppose that the whole round upon the farm, and especially upon the fruit farm, is but one continued round of pleasurable occupation and at the end of the year a pot of gold.

How true in this case is the old proverb "distance lends enchantment to the view."

So old Horace, the Roman poet, puts it when he describes in his first Satire, the people who are always wishing they could exchange their lots with others, fancying that any other occupation is more pleasant than their own.

> "Qui fit, Maecenas, ut nemo, quam sibi sortem
> Seu ratio dederit seu fors objecerit, illa
> Contentus vivat, laudet diversa sequentes?"

Our friends in the town know little of the hardships and discouragements which are the lot of the fruit grower, nor of the many long years spent in battling with difficulties before reaching his present prosperous condition; and it is to give the members of the Hamilton Association some idea of the difficulties which are in our way, as fruit growers, that the writer has agreed to prepare this paper.

The recent problems facing horticulturists come naturally under two heads, first, Fungus Diseases, second, Insect Enemies; and in the brief time which you will be able to place at my disposal, I shall only have time to outline some of those which come under the first head. It is only recently that these two branches of science which refer to the very tiny subjects, such as can only be studied through the microscope, have been pursued far enough by scientists to make their investigations of real use to practical men, but now we are finding that the professor and the farmer are nearer friends than they were in days gone by. "Book larnin" was for many years despised by the latter, but now the prejudices are wearing away, owing largely to the exertions of our professors who visit the Farmers' Institutes throughout the country. A neighbor used to tell me that he could not see any use in "eddication"; he never had any "larnin hisself" and he said that he knew more than those who had. His favorite subject of conversation was astronomy, and he used to delight in meeting with us young students from the university and proving to us that all we learned at school concerning the rotundity of the earth and the distance away of the sun, moon and stars was erroneous and absurd. He could prove to a demonstration that the earth was flat and that the sun was no larger than a cart wheel and went round the "airth on'st a day." He had himself ascertained the exact distance of the sun from the earth by taking the angle, using for his mathematical instruments some chalk, a square, and ten foot boards, and proved to a demonstration that it was just five hundred miles.

Such men remind one of the redoubtable preacher spoken of by Dean Alford in his Queen's English, who used to hold forth at Cambridge, in a chapel on Green street. The Dean says his wont was to rail at the students of the University, trying to make out that it was a waste of time to study Greek and Latin. On one occasion, having wound himself up to the requisite pitch of fervor, he exclaimed in a voice of thunder, "Do ye think Powl knew Greek?"

One of the problems that was long unsolved among us fruit growers, was the cause of the PLUM KNOT, but lately mycologists have given us an insight into its life history. For a long time it was thought to be caused by some insect, and even yet we meet with men who will not give up this theory. Insects are found in it, they say, and this they claim is positive proof that they are the cause. Careful investigation, however, shows that these insects are not the cause of it, but that they simply make use of it as a favorable place for oviposition. We have had many foolish remedies proposed and as often tried by foolish fruit growers. No less an authority than an American Consul, residing in a Canadian town, recommended, as a sure cure for plum knot, boring a hole in the trunk of the tree and filling it with flowers of sulphur. He said this would circulate through the sap of the tree and destroy the insect of the black knot. Any one cognizant with chemistry or botany will see the foolishness of such a recommendation.

The plum knot is now known to be a well defined fungus and is called by mycologists *Plowrightia Morbosa.* Little spores, corresponding with seeds, float along in the air and alight upon a suitable host, either in the form of a cherry or a plum tree. Soon the hated parasities send down their mycelial branches among the cells of the wood and derive means of nourishment. Soon they begin to throw up innumerable filaments, called conidia, on the ends of which are borne egg-shaped spores, as shown in the accompanying drawing, figure 1. These are summer spores which

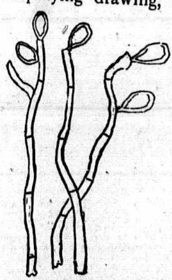

FIG. 1.—Conidiosporesenlarged

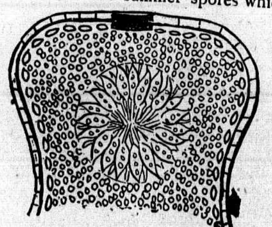

FIG. 2.—Cavity of Perithecium, with Ascospores. (May be seen in February with hand-glass.)

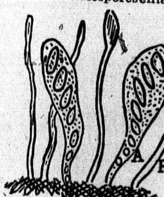

FIG 3.—Asci, containing Ascospores.

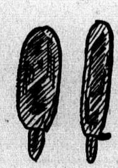

FIG. 4.—Ripe Ascospores.

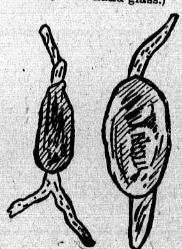

FIG. 5.—Ascospores germinating.

ripen and fall off and are carried by the wind long distances to propagate the disease.

But it is not only in the summer time that the knot is active, but also in the winter. During the month of February winter spores are formed in the little sacs called asci (fig. 3). On cutting through a knot in the month of February, these little sacs are plainly discernible with a small hand-glass (fig. 3). Each contains about eight winter spores, known to mycologists as ascospores, which one by one are carried forth to some favorable host. For a long time the cause of the plum knot was an unsolved problem, but, thanks to science, this problem has been solved, and we now know that cutting and burning the affected limbs will effectually stamp out the disease. We also know that a paste made of kerosene and paint, or turpentine, is destructive to it. But, although we have information enabling us to overcome it in our own orchards, the problem still remains, how we can compel the lazy and indolent in town and country to destroy those plum and cherry trees in their gardens which are affected. The present law seems very inoperative. True, it provides for the appointment of an inspector in every municipality, but the council is not obliged to appoint such inspector except on a petition of at least fifty ratepayers, and this is too cumbersome a mode of procedure. Further, the inspector is not required to act unless he receives written notice of the disease. All this is a mistake. He ought to be obliged to make a round of the orchards several times during the season, and have all affected trees destroyed without receiving notice from anybody.

Another problem in horticulture, which, as yet, is unsolved, is the cause of the YELLOWS in the peach. This mysterious disease originated in the peach orchards of some of the Middle States a good many years ago. It has gradually spread from state to state throughout the larger part of the Union, and across the borders into the peach orchards of our own country. Periodically its visitations seem to be more severe in character, destroying orchards by wholesale. Then, after the peach growers have given up peach growing for some time, they find themselves able to begin again with some fair hopes of success. The Department of Vegetable Pathology of the United States have taken this matter up and spent an immense amount of money in investigating into this disease, and to this work have appointed Professor Erwin Smith, who has made elaborate reports of his work. But, although a large amount of money has been spent in this direction during the last three years, as yet no definite results have been obtained.

A year ago last summer I had a call from Professor Burrill, of Champaign, Ill., who was a delegate to the American Association for the Advancement of Science, then meeting in Toronto. He was looking up cases of yellows, which he said were not common in his own state. He is a man of most careful research, and his opinions are worthy of consideration. He believed that the disease was caused by bacteria, and in this most scientific men are in accord with him.

One thing we do know about the yellows, and that is that it is of an infectious character, in which respect it equals scarlet fever and small-pox. It may be carried from tree to tree, either by the bees in their searches for honey, or by instruments used in pruning the orchard.

We may hope, however, that ultimately the mystery will be solved, for the PEAR BLIGHT was, until lately, quite as mysterious. This latter has been the terror and despair of pear growers in all parts of the country. It would come in a single night upon the choicest trees in the garden and sometimes upon the whole orchard. You viewed them at night, the pride of the homestead, and, on your next visit, the foliage was blackened and sickly and the young fruit shriveled and worthless. Some said it was caused by electricity, others by sunshine, others by insects, and so on, and just as numerous were the remedies proposed; as, for instance, digging in iron filings about the tree, slitting the bark, painting the bark, etc., all of which have been tried in vain.

But now it has been shown conclusively that this terrible disease is the result of a tiny bacterium, which lives in the sap and has the power of locomotion. It is called by botanists *Micrococcus Amylovorus*, and its size, when magnified 890 diameters, is only about half the size of a pin's head and very similar in shape. Prof. J. C. Arthur, who was at that time botanist of the Geneva Experiment Station, in his report for 1887 described this bacterium and stated that it was proved to be the real and only cause of the pear blight. He discovered the organism itself in blighting tissue, and inoculated healthy tissue of other trees with the germs from that which was diseased, and, as a result, the healthy trees were at once affected with the blight. Besides this, he found that the blight could not be communicated to healthy trees by the juices of the disease, after the germs were removed from them by filtration.

The same organism causes the twig blight of the crab apple, the quince and even, to some extent, ordinary cultivated varieties of the apple.

Prof. Burrill told me, at the time of the visit referred to, that the bacterium of the pear blight ordinarily comes through the young and succulent wood of the trees and also through the stomata of the leaves and blossoms in the early part of the growing season. This explains why pear trees, which are stimulated to make a very rapid and succulent growth, are more subject to the blight. The little bacterium, according to Mr. Burrill, has a sort of corrosive nature which enables it to pass through the cellular tissue from cell to cell, thus working along through the wood, carrying destruction in its course.

Still the pear blight is only a half solved problem. It yet remains to be shown how we may prevent its ravages and how to save the trees that are already affected. Spraying with the Bordeaux mixture early in summer, has been recommended by the U. S. Department of Agriculture as being of great value in preventing leaf blight.

One of the greatest plagues of the fruit grower is the APPLE SCAB. This has been known to botanists on the continent of Europe for some fifty years, but, since the year 1869, its habits have been more carefully observed by mycologists, who have named it *Fusicladium dendriticum*. We gave some space to its description in The Canadian Horticulturist, volume X, page 103, and since that time have endeavored to keep apple growers posted concerning the progress of the evil and the success of the various remedies proposed for its destruction. At that time it had reached Australia; now we have reports of its presence even in New Zealand.

An important step in advance was made when it was shown that the fungus causing the leaf blight of apple, which resulted in its early dropping from the tree, was identical with that known as the scab on the fruit itself.

On the leaves, the scab appears first as small olive-green spots, of a definite and rounded outline (fig. 6). These increase in size, and assume a velvety appearance, with a less regular border; sometimes two or more spots will coalesce, as it were, forming one large and irregular one. Sometimes even the petioles and the young twigs become affected; thus in every possible way the fungus tries to rob the tree of its vigor.

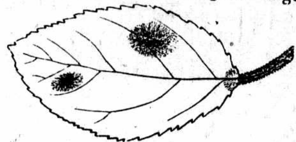

Fig. 6.

The most favorable conditions for its growth are the cool, moist weather of spring and fall, while its spread is retarded by the drouth and heat of midsummer. Owing to the dry, warm weather prevailing in the early part of last summer, our apples were much freer from scab than usual.

The fungus appears to retain its vitality during the winter season, being known to spread even in barrels from apple to apple; and it remains in a living condition through the winter on the twigs of the apples, ready to begin its work of devastation in spring-time. The loss caused to the country is alarming. The Secretary of the Illinois State Horticultural Society places the annual loss due to this parasitic growth at $400,000, but this is very small compared with the annual loss to apple growers in Ontario.

Fig. 7 shows a section of one of the leaf spots, and fig. 8 a section of the skin of an apple with scab bursting up through the epidermis, or outer skin, both magnified 200 diameters. The mycelium, or plant body of the fungus, resembles a dense mass of tissue composed of dark brown walled cells. These do not penetrate the cuticle, or

Fig 7.

Fig. 8.

inner skin, but grow between it and the epidermis, or outer skin, which they soon burst open, and send up brown threads on the ends of which are borne the spores for the propagation of the fungus.

These latter are so tiny, that it would require 3,200, side by side, to reach an inch. They germinate in moisture at a temperature of 50° F., in about eight hours; and the germ tubes have power to penetrate healthy skin and thus quickly spread the disease.

FIG. 9.—Spores of fungus of Apple Scab. One germinating.

Prof. Scribner, in his report of 1887, recommended spraying the trees in the early spring before the buds began to expand, with sulphate of iron, 4 lbs. to 4 gals. of water; then, after fruit is set, with Bordeaux mixture. More recently, Prof. Taft and Prof. Trelease have highly commended the use of ammoniacal copper carbonate.

This spring, in the last report of the Ohio Experimental Station, we observe that Prof. Green asserts that the most satisfactory of the copper compounds for destroying apple scab, with regard to cost, convenience and effectiveness, is the dilute Bordeaux mixture. The method of preparing it is as follows:—Dissolve four pounds of copper sulphate in two gallons of hot water; add sufficient water to cool it. Slake four pounds of quick lime, add water to make a milk of lime. Pour into copper sulphate through sieve to dissolve the lime better. Dilute to fifty gallons.

One advantage of this mixture is that Paris green may be used with it, and no injury to the foliage results. The effect should be bright, clean, healthy foliage and fruit, as well as comparative freedom from curculio and codling-moth.

In the Journal of Mycology, Vol. VII., No. 1, Prof. Goff, of Madison, Wisconsin, reports his experiments in 1891 in treating apple scab. He used, chiefly, copper carbonate (1) in suspension, using one ounce to twelve gallons of water, and (2) dissolved in ammonia, one ounce to twenty-five gallons of water. In the latter case the ounce of salt was first dissolved in a quart of ammonia.

He found that the copper carbonate applied in suspension, just as we use Paris green, was nearly as effective as when half the amount was used diluted in ammonia, and it had the advantage that Paris green for codling-moth could be safely added. Treating the trees before the opening of the flowers was of great value; indeed, in one instance, where the Canada Peach apple was sprayed with copper carbonate, it was found that one application previous to the opening of the bloom was more effective than four after. On trees badly infested, the scab reduces the size of the apples so much as to lessen the crop at least twenty per cent., besides rendering a large part of it worthless.

The result of the use of the diluted Bordeaux mixture was, by Professor Green, a saving of three quarters, at least, of fruit which would otherwise have been ruined, besides increasing the size of the fruit itself, and giving it greater beauty for market purposes. In addition to this there resulted a brighter and healthier foliage upon the tree itself, which means a great deal for the vigor of the orchard. The excellent effect of spraying with this mixture is shown in the results of Professor Green's experiment at the Ohio Experiment Station with the Newton Pippin, a variety perhaps more subject to scab than any other. Of the 100 apples from the sprayed trees, 15 were first class, 74 second and 11 third, while of the same number of apples from unsprayed trees there were no first-class samples, only 40 second, and there were 60 third-class. Thus it appears that, while spraying does not wholly prevent the scab, it pays well for the outlay required of time and money.

There are other ways in which the results are beneficial besides those mentioned. The leaves of our trees, when affected by the scab, fall prematurely, carrying with them much potash and phosphoric acid, a direct loss to the strength of the tree. Now, if the leaves can be made, by spraying, to hold fast until the proper season for maturity of growth, these fertilizing constituents will be withdrawn from the leaves into the body of the tree, and there be stored up for the following year. This spraying is useful also in blight and some think in plum knot.

TOMATO ROT.—This is a fungus for which no remedy has been certainly found. It is very wide-spread in Ontario, and does great injury to the business of truck gardeners. Some varieties, as Acme

FIG. 10.

and Mikado, seem very subject to it, while Perfection, Paragon and Trophy are less so. The appearance of the affected fruit is shown in fig. 10.

By scientists it is called *Macrosporium Salani.* The fungus consists of a dark colored mycelium or vegetable system, the growing tubes of which can be readily traced to the cells of the sound tissue of the tomato, (see fig. 11*a*), and of spores, which are borne on the end of branches, called hyphæ, represented in fig. 11, *b* and *c*. These are at first dark brown, but at length turn olive-black. When these spores come in contact with green or ripe fruit, they germinate rapidly under favorable circumstances, such as heat and moisture, and send out slender tubes, shown at fig. *d*. These spores survive the winter in the shriveled fruit, and in old leaves and stems. The remedy proposed by the United States Department of Agriculture is: One-half ounce sulphuret of potassium, dissolved in a gallon of water, and sprayed upon the vines, so as to thoroughly wet all the fruit.

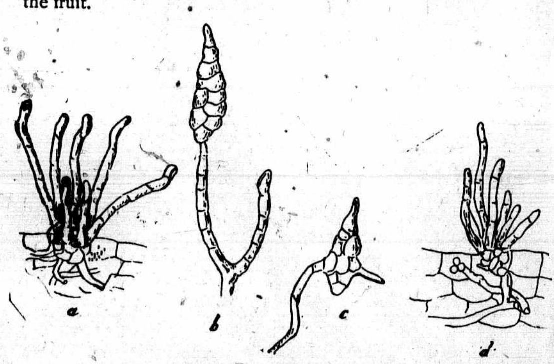

FIG. 11.

THE POWDERY MILDEW of the Grape (*Uncinula spiralis*) is quite common in the Niagara district, and in some varieties very injurious. It appears first early in June, in the form of dull greyish white patches on the leaves and fruit. Under the microscope these patches are seen to be the mycelial growth of the mildew which spreads over the surface of the host plant, and does not penetrate its

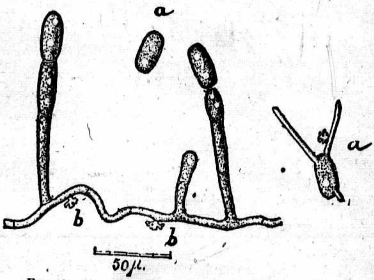

FIG. 12.—Mycelium of Uncinula Spiralis, from a grape leaf.

tissue except that it sends down among the cells occasional suckers (see fig. 12, *b. b.*), by which it draws nourishment. That the threads of the mycelium are not easily distinguished is evident when we note Prof. Scribner's statement that they are each only one six-thousandth part of an inch in diameter. In June or July short upright branches appear, which are jointed, as shown in Fig. 12. One by one these terminal cells drop off. They are really summer spores for the propagation of the mildew, and are known as conidia. Two of these are shown in fig. 12, *a. a.*, which, according to Prof. Scribner, are only one-thousanth part of an inch in length at their largest diameter. These float about in the air, and alighting on a proper host soon germinate under the favoring conditions of summer heat and moisture.

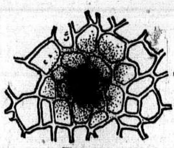

FIG. 13.

Fig. 13 shows a very small portion of epidermis of a grape berry, upon which the mycelium of Uncinula has grown, highly magnified.

Later on in the season, during the months of September and October, spores quite different in character are formed. The case in which they grow is apparent to the naked eye, and is known as the perithecium, or "fruit" of the mildew. Each of these is full of asci, three of which are shown emerging from the perithecium in fig. 14. Inside these, in turn, are the ascospores, or winter spores.

These are safely protected during the winter season by the hard compact walls of the perithecium, which in spring crack open and allow the asci to escape, and bring about a new infection of the vines. While this mildew is not nearly so destructive as that variety called the Downy mildew, still it is capable of wholly ruining the crop of certain varieties which are subject to it, as for instance, the Salem.

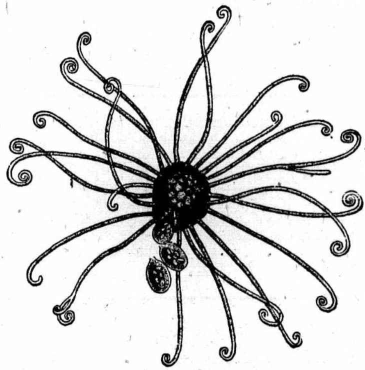

FIG. 14.—Perithecium of Uncinula Spiralis, with hooked arms, which give rise to the name *uncinula*.

The usual remedy found to be quite effectual in most cases in the Niagara district, is dusting flowers of sulphur on the vines, or, in hot weather, underneath them; but a more certain and effectual method is spraying the vines with the Bordeaux mixture, or the carbonate of copper early in the season.

THE POWDERY MILDEW OF THE GOOSEBERRY (*Sphærotheca mors uvæ.*)—Like the powdery mildew of the grape, this is a parasitic fungus, filamentous or thread-like in growth, and only attacks the surface of the host, giving it a powdery appearance. Gooseberries affected, as everyone knows, are rendered both unsightly and undesirable for food, and it is owing chiefly to the prevalence of this mildew in Ontario that so few of the superb English varieties are found in our gardens.

It first appears on the young half grown leaves and young wood, and later upon the young berries. Prof. Scribner, in his report on Vegetable Pathology for the year 1887, gives full illustrations and description of this fungus, and to it we refer any one who wishes to carefully examine its growth. Suffice to say here, that its summer spores are formed similarly to those of the powdery mildew of the grape, the upper segments of the conidia dropping off, and being carried about easily by the wind to scatter the evil; and that its winter spores are also formed within perithecia in a similar manner to those of the grape. When these perithecia ripen they become a chestnut color, hence the gooseberry mildew in its last stage loses its white appearance and becomes a dirty brown; and in this way the condition of the mildew may be determined.

Any remedy to be successful must be early applied. Early and frequent applications of flowers of sulphur are useful, but not so effective as in the case of the grape-vine mildew. Experiments at the Geneva Experiment Station, conducted last summer, have resulted in the discovery that the most successful treatment of gooseberry mildew is with sulphuret of potassium. The bushes were sprayed at an early date with a solution of one half ounce of this substance dissolved in a gallon of hot water. It is therefore recommended as the best known remedy for this evil.

CHERRY ROT (*Oidium fructigenum*) is the most serious obstacle in the way of the successful cultivation of this valuable fruit. The Heart and Bigarreau varieties, and especially the latter, are particularly subject to this fungus. The Napoleon Bigarreau, for instance, is frequently very heavily laden with fruit, but a protracted season of wet weather so encourages the development of this fungus that the rot, beginning in small spots, soon spreads from cherry to cherry, until, before picking time, the whole crop is entirely unfit for shipping. Could we succeed in overcoming this evil, we are of the opinion that the cultivation of the many very excellent varieties of cherries would be more remunerative to the grower than strawberries.

The fungus itself consists of much branched threads, or mycelia, which permeate the tissue of the fruit, causing it to turn brown and decay. When the air is moist these throw up tufts of dirty white dusty fruit stalks. These divide into minute sections which, when ripe, separate and fall off from the top, one by one, in the form of spores. These spores are so light as to be readily carried about in the air from tree to tree, and thus the evil is rapidly spread about through the orchard. Fig. 15 is a representation of two fruiting threads of this fungus before the spores have begun to fall away, magnified 250 diameters. The engraving is reproduced from a late report of the Geneva Experiment Station.

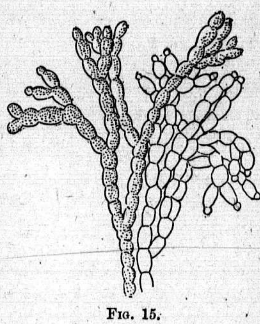

FIG. 15.

Since the spores can only develop in a moist atmosphere, it is quite evident that, if we could keep our cherries perfectly dry, there would be no rot. But, as this is impossible, we must endeavor to find some other means of preventing the evil. The spores have great vitality and preserve their generative powers from one season to another. The old ripe cherries which dry up and hang upon the trees during the winter, as well as the fallen cherries beneath the trees, are the means of carrying the fungus through to the following season. Any mode by which these could be destroyed would be helpful, whether by burning or by allowing the pigs to run in the orchard, so as to eat up all that drop. Probably the most reliable method of combatting the evil will be found in the universal remedy of spraying the trees with the Bordeaux mixture as soon as possible after the blossoms have fallen.

PLUM LEAF OR SHOT HOLE FUNGUS (*Septoria Cerasina*).—The leaves of cherry and plum trees are often affected by this fungus, the appearance of which is well represented in fig. 16.

The holes are frequently so round and even that they awaken considerable curiosity on the part of the observer as to their cause, but lately the mystery has been explained by Prof. Scribner, who says that they are caused by a fungus which is very widely distributed throughout the States east of the Mississippi. Though not a very serious pest, it often inflicts considerable injury both upon the cherry and the plum trees, by interfering with the proper function of the leaves, causing them to drop prematurely, sometimes as early as the first of August. The leaves attacked show at first, scattered here and there over the surface, dark purple spots, visible on both sides, varying from one twenty-fourth to one eighth of an inch in diameter. After a brief period, the tissue covered by these spots becomes dead and brownish in color. On examining one of these brown spots under the microscope there will be detected from one to several minute black points. These are the fruits of the fungus, like little capsules, in which the spores of the fungus are produced in great abundance. These are very slender and many times longer than broad, and quite transparent. They are usually divided by one or more cross walls into two or more cells, and each cell in every spore is capable of producing a new growth of this parasitic plant.

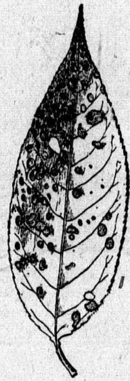

FIG. 16.

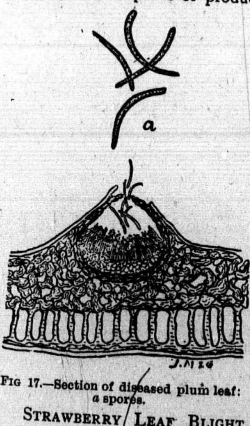

FIG 17.—Section of diseased plum leaf: *a* spores.

Fig. 17 represents a highly magnified section through the leaf, including one of the four capsules, and at *a*, above, are shown some of the spores, still more highly magnified. The parasite buries itself within the leaf tissue and, therefore, any treatment, to be successful, must be preventative. Spraying the trees with the copper carbonate compounds, or with the Bordeaux mixture, for preventing the plum or cherry rot will result, in all probability, in preventing the growth of this fungus.

STRAWBERRY LEAF BLIGHT (*Sphærella Fragariæ*).—This is another of the well known difficulties which meet the grower of small fruits in Ontario. It is commonly spoken of as the "strawberry rust," "sun scald," or "spot disease," although, according to Prof.

Dudley, the term "leaf blight" would be more applicable as a common name.

This blight first appears on the new leaves about the time of the setting fruit, and if the weather of the succeeding months is dry and hot, there will result serious injury to the vitality of the

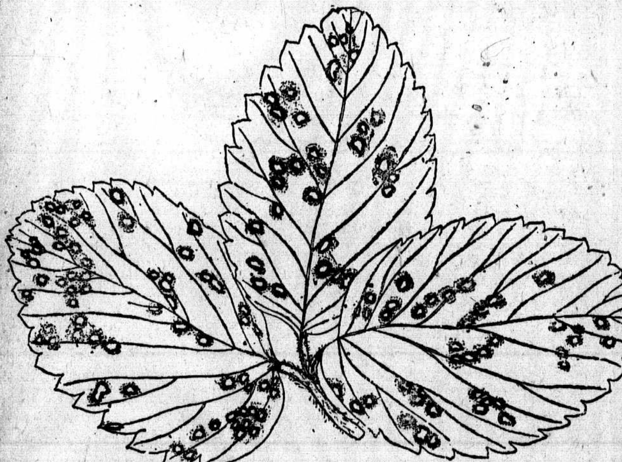

Fig. 18.

plants. You will readily recognize the common appearance of this fungus from fig. 18. The spot is at first brownish or red-purple, but when fully matured it has a circular centre dead white, from one-eighth to one-quarter of an inch in diameter. The red-purple color is the result of a growth of filaments of the vegetative portion, or mycelium, (fig. 19*a.*) of this fungus, pushing their way through between the cells of the interior of leaves, disorganizing their contents and ab-

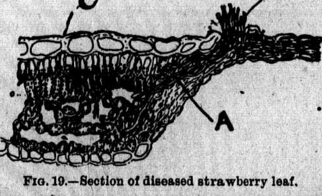

Fig. 19.—Section of diseased strawberry leaf.

sorbing their fluids. Air spaces are then formed in the centre of the spot, giving rise to the dead white appearance which results. In fig. 19 there is seen the transection of a strawberry leaf, of which the portion on the left is healthy and of the usual thickness, while that at the right shows a margin of the "spot," and this portion of the leaf is shrivelled to one-fifth its usual thickness. At *b* is seen the reproductive portion of the fungus known as conidia. The conidia-spores are oblong and very minute, and when they fall on the fresh leaf surface, where there is a moisture, soon germinate, bore their way to the epidermis *c*, and give rise to fresh spots.

In addition to this mode of propagation by conidia, which are summer spores, and short-lived, there are also winter spores grown in sacs called asci. Each ascus, or sac, contains eight ascospores, and these preserve their vitality in the dead leaves through the winter, and mature in the early spring. From this explanation it is evident that considerable benefit might be derived by strawberry growers through the plan adopted by some, of burning over the plantation in the early spring, for, in this way the fungus, to a large extent, may be destroyed.

The fungicide, recommended by Professor Scribner for spraying the strawberry bed, is three ounces of carbonate of copper dissolved in one quart of water, and then diluted with twenty gallons of water. This should be sprayed on the plantation after the crop has been gathered, and repeated once or twice before the first of September. No doubt the Bordeaux mixture would be equally effective.

Some of the varieties, as the Manchester and the Wilson, are especially liable to this disease, while other varieties, such as the Sharpless, are little troubled with it.

THE RASPBERRY ANTHRACNOSE (*Glœosporium venetum*).—This fungus is one which has thus far not prevailed to any great extent in Ontario. But from a late report of the Cornell Experiment Station, we note that it was observed in New York State last season, both on the raspberry and blackberry canes. This may yet become a serious injury to us in Ontario. An instance is given by Prof. Burrill, of a blackberry plantation in Missouri that yielded a profit of $400 one year, which was so reduced by the disease that it scarcely paid expenses the year following. The apparent injury to blackcaps in Missouri in the year 1887 from this fungus was estimated at from ten to twelve per cent. of the entire crop.

FIG. 20.—Raspberry Anthracnose.

It first appears in the form of small purple spots scattered around the lower parts of the canes. These soon rapidly increase in size and spread from the lower portion of the canes upward, giving them a scabby, pithy appearance, as shown in fig. 20. The damage done by these blotches rarely extends to the pith, but the greatest injury is done to the cambium layer, or the portion through which the sap is conveyed in the process of growth, resulting very much the same as if the cane had been girdled. As a result, the leaves do not attain more than half the normal size, and the fruit, if developed at all, does not reach its full development, but ripens prematurely, or simply dries up and is worthless. If the canes are not killed the first year, the continued action of the fungus on the leaves and branches prevents the formation of fruit the succeeding year. After the fungus has appeared upon the canes, the petioles of the leaves are attacked in the form of purplish spots near their base. Gradually the disease spreads throughout the whole framework of the leaves, showing white blister-like spots.

We omit any description of the botanical character of this fungus, but simply remark that in overcoming it, a vigorous condition of the plant is important, and any old plantations which are diseased would be better cleared out and burned. One experiment station recommends spraying early in the spring, before the growth has begun, with sulphate of iron, a pound to a gallon of water, and after the leaves appear, with the Bordeaux mixture.

For many of the illustrations used with this paper, and for much information, I am indebted to the excellent publications of the Department of Agriculture, Section of Mycology, of the United States. In this important field of study a great advance has been made during the last few years, and the results are proving to be of immense value to fruit growers and gardeners. Many of the worst problems facing the horticulturist have been satisfactorily solved, and many others will be cleared up during the coming year. The importance of a widespread dissemination of the work of these experimenters, in its relation to the prosperity of our province, can scarcely be over-estimated.

THE SPELLING REFORM.

Read before the Hamilton Association, March 24th, 1892.

BY C. R. M'CULLOUGH.

"As the instrument of all thought, the medium of all science, language is not only essential to civilization, but its basis. Deprived of a system of intercommunication the progress of mankind would be impossible."

The history of language is the history of civilization. The discovery of a method of symbolizing thought, the invention of an alphabet, the adaptation of independent types, mark the three greatest eras of human progress.

The first writing known to man was undoubtedly hieroglyphic. These hieroglyphs were simply pictures of thought, each picture being illustative of an idea. This system was therefore adapted to a period when ideas were comparatively few, or to a civilization at stand-still. With the increase of ideas came the demand for some more ready means of recording thought, and as necessity has ever been the mother of invention, the idea was conceived of transferring the symbol or picture from the thought to the sound employed in speech to represent that thought.

The Egyptian priests were acquainted with both the hieroglyphic and the alphabetic systems, and kept their secrets of caste and creed by the former on account of the greater difficulty attending its acquisition and retention in the memory. The hieroglyph lives to-day in the Chinese method of language representation, and the contrast between the intellectual standing of the people of that empire, and the rest of the world—the progress in civilization and science of Europe and America, in contrast with the stationary intellect and political status of China—is strong testimony to the relative merits of the two methods for furthering the ends of civilization and advancement.

There were defects in the Latin alphabet which were transmitted from one age and nation to another. As a result modern English in its representation is less true to the alphabetic theory on which it professes to be based than was the case hundreds of years ago, and, owing to the constant change in pronunciation, which is being followed by no corresponding alteration in the spelling, we are being rapidly carried back to the hieroglyphic type of thought representation. The matter should, then, command the profound interest of the progressionist, and challenge the attention and win the efforts of all who have at heart the advancement of the race.

English spelling is not acquired by sound—no, the teacher who should instruct his pupils to proceed on this theory of spelling words would meet with very unsatisfactory results. Learners are, on the other hand, instructed to familiarize themselves with the appearance of words, and to carry them in the eye as they would a picture, a face or a figure—in short, to take the word as a whole, just as the Egyptians of old were compelled to carry their hieroglyphs. The result of this is to render more difficult the acquisition of an elementary education, and were it not for the pluck, perseverance and pertinacity of the race, coupled with improvements in educational methods, English-speaking people would in due time realize the fact that other nations were leading them in learning and advancement.

The spelling-reformer, no less than the reformer in any other department of life and effort, is always exposed to criticism, occasionally to censure, and not infrequently to ridicule. If, however, the reformer is able to maintain his position and prove the truth of his contention, we should, I think, acknowledge the fact and shake off that inertia which is more deadly to the success of any movement than the most uncompromising opposition.

The movement for reformed spelling is not the creation of this pre-eminently creative age. As early as the thirteenth century Ormeen had raised his voice in its behalf. In the sixteenth John Hart and Sir Thomas Smith (Secretary of State under Edward VI), urged reform. These advocates of improvement in language representation were followed by Sir John Cheke, and in the seventeenth Bishop Wilkins appeared with his "Philosophical Language." In the eighteenth Dean Swift, Benjamin Franklin, James Elphinstone and others took up the cause, and during the present century we find a Webster so far convinced of the necessity for reform as to introduce into his dictionary such spellings as "labor," "center," "traveler," "worshiper," etc. So general has been the acceptance of these spellings that throughout the continent of America, and, indeed, to some extent in England, they are the received forms of the words.

When to such a list of famous men as the foregoing we are enabled to add the names of the most eminent philologists and etymologists of our own times, Muller, Sayce, Dr. Murray, Whitney, Skeat, Dr. Ellis, Sweet, March, and such noted men as Tennyson, Darwin, Spencer and Isaac Pitman, I feel that no apologies are necessary in choosing this as a fit subject on which to address the Hamilton Association.

For one hundred years previous to the Norman conquest there had been a fixed spelling in England, almost as much so as ours after four hundred years of the printing press. The author of the Ormulum (1215), prayed that in transcripts from his work respect might be had for his orthography; and the "Father of English Verse" begged that no one should alter the spelling of his little book "Troilus and Cressida." English spelling has, however, seen many changes since the time Chaucer expressed his wish, and it may be added that the changes, especially since the fifteenth century, have not all been for the better. Owing to the conservatism exercised by the press our orthography may be considered as fixed, but a little research will show that not a few changes have taken place within the past century. I have in my possession volume I. of the "Spectator," edition of 1797, in which I noted the following spellings: Aukward, ribband, teint (taint), sculked, irreconcileable, bredes (braids), bason, bull-rush, thorough-base, dropt, smoak, befal, ile (aisle), story'd, cloysters, ribbaldry, inchanted, motely, negociations, malecontents, flead (flayed), cearments, expence, choaked, alledge, corps (corpse), stopt, janty, phraise, controul, merchandize.

English spelling, however, has not kept pace with English pronunciation, which is ever on the move; and owing to the conserving influence of the press the distance between them is rapidly increasing. True it is that in a few instances changes in speech have been accompanied by changed spellings, but the fact remains that the eye is being educated at the almost total expense of the ear. Voltaire said: "Writing is the painting of the voice. The nearer it resembles it the better." The definition given by Dr. Hayward before the Liverpool Literary and Scientific Society is worth repeating: "Language is what is spoken, not what is written; writing is merely an endeavor to convey language to the eye, as speaking is an endeavor to convey it to the ear."

In the thirteenth and fourteenth centuries the English language was respelt after the Anglo-French method, becoming French rather than English in its orthography. Before the latter part of the fifteenth, spelling was practically phonetic, but the revival of classical learning in the sixteenth interfered with this principle, and many words connected with Greek and Latin were altered to conform with the spelling of those languages. At this time was born that absurdity known as "etymological" spelling; an endeavor to render the etymology of words evident to the eye and not to the ear. Spelling after this fashion was proceeding on a false principle which almost wholly ignored the scheme of alphabetic writing. It is needless to point out the many errors in the derivation of words occasioned by the attempts of the pedants of this age. Interested students are advised to refer to Skeat's "Principles of English Etymology," chapter XVI, for information on this point. The same eminent philologist directs particular attention to the phonetic character of Anglo-Saxon, and urges it as a very strong reason why a return should be made to the principle of spelling observed by our ancestors. It appears to me that if the generality of people were aware of the fact that centuries ago spelling appealed to the ear, and not to the eye only, there would not be that opposition to reformed spelling so often met with.

It has been carefully ascertained that not more than one word in a thousand is now spelt as pronounced. This is sufficient evidence to show that we have almost completely lost the central idea of alphabetic writing. It is unanimously agreed by philologists that the invention of letters was the invention of phonetic writing. The scheme of spelling by sound was followed as far as the few symbols would permit or the needs of the writer demanded. As language grew and expanded, difficulties arose which, however owing to the veneration in which the invention of the alphabet was held, were not adequately met by the addition of new letters. The trouble was in a measure overcome by employing the old symbols within certain limits, and in later times by the use of diacritics.

If we examine Sanskrit we shall find the strongest proof that the phonetic principle characterized the earliest alphabets. Changes in speech were marked by corresponding changes in the spelling, and yet it is worthy of notice that in no language can the etymological and grammatical relationship of words be more clearly shown or more easily traced than in Sanskrit.

The alphabet introduced into England was insufficient to represent the many sounds heard in Anglo-Saxon, and was constructed to represent not English but Latin. This system was, however, adopted its deficiencies being in some degree made up by employing digraphs and resorting to other expedients. Two of the runes were retained because there were no Roman letters to take their places. They were "þ," afterwards represented by "th," and "ƿ," superseded by "w," this being formed by the union of two "v" characters (vv). (This "v" had the power of "u" in "rune.")

As the language expanded, the evil became intolerable, and the awkwardness of employing one letter to represent two sounds, led to the introduction of a separate sign for the vowel sound "u," and assigning the "v" to the consonantal sound. "V," as a sign proper for the consonant as distinct from the vowel, was not established in its place until the seventeenth century, although as a spoken sound it had been in use since the conquest. Before the introduction of the written "v," the rule prevailed that "u," when doing duty as a consonant, should be used between two vowels, as in "euil," "liue." The latter of these vowels being generally an "e," it followed that words ending in the "v" sound were written with a final "e." When the "v" came in as the representative of the consonantal sound, it might have been expected that the final "e" in words that had formerly been written "haue," "giue," "serue," would be dropped, and these words written "hav," "giv," "serv," etc., but a stupid conservatism has persisted in retaining the useless terminal "e." "J" was invented during the fifteenth century, its origin being the prolongation of the "i," but did not come into general use until the seventeenth century. In the earliest printed books "i" and "y," as well as "v" and "u," were used in a very arbitrary manner. Caxton spells, "unyversal," "fyrst," "Iulyus," "Byble," "wryte," etc. In Tyndale's New Testament we find "vnto," "seruaunt," "greuously," "vnder," etc. It is to be understood that early printers could use "i," "y," and "v" when they chose, as is to be seen in "leprosie," "sayings," "whiche," "verely," etc.

"Z" is, comparatively speaking, a new-comer; and, as can be seen in King Lear, Act II, Scene 2, Shakspere had not the highest regard for it. In early translations of the Bible in Saxon times it was used in "Zaccheus" and similar words, but owing to the fact that "s" had the power of "z," there was little use for the new letter;

"s" was employed for the "zee" sound until the fifteenth century, and even to-day the province of these letters seems to be undefined. There is a large class of words spelt with "ise" and "ize" indifferently. Webster favored a more general adoption of "ize," and in this Dr. Murray, the celebrated lexicographer, agrees, though not to the extent of general change of "ise" to "ize" when so sounded. He favors the change only when derivations from Greek "z" occur.

In the addition of W, V, J and Z to the alphabet, the phonetic principle was observed, and the question may well be asked if this does not furnish a precedent for other changes, the importance of which I shall endeavor, in a subsequent part of my paper, to show.

ETYMOLOGY.—The favorite exception, practically the only exception, taken to the movement for reformed spelling is that the observance of the phonetic principle in spelling English would obscure or destroy the etymology of its words. Max Muller advises the amateur etymologist to leave the subject alone. I shall, therefore, trust to the opinions of the most celebrated etymologists of the century to prove the utter fallacy of the contention that phonetic spelling would interfere with, or conceal, the etymology of English words.

Professor Skeat, of Cambridge, says, "It is really a gross misnomer to call that spelling 'etymological' which imitates the spelling of a dead language. Every student is, or should be, aware that the only true etymological spelling is one which is phonetic. It is the sound of the spoken word which is to be accounted for, and all symbols which disguise this sound are faulty and worthless. If our old writers had not used a phonetic system we should have no true data to go by."

The same authority, in his "Principles of English Etymology," chapter XVI., says: "The subject of English spelling has to some extent been considered in Lecture VIII of Archbishop Trench's well-known and, in the main, excellent work, entitled 'English Past and Present.' But a perusal of that chapter will show that it merely discusses certain spellings from a supposed 'etymological' point of view, and does not at all attempt to deal with the only question of real importance, namely, what is the true *history* of our spelling, and how came we to spell words as we do. I make particular reference to this chapter because I believe that it has unfortunately done more harm than good, as it is altogether founded on a false principle, such as no scientific etymologist would endorse in the present state of our knowledge. This false principle is, that our spelling ought to be such as to guide the ordinary reader to the *etymology* of the word, because there is 'a multitude of persons, neither accomplished scholars on the one side, nor yet wholly without the knowledge of all languages save their own on the other; and it is of great value that these should have all helps enabling them to recognize the words they are using, whence they came, to what words in other languages they are nearly related, and what is their properest and strictest meaning.' This specious argument has imposed upon many, and will no doubt long continue to do so; but if it be at all carefully examined, it will be found to amount to no more than this, that we ought to spell words derived from Latin and Greek as nearly as possible like the Latin and Greek words from which they are borrowed; and it will be found that most of the examples of the words discussed are taken from those languages. No doubt Latin and Greek form an important element in the English language; but it may be replied that these are commonly the words which are least affected by phonetic spelling. However, the real point is this, that the most important elements are neither Latin nor Greek, but English, Scandinavian and French. The English and Scandinavian elements are carefully kept out of sight by Trench, except in a very few instances; and the French element is treated very briefly and unsatisfactorily, indeed a careful treatment of it would have told the other way. Now, if we are to spell modern English words so as to insinuate their derivation from Latin and Greek, much more ought we to spell them so as to point out their descent from native English, Scandinavian, and Old French. Yet this is a matter quite ignored by the general public, for the simple reason that they are commonly very ignorant of early English, Icelandic and Anglo-French, and so care absolutely nothing about the matter so far as these languages are concerned. Even Latin and Greek they know only by *sight*, and not by *sound*; and there are probably many worthy people who believe that the modern English pronunciation of Latin accurately reproduces the sounds used by Virgil and Horace. Yet if the argument for 'etymological' spelling is to be used at all, it must apply with far greater force to the words which form the back-bone of the language than to such as have merely been borrowed in order to augment its vocabulary."

Professor Sayce assures us that "The objection that reformed spelling would destroy the continuity of a language or conceal the etymology of its words, is raised only by ignorance and superficiality. English spelling is good for little else but to suggest false etymologies. Etymology deals with sounds, not with letters."

An ex-President of the Philological Society (Eng.), Dr. Murray, has expressed his views of the matter as follows: "My dictionary experience has shown me that the ordinary appeals to etymology against spelling reform utterly break down upon examination. Phonetic, that is to say, truthful notation is absolutely necessary to every student of language."

Another ex-President of the Society, Henry Sweet, M. A., in his 'Handbook of Phonetics,' says: "One of the commonest arguments against phonetic spelling is that it would destroy the historical and etymological value of the present system. One writer protests against it as 'a reckless wiping out of the whole history of the language,' imagining, it appears, that as soon as a phonetic alphabet has once firmly established itself, the existing nomic* literature will at once disappear by magic, together with all the older documents of the language from Alfred to Chaucer.

"As a matter of fact our present spelling is in many particulars a far from trustworthy guide to etymology, and often, indeed, entirely falsifies history. . . . . The idea, too, that because etymology is an amusing and instructive pursuit, it should therefore be dragged into practical orthography, is about as reasonable as it would be to insist on every one having Macaulay's 'History of England' permanently chained around his neck, because history is an improving study. In conclusion, it may be observed that it is mainly among the class of half-taught dabblers in philology that etymological spelling has found its supporters. All true philologists and philological bodies have uniformly denounced it as a monstrous absurdity both from a practical and a scientific point of view."

Professor Whitney, of Yale, Past President of the American Philological Society, in his "Language and the Study of Language," says: "We have already noted it as one of the distinguishing excellences of the Indo-European languages that they are so ready to forget the derivation of a term in favor of the convenience of its practical use; he, then, is ready to abnegate a hereditary advantage of his mode of speech, who, for the sake of occasional gratification

*Nomic—In the customary spelling.

to a few curious heads, would rivet forever upon millions of writers and readers of English, the burden of such an orthography. The real etymologist, the historic student of language, is wholly independent of any such paltry assistance, and would rejoice above measure to barter every 'historical' item in our spelling during the last 300 years for a strict phonetic picture of the language as spoken at that distance in the past."

There is much truth in the words of the editor of "Spelling" when he says, "One of the most persistent objections to the proposed reform of English spelling is that known as 'the etymological objection.' In so far as the phrase implies that the objection is made by etymologists, it is misleading. It is an objection made on behalf of etymology by persons who are not etymologists."

The sound of words should, I think, be quite as important a part of their history as the letters which go to make up the words. However, it would appear that etymology, in the minds of most people, looks for its perpetuation not in sounds but in dumb letters. As it is, our present spelling is frequently misleading, and one has merely to mention such falsifications as: tongue, island, foreign, sovereign, rhyme, delight, nephew, currants, wormwood, belfry, isingglass, causeway, fantastic, and leave to the curious the extension of the list, which can be made with little labor.

Let us for a moment look at the word "calculate." How many of those who use this word from day to day are aware that it is derived from the Latin "calculus," a stone or pebble? I must confess it as my belief that if this and other words were written according to the sound heard in the pronunciation, the purposes of etymology would be quite as satisfactorily served. "Kalkulāt" might look strange, but it would be true spelling.*

If the "c" of "phonetics" suggests to us the Greek "k," why should we suppose that it would be more difficult to discern in "kalkulat" the Latin "c"? After all is said and done, is not the root-meaning of the word "language" practically "tongue-action"? If language be "tongue-action," would it not be well to observe in writing a principle in full harmony with the spoken word? Is it unscientific, is it unreasonable, to make writing to the eye what speech is to the ear?

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* Even this strangeness would disappear if "c" were used consistently with the power of "k."

If we are to accept the testimony of one who has done much to promote the study of comparative grammar throughout the world, Professor Max Muller, of Oxford, the etymological structure of our language would not be obscured by phonetic spelling. He says, "The pronunciation of language changes according to fixed laws, the spelling is changed in the most arbitrary manner, so that if spelling followed the pronunciation of words it would in reality be a greater help to the critical student of language than the present uncertain and unscientific mode of writing." The same eminent scholar has also stated it as his opinion that "English spelling is a national misfortune."

Benjamin Franklin stated his views respecting reformed spelling in a communication addressed to a Miss Stephenson, in 1768. This letter is written in his own phonetic alphabet, and the intention of the writer is to meet objections to the proposed reform. It is worthy of mention that even then "the wholly mistaken objection," as Professor Sayce terms it, "that all etymologies would be lost," was put forward.

To trace etymologies with any degree of success it would, in my opinion, be of prime importance that the student should not only have a thorough knowledge of his native tongue, and of the principles of scientific philology, but be well acquainted with the other languages concerned in the research. Changes in sound, as well as changes in meaning, follow fixed laws, and he who would trace etymologies successfully must understand the operation of such laws.

"The scientific etymologist," says Max Muller, "would welcome an accurate representation of sounds by symbols; his object is to know what sounds pass into others in the course of centuries, and this he can only ascertain when the spelling represents the pronunciation."

In Dean Swift's time the "etymological" objection seems to have been advanced, else why should that prince of satirists proceed to prove that the Greek and Latin languages were derived from English? I may be permitted to repeat one of his facetious "etymologies" which may prove of some assistance at this stage of a somewhat serious subject. Swift assures us that the name of the celebrated general, Annibal, or Hannibal, arose from the fact that he was an expert in tennis playing, and could, therefore, take "any ball." Alexander the Great, we are seriously told, was very fond of eggs roasted in hot ashes. As soon as his cooks heard he was come home to dinner or supper, they called aloud to their under-servants "All eggs under the grate." This being repeated every day at noon and evening, made strangers think that the prince's name really was that heard in the command, and posterity "hath been under the same delusion," adds the Dean.

These "etymologies" are quite as probable as many of the popular "origins" so often gravely quoted by contributors to daily papers and weekly magazines, and which the average reader revels in.

In concluding this aspect of the question, to which more attention has been given than the importance of the matter demands, it may well be asked, would not a complete etymological dictionary to which interested persons might refer, much more fully and satisfactorily realize the requirements of the student in search of the derivation of words? How many of the most ardent admirers of popular etymology would risk defining the history of numerous words without first referring to some reliable work on the subject? Each word, like each individual of the human family, has its own particular history, a history which does not concern the every-day use of that word, and it is quite as reasonable to expect to know the history of every man with whom you do business as to insist on the parading of so-called indicators of derivation in words. At the same time be it understood that I do not for one moment confess that phonetic spelling would obscure such etymologies as are at present discernible in our spelling, but would rather assist true etymology. What I desire to state is that etymology is, and should be, a distinct department of study, and ought not to be dragged on all possible occasions into the practical affairs of life, and be unwillingly employed as an enemy to progress and convenience. "Philology," says the learned Dr. Murray, "has long since penetrated the mere drapery, and grappled with the study of words, not as dead marks, but as living realities, and for these living realities it first of all demands—'Write them as they are; give us facts and not fictions to handle.'"

INCONSISTENCIES.—That our present mode of spelling is unsystematic, uncertain, and exceedingly difficult of acquirement must be conceded by even its most zealous champion. What Lord Lytton has said regarding the subject might be considered as bordering on the profane However, the task of learning to spell is perhaps equaled only by the endeavor to equip others in this portion of a "primary" education. To spell in accordance with the fashion of to-day is considered an essential of education, and yet you cannot find one person in ten who would risk writing an ordinary letter to the daily press without the aid of a dictionary to assist him in determining the correct spelling of his native tongue. The dictionary has become, to the majority of people, a book to set forth not meanings, but spellings! The present alphabet to say the least is defective. "Digraphs," as Dr. A. J. Ellis, of Oxford, says, "must be looked upon as single letters quite as much as single letters themselves; for they have not the value of a combination of letters, but of one letter. Viewed in this light, the English alphabet will be found to consist, not of twenty-six letters only, but of two hundred! And almost every one of these two hundred symbols varies its meaning at times, so that after having learned one meaning for each of them, the reader has not learned all their meanings; and having learned all their meanings, he has no means of knowing which one he is to apply at any time."

Look at the combination "ea" Observe the changes in sound it undergoes in: bead, dead, breast, beast, sheath, death, beard, heard, sheaf, deaf, lead (to conduct), read (past tense), plead, lead (metal), read (present tense), head, fear, bear. It will be noticed that the substitution of an initial letter changes the sound of the combination, as is also the case when the final consonent is changed. Again: steam, steak, team, tear (to rend), beam, bear, peach, pear, ear, earl, pear, pearl, lean, leant, mean, meant. Mr. Eizak Pitman is authority for the statement that this combination ("ea") occurs in 160 monosyllables, and in a large number of polysyllables, how many he does not say. From this it will be seen that a child or foreigner, learning to read the English language, has to commit to memory the pronunciation of all these words separately, for the spelling will furnish no satisfactory clue. An old verse has it, "Consistencie's a jewell." It can hardly be claimed for our spelling that the bard had it in mind, evenly remotely. The late distinguished Professor Gregory of Edinburgh University, who will be remembered for his chemical attainments and his translations of Liebig's works, contributed the following, in which he ingeniously contrived to spell by what I might term analogy, that is, he employed a set of letters representing a certain sound in a particular word, to produce the same sound in some other word in which a different set of letters had been used to set forth the same sound. The satirist desired to show the "infignit vareyeety" which English "orthoggeratey" sanctions. It was written in 1846:

"... eiveri wone nose thaibt woen grate boossed owve Ingglyshmean yss, thaght itt eez ymnposcible far faurenors theo lirn ourr langwech. Theis, wieth owr seau-cauled aurthografi, ez, unforteanattli, noht choit troe. Buet iph migh meathoud wwer adopped aour langgwege wood bei absoughleautli ignakscessible phthoo mounsears ande aul souch stewpid peeple az calnot speek Inglisch. Theye reseaved spaeling aunserz thuis pourpus thollarabli weall, boot ite ise eavideant thabte ohn meigh plagn, phor ah fourenar phtho speal Inglich weil bey, azz ute aught phthough bi, cwite owt ouve theui ckwestiun."

Every spelling in the above can be borne out by some received orthography, and this specimen is given by me not in the spirit of ridicule, for ridicule is a sign of weak argument, but as a very pertinent method of directing those among us who have not given that attention to the question, that the importance of the matter calls for, an opportunity to consider for one moment the almost insuperable difficulties in the way of those who set out to master the spelling of our noble English tongue. Let it be borne in mind that I am not promoting a scheme to reform the English language—I have under consideration here, merely the clothing of that language—and I believe there will not be found many who will maintain that the orthographical garb of a language is *the* language. Because the Italians write "filosofo," and the English "philosopher," can it be argued that the *word*, the innermost meaning, is altered? Can the coat of the schoolmaster transform the dunce into a man of learning, or, on the other hand, can the coat of the fool alter the mental texture of the sage?

Rapp, the German philologist, in his "Philosophie der Sprache," says: "Although the French has become the common language in a diplomatic and social sense, it has never acquired a firm footing in extensive regions out of Europe, and by its bold fusion, with the consequent decomposition, of the forms of its Gothic and Roman elements this idiom [English] has acquired incomparable fluency, and appears especially destined by nature more than any one of the other living languages to undertake that part. Were not the impediment of a bizarre, antiquated orthography in the way, the universality of this language would be still more apparent; it may, perhaps, be fortunate for us other Europeans that the Englishman has not made the discovery." Those who are busying themselves about the establishment of a "world language" would do well to bear in mind the kind suggestion of our German friend, and join hands with those who desire to place English in such a position as will most rapidly secure that great end. At the Columbian Exhibition next year it is expected that an international convention will be held to discuss ways and means of improving English spelling. May success attend their laudable efforts to bring to a happy conclusion a reform that would confer upon theworld at large incalculable blessings!

The past fifty years have done much to spread a knowledge of the aims and objects of the spelling reform throughout the English-speaking world, for which the venerable inventor of Phonography, Mr. Eizak Pitman, of Bath, England, deserves in no small measure the thanks of those who desire to bring to a successful issue so greatly needed a reform. Through the medium of phonetic shorthand hundreds of thousands of people throughout the world have been taught in a very practical and forcible manner the benefits attaching to the substitution of the phonetic for the ordinary or nomic method of spelling. In 1891 the number of primary shorthand books, in one system alone, had reached the enormous edition of 1,600,000 copies, and when captious critics ask what progress the movement is making, the answer is that spelling reform is no longer a possibility, no longer a probability, but a certainty. Phonography has been and is being introduced into hundreds of schools and colleges, where a few years ago it was unknown. This, taken in conjuncion with the fact that the "phonic" method, now being persued in our primary schools, is meeting with great success, is educating public opinion to that point when the demand will come in no uncertain tone for a more simple and scientific system of orthography for general purposes. "Within half a century, too, philology has become a definite science, with definite aims," and, although among the vast majority of people it is no more than an occult science, yet the application of one of its truths in modern shorthand is bringing to the notice of a rapidly extending constituency of persons the reasonableness of a system of language representation based on phonetics.

The Phonetic Society of Great Britain, with a membership of over five thousand persons, is doing much to promote spelling reform. A large number of those composing the association are familiar with shorthand, to whom the question has presented itself, 'Why should not a system of spelling by sound, which has been employed so successfully in stenography for fifty years, apply in a like manner to our longhand? Why should not science on the one hand meet practice on the other?'

An alphabet to answer all practical purposes should consist of thirty-six letters, representing as many vowels and consonants, which might, if desired, be extended to forty, to include four diphthongs. "Every single sound should be represented by a distinct and unvarying sign, and no sound should be represented by more than one sign. Changes in speech should be followed by changes in spelling" Pronunciation changes according to fixed laws and to prevent spelling becoming archaic, as at present, where we spell in the fashion of Elizabeth but speak in the fashion of Victoria, it would be necessary to follow such changes.

If we are to accept the advice of Herbert Spencer, given no later than November of last year, a complete phonetic system is the only desirable one to introduce, as a partially phonetic or consistent method of spelling would stand in the way of a complete phonetic system. Spelling reformers are, however, constrained to make the transition from the present mode to that advised by the eminent Englishman, by steps. Without doubt the full recognition of distinct signs for all the elementary sounds of our language meets with the hearty approval of all phoneticians, but if this were insisted upon, doubtless there would be a longer postponement of the consummation of their hopes than some persons continue to believe even under the present condition of affairs.

A general adoption of the following rules would simplify English spelling to such an extent that a further step in the right direction would, in the time to come, be comparatively easy to take. To posterity we may, however, leave that matter. What the members of the Phonetic Society are laboring for to-day is the following:—

"FIVE RULES FOR IMPROVING SPELLING, AS A FIRST STEP TOWARDS A SPELLING REFORM.

"RULE 1.—The letters *c*, *q*, *x* are rejected as useless, and every other consonant is confined to the representation of one sound, as every figure represents one number.

"RULE 2.—*A*, *e*, *i*, *o*, *u*, represent the short vowels in *pat*, *pet*, *pit*, *pot*, *put*; and *u* represents, in addition, the vowel in *but*, *double*. The diphthongs in *bind*, *boy*, *bound*, *beauty*, are written by *ei*, *oi*, *ou*, *iu*; and the open diphthong in *naïve*, *Kaiser*, by *ai*. (*I*, in preference to *ei*, is allowed to represent the first personal pronoun.)

"RULE 3.—*Th* represents the two sounds in *breath*, *breathe*, (called, as single letters, *ith*, *thee*,) and the recognized digraphs *ch*, *sh*, *ng*, (called as single letters, *chay*, *ish*, *ing*,) represent the sounds heard in *much*, *wish*, *sing*. *Zh* (*zhee*) is introduced for the voiced *ish* in *vision* (vizhon).

"RULE 4.—In monosyllables, and sometimes in polysyllables, *n* represents *ng* before *k* and *g*, as *think* (thingk), *anger* (ang-ger).

"RULE 5.—The spelling of the LONG vowels is not altered, except in cases of gross irregularity, such as *beau* (bo), *cocoa* (koko), *receive* (reseev), *believe* (beleev), *people* (pepel), *gaol* (jail), because any system of digraphs that might be adopted to represent the long vowels would prejudice the reform. Every letter of the old alphabet is used UNIFORMLY, ONLY for the representation of consonants, short vowels, and diphthongs.

"No chanje iz at present propozed in the speling ov proper namez, or in the teitelz ov buks. This department ov orthografi, ov reit, belongz tu the ownerz ov the namez, the inhabitants ov the plasez, and the reiterz ov the buks."

The change from the present spelling to that recommended in the above would not prevent anyone accustomed to the ordinary printed page from reading the new at once with comparatively little difficulty, and a few weeks would prove ample time in which to write with fair freedom.

It will be seen that the spelling of long vowels is not affected, except is cases of great irregularity. To do this successfully it would be necessary to add new characters to the alphabet, and this is outside the scope of the "first stage."

If the question were asked, "Why is the letter 'e' written at the end of the words 'bone,' 'stone,' etc.?" I have no doubt the answer would be "To indicate the vowel length of 'o.'" We certainly have come to believe this, but it will be well to remember that the 'e' in this class of words was at one time a distinct syllable, thus making 'bone' a dissyllable. Such a device, says Professor Skeat, "would never have been consciously invented by any sane being. It is the greatest stumbling-block to reformed spelling."

Is it to be deemed a thing incredible that the Anglo-Saxon race should amend its present unscientific and cumbrous orthography? Is it not very unwise, to obstruct the avenue to education with an obstacle such as the present spelling? What stands in the way of reform—sentiment? Sentiment may constrain some to oppose the movement for reform. We respect sentiment—sentiment has been the lever of great actions in other days, and will be in the time to come; however, sentiment has her confines and should not trespass on the ground of education, progress and refinement. Sentiment may induce the artist to choose as the subject for his picture a stage-coach rather than a railway carriage; a sailing-vessel rather than a modern steamship; wild, rocky scenery rather than a well-tilled farm—but then the majority of us are not picture painters, nor, for that matter, word painters. I may hazard the opinion, too, that the artistic sentiment of the painter would not enter into the question if speed, comfort and convenience were under consideration. I think, however, that sentiment can be satisfied if hoary age will at all do so. Our ancestors in the centuries gone by spelt according to sound, and spelling-reformers, recognizing the wisdom of such a principle, desire to return to that laudable method, nothing more.

Other great nations of the world have reformed their spelling. French is fairly consistent, which ours is not. German is practically phonetic, Spanish is readable at once to anyone understanding the sound values of the letters of the alphabet, and Dutch, Italian, and other languages have also been successfully phoneticised. Are we less able than they to perform that work? Cannot the scholarship be found in English-speaking lands to accomplish this end? I say yes, emphatically yes; and it is to be borne in mind that all scholars eminent in the field of philology in England and America have declared in favor of a change. If the English tongue is to become the universal language of the future it must shake off, as Rapp has pointed out, that orthographic impediment, of which the Rt. Hon. W. E. Gladstone says: "I often think that if I had to set about learning to pronounce English I should go mad. I honestly can say that I cannot conceive how it is that foreigners learn to pronounce English, when we recollect the total absence of all rule, method, system, and all the auxiliaries which people generally get when they have to acquire something that is difficult of attainment. . . . . . I am afraid our language bothers the foreigners dreadfully."

Observation is the key to English spelling. Each word has to be stamped on the memory separately, and when one pauses to consider the large number of words in our language, the task of associating the correct letters in the formation of words seems almost impossible. If we bear in mind the many ways in which the same sound is indicated, and if we were to follow this method in connection with the study of arithmetic what degree of proficiency would be reached by children in our public and higher schools? Imagine the effect, if a child were taught that 1234 stood, and properly so, for one thousand two hundred and thirty-four, and that the combination 1243 represented the number two thousand one hundred and thirty-four, not one thousand two hundred and forty-three; the value of the numerals differing in various combinations! If this ridiculous and inconsistent method prevailed, how long should we tolerate it? Again—What would be thought if to the difficulties already experienced in learning the game of chess this were added, that under certain conditions moves and the values of the pieces must sometimes be altered, and useless pieces permitted to remain on the board? What degree of perfection would be attained if in music flats were to be read for sharps and *vice versa*, the whole matter being subject to no rule but dependent upon the performer's judgment? Some, doubtless, would see value in such a course of instruction, as a means of developing patience, but the majority would not. Our present mode of spelling is not less inconsistent, not less unscientific, not less trying to the young student, than would be the case were an analagous method employed in arithmetic, chess, and music.

If the progress of a people is dependent upon its facility of mental intercommunication, and it must be admitted that language is its means of mental intercommunication, it follows that language should be easily understood, acquired and used. All irregularities, anomalies and inconsistencies should be eradicated as completely as possible. This would appear especially true in the case of the English tongue, which, like the Anglo-Saxon race, is destined to extend its dominion to every quarter of the globe. In my opinion the greatest obstacle in the way of the universality of the language we speak is its cumbrous and archaic orthography. Despite this the language is rapidly gaining ground, but who is competent to forecast that degree of increased impetus which a phonetic system of spelling would give the conquering Saxon tongue?

The six great nations of the world had, at the beginning of 1890, the following number of followers: Portuguese, fifteen millions; Italian, twenty-nine millions; French, fifty millions; Spanish, forty-five millions; German, sixty-eight millions; and English was spoken by at least fifty millions of the subjects of Victoria, and by an equal number of citizens of the United States. In ten years Portugese rose from fourteen to fifteen millions; Italian, from twenty-eight to twenty-nine; French, from forty-one to fifty; Spanish, from forty-four to forty five; German, fifty-six to sixty-eight; while English rose from eighty to one hundred millions. The question occurs to my mind—of the three hundred and four millions of souls composing the British Empire, how many of these, their children, and their children's children will speak the language of England? Further, sum up the time lost by each unit, composing this enormous national mass, in tracing useless alphabetic characters, calculate the additional time and labor which our present orthographic system demands and which all experience, then multiply this by the millions employing it, and we shall realize how important the question of reform is; we shall see a total loss of millions of years of that most precious of all things—Time.

Reprinting.—It has been urged by some that reformed spelling would render existing books useless, or nearly so. The contention is, however, groundless, for the simple reason that the desired reform would not effect so great a change in the appearance of the words as is generally supposed. In hundreds of words the change would amount to no more than a slight transposition of letters, in others the omission of superfluous characters. The difficulty in reading old works arises from the presence of obsolete words and allusions, and but slightly from the difference in the spelling. The "suttle theef" of Milton causes us no trouble; "Pittyful weak hammes, gowty legges," in Shakspere's first edition of "Hamlet," does not hide the meaning of the words from us, and, in like manner, reformed spelling would prove a far from difficult task to those accustomed to the prevailing spelling.

STRANGENESS.—The strangeness in appearance of the new spelling is another objection. This, however, is not a very valid one. Were we to write "smoak," doubtless the recipient of our communication would be somewhat surprised, and yet the word was written that way not so many years ago. "Ouisconsin" was the spelling of Wisconsin as late as the first quarter of this century, as can be seen in a book, entitled "A Winter in the West," published in New York in 1834. We might indefinitely extend the list, but few will desire proof in a matter of this kind.

PRONUNCIATION.—Regarding the claim that confusion would arise if reformed spelling were introduced, on account of the present differences in pronunciation, it may be said that there is a received pronunciation which is neither local nor provincial. This pronunciation would be adopted by the majority of people had they the means of acquiring it, and no better means could be found than through the employment of a phonetic system of spelling. I do not claim for the reform that pronunciation would be minutely indicated, that is out of the question in an alphabet for practical purposes, but approximately. It is very doubtful whether the finer shades of pronunciation heard by the trained ear can ever be presented to the eye by means of an alphabet. The phonograph offers the critical student of phonetics means for experiment in this direction, but the generality of people have no great concern in the matter. However, if perfection cannot be obtained in indicating the exact pronunciation of words through a practical phonetic alphabet, it is certain the substitution of an improved method of representing our language would wonderfully improve the pronunciation of the English tongue, and tend to produce a uniformity which does not at present exist. The observant teacher cannot but have noted the marked improvement in the pronunciation of words by the student of phonetic shorthand, and it will be granted by my hearers that the principle ought to apply in a like manner in the case of phonetic longhand. Pronunciation is now learned from hearing the words spoken by others who are supposed to be competent to govern in such matters. The learner is compelled to remember each word separately, and the extension of the list is a matter of no small difficulty. Give each its independent and unvarying sign, and pronunciation would be made evident to the eye, and it must be remembered that the eye is a more reliable servant than the breath.

Such a diversity of pronunciation exists throughout the English-speaking world that one can with difficulty understand the words addressed to the ear by people of various sections of the Empire. English spelling, which does not correspond with received pronunciation, is doing much to perpetuate this condition of affairs, and the crying need is for a more perfect method of language representation which shall enable these people to acquire a better and more uniform enunciation of their common tongue. Make pronunciation evident to the eye and changes would in a large measure be checked.

An ingenious Frenchman, Addison tells us, placed on record the intelligence that the ladies of the court of France, in his time, thought it a sign of ill-breeding, and a sort of female pedantry, to pronounce difficult words correctly. Hard words were, therefore, frequently chosen so as to afford the fair ones an opportunity of exhibiting their politeness and good breeding. A lady of note having by accident employed a hard word in the right place and pronounced it properly, the whole assembly was shocked at her breach of etiquette. There are among us some who would welcome such a convenient fashion as this, seeing that the danger under the present state of affairs is not that we shall pronounce words correctly, but rather incorrectly, and that many in high places do pronounce certain words outrageously is evidence of the difficulties surrounding the acquirement of a good enunciation under prevailing conditions.

ECONOMY.—A phonetic system of spelling would reduce the cost and labor of printing and writing by twenty-two per cent. It would enable a child to obtain an elementary education in two years' less time than under the prevailing system. This fact is vouched for by Dr. Gladstone, of the city of London (Eng.) School Board. A book printed in the present spelling and retailing at one dollar would, if phonetic spelling were adopted, sell at eighty cents. The adoption of the "Five Rules," would not of course confer the full benefit of the complete phonetic system, but would be so great a step in advance that people would be convinced in a most practical manner of the necessity and wisdom of proceeding to the ultimate stage of representing each elementary sound of the language by a distinct and unvarying sign.

The great Forth Bridge, constructed at the enormous outlay of two million pounds, sterling, was built to expedite the journey from Edinburgh northward. The St. Clair tunnel, planned by a gentleman of whom Hamiltonians are justly proud, cost many thousands of dollars (how many I am not able to state). This tunnel was built to facilitate communication between Ontario and Michigan—and yet there stands, and has stood for several centuries, an obstacle, in comparison with which the difficulties experienced previous to the completion of these wonderful engineering feats, were as nothing. This stumbling-block hampers a school child in his battle for knowledge, delays our youth entering higher schools of learning by some two years, forces us to expend over twenty per cent. of time and money more than is really necessary, is a source of no small difficulty to ourselves, and of infinitely more to the foreigner who desires to learn the English language. Unlike those barriers to rapid travelling, which were natural, this is purely artificial, and could be removed at a cost which would fall into comparative insignificance when compared with the outlay of treasure in the Forth and St. Clair enterprises. This barrier to education, progress, and refinement, this enemy of economy of time and money, is our illogical and inconsistent method of spelling.

To reform our spelling, to reform all evils, to spread a knowledge of truth in all its departments, is the spirit of the age which the poet echoes, when he sings :—

"Let knowledge grow from more to more."

The English language is a noble language, rich in perspicuity, exactness and euphony, and were it not retarded by an archaic and clumsy orthography would speedily take the place for which it is pre-eminently fitted. What are we doing to place this wonderful Saxon tongue, enriched by grafts from all languages of the world, in a position to assert her right to universal sovereignty? Why is it so many prefer hobbling along with a defective alphabet and a far more defective orthography? Why so much inertia in a matter of such far-reaching importance?

In conclusion I cannot refrain from adverting to Richard

Steele's contribution to the "Tatler," June, 1710. The subject is a noble one—"On the Love of Country as a Principle of Action." One sentence struck me as being peculiarly applicable to the question under consideration this evening. The words were "But however general custom may hurry us away in the stream of common error, there is no evil, no crime, so great as that of being cold in matters relating to the common good." It may be claimed that I am usurping too high a place for my subject. I cannot believe so. Knowledge is power, and anything that stands in the way of the acquirement and diffusion of knowledge is a national misfortune, nay 'national' is too narrow a term in this age of the world. When primary education is receiving a larger share of public attention than ever before, this question of our spelling must assume greater prominence. When it is of the greatest importance to educate the mind, it is positively cruel, and none the less cruel because sentimental, to force the child to spend its energies upon the mechanics of language, to compel the mind to digest the dictionary to learn the spelling, the drapery, of words. When the mind is being introduced into the realm of education it is cruel to present to the little student, in language representation, chaos instead of exactitude and order. No wonder that the little minds are frequently perplexed over the inconsistencies and anomalies of spelling; no wonder that the child feels so much difficulty in expressing his thoughts just so soon as a pen is placed in his hand. Is it not easily seen that the mind distracted from the idea sought to be expressed and occupied by the superficialities of words, their ever-changing garb, can have but a moderate degree of success? Why should the mind be obstructed by such a demoralizing obstacle? Ought not some means to be provided whereby the hand might keep company with the mind?

How is a reform to be brought about? By a vigorous presentation of facts in the matter to the people at large, and the education of public opinion to that point which will ensure the success of the movement. Philologists are unanimous in their demand for a better mode of writing and printing words; that mode, they say, must be phonetic, or practically so. Each individual must do his share of missionary effort in behalf of the reform, and last but not least, the press, which is responsible in a large measure for our present stereotyped spelling, must lend its powerful aid.

NOTES ON THE GENUS RHUS.

Read before the Hamilton Association, March 24th, 1892.

BY T. J. W. BURGESS, M. B., F. R. S. C.

The paper that I have prepared for your consideration deals with a class of plants, which, whether considered with reference to their beneficent or toxic effects on the human race, should be much more familiar to the general public than they now are,—I refer to the various species of Rhus.

The most noteworthy example of this genus in our own country, and the one to which the greater part of my remarks will apply, is commonly called Poison-Ivy. When we consider how common this plant is, and the number of persons liable to exposure to its noxious influence—the laborer engaged in railway work and in clearing bush land, the farmer working about his fences, one of its favorite habitations, and the child so often employed in berry-picking or in gathering the wild flowers with which our woods and meadows abound—I cannot impress on you too strongly the necessity for a thorough knowledge of the various species, their appearance and that of the plants with which they are most likely to be confounded, their poisonous effects and the prevention and cure of these. Some of the varieties being used for domestic purposes, others as medicines, I will also call your attention to their uses in the arts and sciences.

The only representative of the large order, *Anacardiaceæ*, the Cashew family, in northern North America, is this genus Rhus, a name derived from the Greek verb *reo*, "to flow," so called because it was thought to be useful in stopping hemorrhages. Truth to tell, the name was not inaptly applied by our forefathers, all the varieties being possessed of more or less astringent properties, some of them in a very marked degree. The genus, to the non-botanical commonly known as Sumach or Shumach, is composed of trees or shrubs having a resinous or milky acrid juice; alternate leaves; small, regular, greenish-white or yellowish flowers; and a fruit forming a sort of dry drupe.

Not less than fourteen varieties of Rhus are or have been used in the arts and sciences (the term including medicine), and these I shall, for convenience of description, divide into two classes, native and foreign, dismissing the latter with but a brief mention of their uses.

Of the foreign species there are six.

Rhus Cotinus, sometimes cultivated in our gardens for ornament, under the names "smoke-plant," "purple fringe-tree," and, from the curious appearance of its seed-vessels, which look like a powdered wig, "periwig-tree," is known in commerce as Venice sumach. It is a small tree with purplish-green flowers, supported on hairy peduncles, and is a native of Siberia, Austria and Northern Italy. It is not used in pharmacy, but yields one variety of a wood known in trade as *fustic*, which has been largely employed for producing a yellow dye. A noticeable pecularity about this species of Rhus is that its leaves are simple, like those of the elm and maple, not compound like those of the horse-chestnut and ash, as is the case with the rest of the genus.

Rhus Coriaria.—Of this both the leaves and the berries have been used as astringents and tonics, and the ground twigs as a dye-stuff. It is a native of the Ukraine, in Russia, and has been regarded by the inhabitants, when combined with a decoction of Genista Tinctoria leaves, as a preventive of hydrophobia. It is employed both internally and locally, and the peasantry have great faith it its curative powers, but extended trials in other parts of Europe have shown it to be useless in this much dreaded affection.

Rhus Succedanea is indigenous in Japan. From its berries is expressed a wax sometimes used in pharmacy known as Japan wax. It is of medium quality, ranking between beeswax and the ordinary vegetable tallows.

Rhus Vernicifera, varnish or Japan sumach, inhabits India and Japan, where it is highly prized for its yielding, from incisions made in the stem, a gum from which is made one of the best of varnishes.

Rhus Metopium is found in the West Indies, chiefly Jamaica, and is said to be one of the sources of "hog-gum," extensively used by book-binders in the process of marbling paper. This peculiar, and certainly not euphonious, name is derived from the fact that hogs, when wounded, are reputed to rub themselves against this tree so as to cover the wound with its juice and form a protection against the irritation of insects.

Rhus Semi-alata, a native of China and Japan, yields a gall largely used, especially by the Chinese, in dyeing their famous yellow silks. It is also highly esteemed by them as an astringent medicine.

Of the native species of Rhus I shall speak of eight, and, not to afflict you with their scientific distinctions, I will classify them as poisonous and non-poisonous, confining my botanical descriptions chiefly to the poisonous class, it being most important, to be able clearly to distinguish these from certain non-poisonous plants resembling them. The eight species are equally divided, four being innocent and four highly noxious. And first let me call attention to the non-poisonous varieties, meaning by this non-poisonous by contact with the plant, for, if given internally in large doses, even the innoxious ones act as irritants.

Rhus Aromatica, fragrant sumach—is a straggling bush with tri-foliate, hairy leaves. The pale-yellow flowers, in clustered spikes like catkins, precede the leaves, which are sweet-scented when crushed. It extends from Lake Superior westward and southward, in dry, rocky soil, a variety, the *Rhus Trilobata* of Nuttall, chiefly affecting the Rocky Mountains and Sierra Nevadas. This plant, a few years ago, had a high reputation among some authorities as an astringent in enuresis, the diarrhoea of children, and the night sweats of consumption, but it has now fallen into disuse to a very great extent.

Rhus Glabra, variously known as sleek, smooth, Pennsylvania and upland sumach is found over the greater part of North America, south of the Arctic Circle. It is a short two to twelve feet high, with straggling branches, covered with smooth, light gray or somewhat reddish bark. The compound leaves, consisting of eleven to thirty-one leaflets, whitened beneath, in autumn change to a beautiful red. Growing along fences, borders of woods, and in rocky fields, its flowers open about July, and the fruit, often eaten by the country people, ripens in early fall. Excrescences produced on the under side of the leaves have been used as a substitute for the officinal galls obtained from the oak, *Quercus Infectoria*. Like galls, these excrescences are due to puncture of the young shoots by a hymenopterous insect to deposit its eggs. This irritates the part and a tumor arises, the result of morbid growth. The eggs enlarge with this growth and are converted into larvae, which feed on the vegetable matter. Finally the larvae become flies and escape by eating their way out. For use, these excrescences should be collected when of full size, just before the eggs are hatched. All parts of this plant contain a large amount of gallo-tannic acid, and the bark is often used in tanning. The berries have a sour, astringent taste and owe their acidity to malic acid, which, however, according to Mr. Cossens, is not contained in the berries themselves but in the pubescence which covers them. An infusion of the fruit has been used as a refrigerant drink in fevers and as an astringent gargle in ulcerated sore throat.

Rhus Copallina, dwarf sumach, mountain sumach, or the Gum Copal tree, is a shrub with running roots, one to seven feet high, inhabiting rocky hills. The only known station for it in Canada is the Thousand Islands. Its branches are downy, and the petioles between the leaflets are wing-margined. Gum Copal so largely used in making varnishes, is the product of a number of different trees, one of which, according to some authorities, is the Rhus Copallina. The plant possesses similar, but less strongly marked, medicinal properties to Rhus Glabra, already described, and may be used as a substitute therefor.

Rhus Typhina, staghorn sumach, grows very commonly throughout Canada, from Nova Scotia to Lake Superior, along railway tracks and on sterile hillsides. It forms a tree ten to thirty feet high, with orange colored wood. The branches and stalks are densely velvety-hairy, with serrate leaflets pale beneath. This, the the fourth and last of the innoxious species to be described, also possesses properties similar to Rhus Glabra, and may be substituted when that plant cannot be got.

Of the four indigenous species which have poisonous properties, one is an inhabitant of the Southern States, and a second of California, while the third and fourth are common in all parts of North America between the 35th and 60th parallels. Since their poisonous, and probably their therapeutic, effects are similar, I will first give a short description of each species and devote the remainder of my remarks to the physiological and therapeutic actions of Rhus Toxicodendron, the common form of poison ivy in Canada.

Rhus Pumilum, growing only in the Southern States, and very common in North Carolina, is a pubescent shrub, about a foot high, said to be the most poisonous of the eastern varieties. The pinnate leaves, consisting of about eleven oblong, coarsely-toothed leaflets, are downy beneath. The three upper leaflets are often confluent, the terminal one, when distinct, being alternate at the base. The flower panicles are nearly sessile, with the drupes are covered with a red, silky pubescence.

Rhus Diversiloba of Torrey and Gray, or Rhus Lobata of Hooker, approaches very nearly to Rhus Toxicodendron. It is generally a shrub, but sometimes a climber, and is said to be the most poisonous of all the Rhuses. It is chiefly a native of California where it is known by the Spanish name of "Hiedra," but is said by Douglas to occur on the north-west coast. Its leaves consist of three, rarely five, obtuse lobed leaflets; its flower panicles are shorter than the petioles; and its fruit is white and pubescent. With her usual generosity, nature, according to Dr. Canfield, provides an antidote to poisoning by this species in the shape of another Californian plant, the *Grindelia hirsutula*, of which either the bruised plant itself, or a decoction, is applied to the parts.

Rhus Venenata, formerly called *Rhus Vernix*, is known by the different names of poison dogwood, poison elder, poison ash, poison sumach, swamp sumach, white sumach, and varnish tree. Affecting rich, swampy ground, in shaded situations, it is a shrub or small tree usually growing from six to eighteen feet high, and is one of the largest of our native species of Rhus. The trunk seldom exceeds three inches in diameter, and, branching at a height of three to five feet, usually makes a repeatedly two-forked ramification, the final twigs terminating in thick clusters of leaves. The smooth bark is dark gray on the trunk, lighter on the branches, and reddish on the twigs and petioles. The leaves, expanding in May, are at first dark yellow in color, but become deep green with a paler under surface when mature, and finally, at the first touch of frost, assume a beautiful deep crimson hue that can fairly vie with the maple for brilliancy of effect. The seven to thirteen leaflets forming the compound leaves are obovate-oblong in shape and entire. The small yellowish flowers are arranged in loose and slender axillary panicles, forming large masses of fragrant bloom at the ends of the branches, which attract innumerable swarms of bees. Whether the honey derived from this source possesses any poisonous properties I am unable to say, but, as at various times there have been reports of poisoning by honey in particular localities, it would be a point well worthy of investigation whether this form of poison-ivy does not also abound there. The berries, ripe in October, are whitish or dun-colored, with striate stones, and look somewhat like bunches of small grapes —a similarity, however, which need give rise to no error, as a glance at the leaves shows them to be *compound*, whereas in the grape they are *simple*. Taken altogether, this Rhus is one of the handsomest shrubs imaginable when in bloom, but is unfortunately one of the most dangerous. Rhus Venenata has been thought to be identical with the *Rhus Vernicifera* of Japan, and when incisions are made into its bark there is a copious flow of viscid fluid, yellowish at first, but soon changing to a deep black, which, when boiled, makes a fine varnish. The poisonous properties of this tree are said to be more powerful than those of Rhus Toxicodendron, persons exposed to its influence being more apt to suffer, and more severely. I have known several cases of poisoning due to this plant being mistaken for the common elder, an error which could never arise were the fact borne in mind that both varieties of elder, found in this country, have the margins of the leaves toothed, whereas in Rhus Venenata they are entire. In addition, the elders have dense masses of flowers, and a fruit which, when ripe, is either red or black, while the form of poison-ivy has slender, scattered bunches of flowers, and a fruit whitish in color when mature. Rhus Venenata is not very common in Canada, but is occasionally found in the western part of Ontario. The recorded localities are Weston, Port Colborne, Niagara Falls, Hatchley and London, Ont.

Rhus Toxicodendron may be made to include *Rhus radicans*, as botanists are now pretty well agreed that it is but a variety of the former, its differing form and characters, viz., more entire leaflets and high climbing stem, being dependent on the circumstances of its *habitat*. Rhus Toxicodendron was first described in 1635 by Cornutus in his work on Canadian plants, as a species of ivy. The Indians were well aware of its properties, and its effects were mentioned by Kalur and other travellers in North America. Poison oak, poison ivy, poison vine, poison creeper, and sometimes poison mercury, are names applied to it. It is very common throughout Canada from Nova Scotia to the Saskatchewan at Fort Edmonton, and is also recorded as occurring in woods near Yale, British Columbia. It is commonest in fertile and low grounds, but will thrive in barren and elevated places, and attaches itself to any bodies in its vicinity by numerous thread-like rootlets given off from the stem. Sometimes it climbs spirally to the tops of our tallest trees, attaining a height of forty or fifty feet, again it is met with along the sides of fences which serve as a convenient support, or crawling over bush or rocks, along the ground, in which cases it never exceeds from one to three feet in height. This low form sends off many small branches, the pendulous extremities of which often give the plant a bushy appearance. The stems are from a quarter of an inch to two inches in thickness, and covered with a grayish-brown bark. The leaves, which are said to be eaten by cattle with impunity, are trifoliate; the leaflets being rhombic-ovate, pointed, pubescent beneath, and variously notched, of a shining red when they first appear in spring, but bright green at maturity. The flowers are small, greenish-white in color, and disposed in simple axillary racemes. The fruit is a round, dry berry, about as large as a pea, of a pale green color, and ripe in October. As in Rhus_Venenata, from the bark when wounded exudes an acrid, milky juice, which exposed to the air for a few hours changes to an intense black, which will leave indelible stains on linen or cotton, not effaceable by any known chemical, and which has been used as a marking ink. The researches of Professor Maisch have proved that the acridity of the juice of Rhus Toxicodendron is due to the presence of a hitherto unknown volatile acid, analagous to, but distinct from, formic and acetic. Toxicodendric acid, when isolated, is found to affect the skin, either by direct contact or by its vapour, exactly as the fresh plant itself does, proving beyond doubt that the poisonous properties of the plant are due to it. This principle is in a great measure dissipated in the process of drying, and hence dried preparations of the plant are much less apt to act noxiously, though even these should be handled with great care by such as are susceptible to poisoning by it. The plants for which Rhus Toxicodendron is most often mistaken are the Virginia Creeper or American Ivy (*Ampelopsis quinquefolia*) with which the climbing variety often entwines itself, and the *aralias nudicaulis* and *quinquefolia*, commonly known as Wild Sarsaparilla and Ginseng, often found growing with the low form. These plants are very easily distinguished if one will take the trouble to remember a single simple distinctive mark, viz., that they have *five* leaflets on a single leaf-stalk, whereas the poison ivy has only *three*. Other distinguishing marks are that the aralias have regularly serrate leaves and in nudicaulis the flower-stem is separate from the leaf-bearing one.

The toxical effects of the poisonous species of Rhus are produced in various ways and degrees of severity, but in all cases they are due to absorption by the system of toxicodendric acid. They may be the result of direct contact with any part of the plant or its juice; of exposure to smoke from the burning of it; of inhaling the steam arising when making pharmaceutical preparations of it; of internal use; and of emanations from the growing plant. The most specially noteworthy of these methods of poisoning is that by exhalations from the living plant itself. According to Cazin, such exhalations are only given off when the plant is not exposed to the sun's rays (as when it grows in the shade and at night) and consist of hydrocarburetted gas mixed with toxicodendric acid in a volatile state. That they will cause poisoning in those exposed to their influence, without actual contact with the plant, and even at considerable distances, is doubted by many scientists, but there is considerable weight of evidence pointing that such is really the case. Wyville Thompson, of the late *Challenge* exploring expedition, states that among the blacks of the West Indies there is a *superstition* that some species of Rhus will poison without actual contact. Aboriginal traditions are rarely found to exist without some foundation, and in this case so strong a one that it should have prevented the report being called a superstition without fuller investigation. I could cite a number of instances of poisoning, both recorded and coming under my own notice, where all the evidence goes to show that there was no possibiliiy of contact with the plant. "A lady of known susceptibility was attacked after being out driving, though she had never left the vehicle, which kept the centre of the road. Here the nearest distance of possible exposure would be that of plants growing, where they were afterwards discovered, along the fence, a distance of over twenty feet." Again, a medical friend of my own experienced a severe attack after passing, at a distance of at least three feet, a thicket in which grew a mass of the plant; while a gentleman so noted in the scientific world as to vouch for the accuracy of his powers of observation, while engaged in geological researches, found to his cost the effect of passing some, though he had previously noted it, and was hence most scrupulous not to let it touch him. It seems to me, too, that the knowledge of this method of poisoning by Rhus is peculiarly interesting as offering a plausible solution of what are generally regarded as fabulous stories of the deadly effects of the upas tree of Java, under which the wearied traveller laying himself down sinks into that sleep which knows no waking. Is it not at least within the bounds of possibility there may be a Javanese tree possessing similar, perhaps stronger, noxious properties to Rhus Toxicodendron, and thus capable of poisoning its surrounding atmosphere?

The poisonous effects of Rhus are both local and constitutional, according to the idiosyncrasy of persons; acting upon some only locally, upon others only constitutionally, and upon yet another, and the most frequently met class, in both these ways. A certain constitutional predisposition is requisite for the occurrence of poisonous symptoms, many individuals being quite insusceptible. I myself am a case in point, having often rubbed both Rhus Venenata and Rhus Toxicodendron, as well as their juices, over my hands and face without suffering the slightest inconvenience therefrom. To illustrate the peculiar virulence of this plant toward some constitutions, I might state that the celebrated chemist Fontana, knowing himself to be easily poisoned by it, and wishing to examine into its properties, caused specimens to be got ready by another person, but accidently touching one of the leaves, under some water into which it had dropped, in a short time began to suffer from its poisonous effects. This susceptibility varies greatly under certain conditions of animal and atmospheric temperature. In some persons a difference is observable whether in a warm or cold climate, and some suffer only on very hot days. With others climate and season seem to make very little difference. Children are much more liable to be poisoned than adults, and females than males. When the skin is moist the poison is more readily absorbed. A gentlemen who had often handled the plant with the greatest impunity, experienced his first attack through rubbing against some of it while his skin was still undried after bathing, and though he has several times since rubbed the plant over the dry skin, has suffered no ill-effect. For this reason also, persons perspiring, especially if fatigued, are more liable to be affected.

Instances are related in which a periodical return of the symptoms of poisoning, without fresh exposure, has occurred for a number of years. This is doubted by some, who ascribe the succeeding attacks to fresh exposures to the plant's emanations, without the patient's knowledge. An able advocate of this view thus expresses himself in regard to the poisonous emanation: "Being volatile, it may be readily diffused, and like malaria or the cause of hay-asthma, may act under favorable circumstances, as of aerial currents and susceptibility in the recipient, at a considerable distance from its source. Now it is well known that no protection is conferred by a prior attack, and hence it might reasonably happen, that a person having suffered from ivy poison one season, would also suffer the next by reason of susceptibility, even though scrupulous precautions should be taken to avoid direct exposure. In such a case the diffused emanations might be sufficient as an exciting cause to account for the recurring attack. It is to be noted that the so-called recurring cases always take place during the summer season, and at the period of the plant's poisonous activity, but never in the winter, which lends support to the supposition of the existing cause being diffused in the atmosphere." These plausible arguments do not however, to my mind, clear up all the reported cases of recurrence. A gentlemen was poisoned one year in this country, and the next he went to Europe, where, at the same season of the year as that when he was first poisoned, most of the symptoms returned. Now, being in Europe, he could not be exposed to the noxious emanations of poison ivy, and the opponents of the recurrent theory would have to fall back on the far-fetched argument that he might have been exposed to noxious effects, resembling those of poison ivy, from some poisonous shrub of Europe. Further, in some cases the eruption is said to have returned annually for several years, and one can hardly imagine a person suffering a number of consecutive attacks without noting his fresh exposure in at least some of them.

In the New York "World" last year there appeared in an article, by one Edmund Collins, on the poisonous rhuses, the following extraordinary statement: "Every one does not know what is the meaning of the term 'poison-ivy.' They do not know that a little while after touching the leaves or branches of a poisonous tree or ivy, a vivid red rash appears upon the hand, wrist or leg, and then spreads over the whole body. A microscopist removes a little of the rash, puts it on the slide of the microscope, and, under a glass with a magnifying power of 300 diameters, sees an active little parasite. This parasite lives in millions on the 'poisonous' tree or plant, but when the leaf or stalk where they cluster is touched by one's hand or wrist, a score or more of them may be found clinging to the skin. They cannot be seen with the naked eye, but they may be removed by the edge of a sharp instrument and put on the slide of a microscope. They are rather oval in shape, and have a wonderful power of reproduction. Suppose a child touches a leaf or stem with his hand or wrist, five or six of these parasites get upon the skin, huddling close together, and remaining in the same spot for hours. The child doesn't feel them and can't see them, but the pests at once begin to burrow under the skin, feeding and building nests. In a short space of time they have increased a thousandfold, after which they all move about, making little settlements all over the the body, turning the skin rough and red, and producing a torment of itching. These parasites are communicated even by shaking hands, though the bacillus (which it really is) will not burrow so readily in the skin of an adult as in the softer skin of a child. I have known about eighty per cent. of a school, consisting of nearly sixty pupils, to be contaminated by one small boy who had the rash of poison ivy on his wrist. He was the only one in the school who had been in the woods, and he had brushed through a clump of poison ivy. It was the belief down to a very late period that the poison from these plants was an acid or sharp juice, which, getting upon the skin, irritated the part and set up an inflammation. The modern microscopists know it is a parasite which can live on the petals or stems of the plants named, or on human blood, and thrives best on the latter. The two poison sumachs are provided with a thick, viscid juice, which exudes when a branch, stem or leaf is crushed or broken. In this matter are myriads of the parasites, but, as already stated, they are communicated to the skin by the brief contact of any exposed portion of the hands, arms, face, or any other part of the body."

On reading this strange statement I at once communicated with Dr. Van Harlingen, of Philadelphia, one of our best authorities on skin diseases, who told me, as I had surmised he would, that the statement was a mere newspaper "yarn," which advanced an utterly untenable statement, and one of which he had never even heard.

The symptoms of rhus poisoning are violent itching, redness, burning, and erysipelatous swelling of the parts subjected to its influence. The face and hands are most apt to be affected, in some cases the swelling being so great as to obliterate the features, but any part of the body may present similar appearances. Of poisoning by its internal use there are five cases on record. In one instance two children, aged respectively six and eight years, ate the berries; and in the other, three persons, a boy aged twelve and two girls aged fifteen and seventeen, took an infusion of the root in mistake for one of sassafras. In a few hours there was drowsiness and stupor, followed by vomiting, convulsions and delirium, and in some of the cases there was an eruption over the body. All these persons recovered after varying intervals.

The prevention of poisoning by the rhuses should be strongly impressed on the community at large. Everyone should know the distinctions, which I have already given, between the various species and the plants with which they are most liable to be confounded. Being worthless and of little value except medicinally, and even then probably much overrated, they should be extirpated by every thrifty farmer. A strong alkaline solution, used immediately after exposure, will often prevent the poisonous effects of rhus on those known to be susceptible to its influence, while anyone obliged to work near poison ivy should smear his face and hands freely with sweet oil or grease, when no ill effects are likely to follow.

REPORT OF THE COUNCIL.

Read at the Annual Meeting, May 12th, 1892.

The Council have much pleasure in submitting their report for the session 1891-2, and especially in directing attention to the progress the Association has made since the last annual meeting.

Twelve meetings of the Council have been held, the proceedings of which have regularly been reported to the Association.

Shortly after the election of the present Council, arrangements were made for holding a number of special meetings of the Association, at the first of which, held on the fourth Thursday of September, Professor Ramsay Wright, of Toronto, kindly consented to be present. In all fifteen general meetings of the Association have been held during the year, the average attendance being fifty-four. The following is a list of the titles and authors of the various papers read :

Sept. 24.—" Microbes—their Life and Work," an address by Professor Ramsay Wright, of the University of Toronto.

Oct. 8.—" Notes on Fossil Silurian Plants," by Col. C. C. Grant.

Oct. 22.—" How we Measure," by W. H. Ballard, M. A.

Nov. 10.—" The Study of Biology," Inaugural address by the President, A. Alexander.

Nov. 26.—" A Criticism of our School System," by Rev. A. Burns, D. D.

Dec. 9.—" Canada : its Canals and Waterways," by H. B. Witton.

Jan. 14.—" Memory," by S. B. Sinclair, M. A.

Jan. 28.—" Man Scientifically Considered," by J. Alston Moffat.

Feb. 11.—" The Chemical Reactions of the Bleaching Processes," by J. B. Turner, B. A.

Feb. 25.—" Messengers from the Skies," by H. B. Small, of Ottawa.

Mar. 10.—" Fungi affecting Fruits," by L. Woolverton, M. A., of Grimsby.

May. 24.—" Spelling Reform," by C. R. McCullough.

April 14.—"The Jews and the Persecutions in Russia," by W. H. Schofield, B. A.

April 28.—"Notes on the Genus Rhus," by T. J. W. Burgess, M. B., F. R. S. C., of Montreal.

May 12.—The Origin and Development of the Horse," by Wm. Mole, M. R. C. V. S.

Two sections of the Association known as the Physical and the Philosophical were organized in November; these and the three previously existing will submit reports of their work during the year. Within the past month a Camera Club has been organized as a Photographic Section of the Association, and the prospects for good work in it are exceedingly bright. Working rooms have been secured for it and the Physical Section within a short distance from the Museum.

One corresponding member and fifty ordinary members have been added to our list during the year; one has withdrawn, and two, Charles Robertson, M. A, and Thomas C. Mewburn, have been removed by death. Mr. Robertson was Chairman of the Philological Section from its formation, and took a deep interest in its welfare. His death, mourned by all who knew him, will be a severe loss to the Association. Mr. Mewburn was a especially frequent and valuable contributor to the Museum, and the collection which he has left us will constantly remind us of his worth.

A number of valuable donations to the Museum have been made during the year, and increased shelf accommodation has had to be provided. The Council would call attention to the necessity for placing in a public collection as many as possible of the Indian relics in which this district abounds, and will undertake on behalf of the Association the care of all entrusted to it.

The last issue of the Journal and Proceedings of the Association was sent to a largely increased number of Societies, and most of these have in turn sent us copies of their transactions, many of them of great value. Seeing the importance of enlarging our exchange list the Council have determined to issue a larger number of copies of this year's Proceedings: the publications received from other Societies are at all times easily accessable to members.

The Council would recommend that Mr. H. B. Small, of Ottawa, an honorary member of the Association, be our representative at the approaching meeting of the Royal Society of Canada, and that our annual outing to held at Grimsby on Saturday the 11th of June.

All of which is respectfully submitted.

A. ALEXANDER,
President.

A. W. STRATTON,
Secretary.

REPORT OF THE GEOLOGICAL SECTION.

Read at the Annual Meeting of the Association,
May 12th, 1892.

The Section, in submitting this report, desires to state that an active interest has been maintained by the members throughout the year, and many valuable specimens have been added to our already large and representative collection.

Nine meetings have been held, at eight of which papers were read. The Section is deeply indebted to the untiring energy of its chairman, Col. C. C. Grant, who has contributed all the papers.

The papers read have been as follows:

1891.

May 22.—"Irish Celts and their Relics, III," (published in last years' Proceedings.)

June 26.—"Notes on the Niagara Falls Rocks."

Sept. 25.—"Geological Notes on the Marl Lake, Anticosti."

Oct. 23.—"Fossil Plants, Hamilton," supplementary notes to the paper read before the Association on Oct. 8th.

Nov. 27.—"The Fossils of the Cretaceous and Eocene Formations, I."

Dec. 25.—"The Fossils of the Cretaceous and Eocene Formations, II."

1892.

Feb. 26.—"Fragments of Palæozoic Sea Floors."

April 22.—"Mesozoic Reptiles. Have they any living representatives?"

At the meeting of Jnne 26th, the following fossils were reported as having been found on the Field Day:—Favosites Niagarensis, Caryocrinus Ornatus, Caenostoma Constellatum, and a new variety of Stromatoporæ.

A number of specimens have been added to our collection during the year, for which we are especially indebted to Messrs. Charlton and Walker and the Geological Survey of Ottawa.

Respectfully submitted,

A. T. NEILL,
Secretary.

NOTES ON THE NIAGARA FALLS ROCKS.

Read before the Geological Section, June 26th, 1891.

BY COL. C. C. GRANT.

So much has already been written regarding the Falls of Niagara that no point seems left for investigation. The rate of recession has been determined by a host of writers, who widely differ on the matter. I may add, however, that periodical surveys have been made within the past fifty years, by which it is computed the gorge at the present time recedes about 2.4 feet in the year. This recession must have been much slower when harder material than the earthy shales rested at the base. As the river gradually cuts back its way to Lake Erie, owing to the dip of the beds, about twenty-five feet in a mile, the Niagara limestones now at the top must occupy the lower position of the softer layers, and then its backward course will be considerably checked.

While all I have stated is already known to the senior members of the Geological Section, I feel assured they will pardon me for explaining to our younger brothers of the hammer. The rocks exposed in this neighborhood in descending order are as follows: Boulder clay and gravel, containing fresh water shells have been found resting on Niagara limestone, overlying shales and limestones of the same series, followed by the Clinton beds, which are about eighty-five feet in thickness and particularly well displayed along the Niagara escarpment near Hamilton. This overlies the Medina beds, shales capped by a freestone band, known as the grey band. All except the first (Post-pliocene) contain corals, marine shells and encrinites, in addition to fucoids or sea plants. No reasonable doubt can be entertained respecting the occurrence of the sea lilies in the Medina sandstone. No crinoid, as far as I know, has ever been discovered here or elsewhere in these beds; fragments of the stalk of two distinct species were obtained, and both were in better preservation than the Tentaculites (unrecorded) found at the like horizon. I may notice here that in many instances these marine remains have been mineralized or converted into iron pyrites.

I have already explained the difficulties we encounter in recognizing fossil algæ fucoids, decayed as many were when imbedded, and the internal structure so flattened and compressed that the microscope can afford little if any light, even when fairly preserved specimens are obtainable. However, I may state, the grey band contains about seven or eight species of plant remains. I forwarded to Sir Wm. Dawson some in excellent preservation from an abandoned quarry near the reservoir; but as I intend to call the attention of the section to this class of fossils on a future occasion, I need say no more on the subject now. If any of our members should ever pay a visit to Grimsby, by following up the bed of the stream you may collect well preserved examples of the Arthrophycus Harlani, a branching fucoid which some palæontologists think represents the filled up sand burrow of an extinct Crustacean.

The Niagara shales in the high cliffs to the right as you enter the ravine there from the Grimsby road, hold numerous heads of the well-known encrinite, Caryocrinus ornatus. A few have been collected by Hinde and Nicholson along the banks of the river Niagara, also below the Falls.* It has been remarked, when you find a single specimen of this sea lily you are almost certain to unearth an entire colony of the crinoids by searching carefully. About four feet from the base of the Niagara shale, near the rock cutting, Hamilton and Erie Railway, I found nearly three dozen in a few days, shortly after the line was opened, also two heads of the fine crinoid, Eucalyptocrinus decorus, and upwards of fifty of the singular little encrinite, named Stephanocrinus angulatus. All were previously described by Dr. Jas. Hall, or other geologists, as characteristic of a like Silurian horizon in the State of New York. The Silurian star-fish, Petraster bellulus, described and figured in the Palæozoic Fossils of Canada, was discovered at Stony Creek by an old friend of mine, Johnson Pettit, of Grimsby. Unless this locality is included in the township of his residence, the error admits of rectification. He pointed out to me the exact spot where he extracted it from the Niagara shales. We have no reason to suppose that such rare fossils are confined to particular parts of the elevated sea bottom. The red and mottled shales of the Medina series, running out near Oakville, only contain a few ill-preserved

* The exact locality they refrain from making known.

plant remains. The absence of free shell, for instance, is very remarkable; but, although the 340 feet of it in Canada has been carefully examined by field geologists, it has only yielded the doubtful fucoids. Not long since it was thought to be a deep sea deposit, and this may account for it. Such an idea cannot be entertained. Deep sea dredging expeditions revealed the secrets of the sea's abysses. The capping band (sandstone) points to an ancient coast line, and seemingly it was deposited in shallow water. Prof. Wilkins' idea that the shales were laid down in a sea impregnated with mineral salts injurious to life, appears to be more worthy of consideration than any other theory advanced on the subject yet. He certainly deserves great credit for boldly grappling with a disputed point which few field geologists would dare encounter, and the majority are anxious to carefully avoid. All the four Clinton bands, red and green, are fossiliferous, they thin out to the east, the lower ones contain star-fishes and crinoids, one of the latter, probably undescribed as yet, is exceedingly delicate. It possesses so slight a stalk that I was induced to suppose it could only exist in some well-sheltered cove or bay, protected from wind or wave, or in deep water where their influence is unfelt. All the beds of the May Hill sandstone series, known to us as Clinton, I examined on this continent, were laid down in shallow water. Apparently the portion called the Iron band is well displayed in rear of the small reservoir at Hamilton, and is of great interest. It contains many plants, differing altogether from fucoids in their nature. They may not be land plants in the usual acceptation of the term, but I believe them to be allied, if not identical, with the ones Sir Wm. Dawson mentions as growing in marshes, with only their upper parts in the air. They are distantly related to the "mare's tail." The iron ore, peculiarly characteristic of the upper red band, was derived from plants, I think, which grew in low swamps to which the sea had access occasionally as litoral shells, lingulæ, etc., are found in it.

Probably the sea bed was undergoing slow submergence when the overlying band, green shale or sandstone, was deposited. Burrows or casts of the lob-worm, and thin ripple or wave-marked layers, may be noted through its entire thickness. The Pentamerus bed, Niagara limestone, lying on the upper part, attaches to its under surface about two inches of the compressed shale; this holds an alga, perhaps a new species. In addition to the large shell Pentamerus oblongus, the base of the wenlock or Niagara holds seven species of graptolites. The still larger Stricklandinia of the late Professor Billings is generally obtained from the second layer below the thick four and a half foot bed known to the quarrymen as the Nigger-head. This is the one you may remark lying so frequently at the foot of the escarpment from which it has fallen. The Niagara shales, seventeen and-a-half feet thick at Hamilton, contain many graptolites, but they fall to pieces when they become dry. There are, however, interspersed in the dolomitic shales a few impure layers of limestone from which good specimens are obtainable, as also the fucoid Buthotrephis Granti. The blue building beds overlying, about five and-a-half feet in thickness, contain a great many graptolites, and the two upper beds are rich in trilobite remains, head and tail shields, but a complete one is very rare indeed. Conularia magnifica (Spencer) and C. Niagarensis also occur, perhaps in better preservation than in the chert macadamizing beds, higher up. From the base of the latter, about two feet above the limestone band, I secured the fragments of the great crustacean, Pterygotus Canadensis, the predecessor of Pauglicus, of the Devonian rocks of Scotland.

It would afford much pleasure to point out the position of the most fossiliferous chert and Niagara-Barton beds near Hamilton. The waterlime quarry of the latter is the only one now open, and presents but few specimens, the fossils of the higher layers in many instances, Trochoceras displanense for example, are like Guelph shells.

When we consider the very limited time at our disposal, and that the Falls themselves and neighborhood have been the common hunting ground of many thousands of geological tourists from all parts, I do not think we should be ashamed of the small collection we made during our visit. We may claim to have discovered that the higher Barton beds at Lime Ridge, near Hamilton, are also represented there, a circumstance hitherto unnoted. I noticed particularly two circumstances on our recent visit to the Falls. They have been rapidly receding during the past twenty-five years, and the body of water is very sensibly diminished since I saw them in 1867. I experienced no difficulty in approaching the part known as the Horse Shoe Falls, over rocks formerly partly under water. Despite the protection vegetation affords, the high cliffs below the cataract are also retreating in some places, not so much from the river undermining the banks, although perhaps, at some points such was the agent, but chiefly from the expansive power of the frost during the winter season, which is sufficient to rend asunder and disintegrate the face of the hardest layers exposed to its influence. You may notice at the upper reservoir, every year, what a vast amount of loosened material has to be carted away when the frost disappears. It must be admitted we committed a grave error in not taking a chisel or two and a heavy hammer with us. Had we been provided with them we could have added a considerable number of much better specimens to our collection of stromatoporæ, strange fossils, to which Mr. Walker recently called your attention, whose classification remains as yet undetermined.

Dr. Spencer, who has studied the Field Geology of the Niagara District most carefully alleges the Falls commenced their history when the lake level of Ontario was 138 feet higher than at present, the predecessor of the modern body of water he calls Lake Iroquois. I consider his conclusion quite correct regarding its existence since the glacial period; but I believe the vast inland sea, fresh water, he has named Lake Warren, existed before the great Ice Age. Could any quantity of lake ice have scored and polished with such regularity the glacial markings we see every where for miles around us, or deposited moraines of the dimensions we meet with on the brow of the mountain?

GEOLOGICAL NOTES ON MARL LAKE, ANTICOSTI.

Read before the Geological Section, Sept. 25th, 1892.

BY COL. C. C. GRANT.

Perhaps the most interesting spot on the Island ot Anticosti to the field geologist is the small lake so appropriately named by Richardson in his report addressed to the late Sir Wm. Logan. He remarked, near the village of English Bay, the chief settlement on the northwest shore, a little brook of milky appearance which left a considerable deposit ot carbonate of lime not only on the bed of the brooklet itself but for a considerable distance into the bay. Following it up, I presume, under many difficulties, he found it proceeded from a swampy lake, in size and appearance not unlike Medad, near Waterdown. It lies perhaps about a mile or more inland from English Bay. The inhabitants of this village, including women and children, amounting to 1000 or so when I was there, were, with few exceptions, French fishermen. They build their own houses ot frame work, neatly constructed, internally clean, and whitewashed on the outside with the marl derived from the lake. Lime kilns are structures apparently unknown to these Celts, long separated from the ancient stock of the mother country, France.

From the distant shore of this lake when it is frozen over, they obtain by means of dog sledges the greater part of the fuel supply. A rough passage from the village to the near margin has been cut through the dense bush. In winter, no doubt, it would prove more practicable than it appeared to me in autumn, when obliterated by a season's growth of underwood, tall ferns or branches. Indeed I found the pathway so obliterated, even close to the lake shore, that I lost it completely, and, on my first visit, it must have cost me some hours' hard work to worm my way through a few hundred yards, exposed to gadflies and mosquitoes. With great difficulty I had a light skiff conveyed over land and launched on its waters, by means of which I ascertained that the Marl Lake itself is merely the outer one of a chain stretching inland, connected by brooklets. There is little doubt that at a very recent period they formed an uninterrupted body of fresh water. I was particularly anxious to ascertain if the apparent drainage was owing to a recent coastal elevation of the island. I have already adduced proof that Anticosti is undoubtedly rising, while the continent to the south along the Atlantic coast is said to be gradually undergoing a marked depression.

The Marl Lake is quite shallow at the edges all round, the shore line sandy in patches. In the centre I found it scarcely exceeded six feet in depth. I was quite astonished at the immense thickness of the marl deposit; even a few feet from the margin a pole twelve feet long was thrust through it without finding the bottom bed. On removing a portion of the peat soil adjacent, clear proof was obtained in several places that the former body of water was much greater than now. It has simply shoaled up and shrunk to its present dimensions by means of the countless myriads of fresh-water shells extracting the lime for the purpose of forming their habitations in much the same way as the coral reefs are raised to the surface. However, the marl lake molluscs differ from the coral insects, they do not form a consolidated mass, as was clearly shown by the pole so easily penetrating in the way it did. Dr. Geikie considers that many of the plains in the United Kingdom were originally lakes. The same may be said of the mosses or bogs in Ireland. In numerous instances I noticed shell marl underlying the peat, but the average thickness was inconsiderable, a few feet perhaps; when dry it was not unlike chalk.

Mr. Robinson, who accompanied me on my second visit to Marl Lake, had but little difficulty in getting the light skiff back to the village by the brook, which connects it with the bay. During my stay at Anticosti, a lad brought in some fine speckled trout from the brooklet which flows from the lake beyond, seen at a distance only, into the one we explored.

I ascertained at the South Point Lighthouse that another lake was discovered some two miles inland. The keeper kindly volunteered to accompany me. By following bear paths and wading through swamps, we at last arrived at our destination. I found the Little Marl Lake also had a rich deposit of shell marl, admitting, however, of no comparison with that near English Bay. Strongly acidulated springs, I believe, were only capable of dissolving the enormous quantity of lime in solution in the latter. May not this explain why cattle, as was stated, frequently appear to be reluctant to use the water? I may add, however, as a set off to this circumstance, if well authenticated, that sickness is almost unknown among these healthy and robust French fisherman, that their children, exceedingly numerous, seem altogether exempt from the fatal diseases of childhood elsewhere. And, strange to say, there are no medical men on the island.

The immense swampy plain, extending from South West Point to Heath Point Lighthouse, parallel to the southern shore, also formed, perhaps, a chain of lakes at one time. It is about eighty miles long by one-and-a-half to two-and-a-half broad; its edge did not display any marl along the strand, but although now treeless I remarked in the peaty soil the roots of trees larger than you meet along the sea margin at present. It may be on an average six feet above the waters of the gulf at high tide. The moss on the surface is beautifully green in color, and at a short distance gives it the appearance of rich meadow land. It could easily be drained, and I doubt not will become valuable at some future time.

Deep sea fishing is not pursued there. Harbors for larger boats than the inhabitants use are much needed. If means were adopted to enable salmon, white trout and eels to get beyond the perpendicular falls close to the outlets of some of the northern streams, the angling capabilities of Anticosti would be considerably increased. In all the rivers, as far as my examination goes, there are numbers of roots of trees, as well as fallen timber, which would prove almost insurmountable obstacles to the best angler that ever cast a fly for salmon or trout.

As a field for Botanical researches Anticosti presents one of the most interesting on the continent, from the large number of strange specimens it contains. I suspect many of them were introduced by way of Labrador or Newfoundland. I was informed that Professor Macoun had recognized several Arctic forms there; but, I presume, his time was limited, for he examined only a small portion of the south-west shore. And this part struck me as the least interesting botanizing ground. In a swamp near the burial place at English Bay, I noticed an exquisite little pink heath.* Bushy, a complete mass of blossoms, which reminded me of the white heather of our

* I am not certain, however, regarding its classification.

Munster Hills more than any other plant I recalled to memory. It may be rare, for it was not seen elsewhere on the island.

Although not a botanist, I may claim at least that I have always been a fern collector or admirer. In Jamaica, in the West Indies, Newcastle, where I was quartered, and the Blue Mountain Range, where it is situated, contain, according to Hooker and others, no less than five hundred species of tropical or sub-tropical productions. When I arrived at Anticosti and noted the humidity and foggy atmosphere, the ravines and streams of fresh water shaded by the stunted pines, so characteristic of the coast line, I concluded it would prove remarkably productive in northern ferns. I was, however, disappointed, nothing but such as the coarse bracken and commoner kinds were obtained.

The Pitcher Plant frequently covers patches in the swampy places. On the sandy soil, above high water mark, between English Bay and the cliff called North Point, I noticed a wild pea, which grows to a considerable height, and is quite robust. The inhabitants use it as winter fodder for the few horses and cattle they possess, and animals greatly relish it. It may be worth while to ascertain whether it would flourish elsewhere. A small strip was said to produce more food than an acre of meadow land. If this be true, it may be a valuable crop. It may require the salt spray, however, for its full development. The wild strawberry, larger than any in Quebec or Ontario, seems common where fishing stations formerly existed, as also the raspberry and currant—red and black; two bushes of the white species were seen. All are apparently indigenous. Though confined to the clearings I do not think they could have been introduced. Near Heath Point Lighthouse, in addition to the cranberry, blueberry and crowberry, I remarked a fruit on the moss or swamp bearing some resemblance to a yellow strawberry. I was informed it was used as a preserve when ripe or fit for gathering; it presents a reddish color. I do not remember the local name.

Of the localities for Anticosti fossils Richardson's report on the Field Geology of the island coast furnish on the whole a very accurate description. True, he failed to notice the Post-pliocene deposits, but when we reflect on the difficulty of ascertaining the heights of cliffs, the dip of the beds and their thickness, we may not be much surprised at a single oversight on his part. For my part I wonder how he ever accomplished so much in the limited time at his disposal. While I agree with him, that Gamache or Ellis Bay has been carved out of the Niagara beds proper, I doubt that Junction Cliff displays any point of contact between the Cambro-Silurian rocks and those formerly described as the Middle Silurians. I spent three days in examining the beds deposited there, independent of several visits subsequently for the purpose of collecting fossils, but I failed to obtain any confirmation of this. I found it utterly impossible to make any separation of the series at this point. All, or nearly all, the organic remains I obtained there were well defined Niagara. There is a low cliff between this and the West Point Lighthouse, rather shaley at the base, containing only a few fossils of the late Professor E. Billings' Anticosti group. It holds, however, a great many specimens of Hudson River species. I feel inclined to think the upper or almost inaccessible part of this cliff may display the meeting place of both. For my own part I believe Mr. Billings was quite correct when he asserted no division existed, and no break in the chain of life has been noticed as occurring at Anticosti.

I succeeded in extracting from the soft shales a magnificent and well preserved Murchisonia Gigantia, and quite a large collection of Orthidæ, Orthisina, Ambonychea radiata and others, characteristic of the upper Bala beds of Ontario. I placed them on a large flag near the shore. Unfortunately while I was engaged in adding to my collection, a French fisherman came along, and, unnoticed by me, raised up the largest and rarest one to examine it. You may easily fancy the result, it slipped through his clumsy fingers and fell into fragments on the rock below. The interior was hollow, but partly lined with spar or silex. Ellis Bay is one of the best places for organic remains on the island, in addition to Bratrecea, the Paceolus, a yet undetermend organism, may be had there. Although the exterior resembles a coral, the inside is filled with muddy sediment. This I ascertained by breaking up the oval species. It may be noted, the late Professor Billings previously stated it could not belong to the Actinozoæ. Whatever the classification, the beds at Ellis Bay are very fossiliferous, they form the lower division of the Anticosti group. They are remarkable for containing so many Hudson River species, and I consider they may be looked upon as birds of passage only.

On glancing over the list of specimens collected by the officers of the Canadian Survey, I find Xamerella Ops omitted in the lower subdivision but credited to a succeeding one. It is very numerous and remarkably well preserved in a miniature cliff about six feet high, at the head of the bay near the western horn or entrance. Ascoceras, Beatrecea, Halysites, etc., occur in an upper part at the other side of the harbor near Eagle Cape. When I visited the island, a road, over which I travelled, was in course of construction along the shore from English Bay. The locality can be now easily reached by land.

As you may find in Richardson's report all necessary information regarding the organic remains of the remaining part of the Anticosti group, I need say nothing more on the matter. Between Jupiter River and the South West Point Lighthouse, an interesting section of the higher body may be remarked abounding in Trilobites, Corals and Brachiopods. On the north shore Charleston Point presents numerous Crinoids (Hudson River) and remarkably well preserved Brachiopods. The cliff has a considerable slope near the eastern curve, and many of the layers, thin limestone and shales, can be examined from a platform at some distance above the base. The cliff is only one hundred feet high, an inferior elevation when we consider the abrupt perpendicular rise of others on the northern shore of the island. If you stand on the lake shore, imagine what we call the mountain towering above you, then almost double its height, and you may comprehend the meaning of elevation above the ocean surface of many of the Anticosti rocky wall-like elevations. The gradual ascent of a mountain chain, however steep, fails to impress one as regards its altitude in the same way as the sheer perpendicular height of the canons of Colorado or the bluffs of Anticosti. Soaring considerably above the noisy gull, attending a school of herring or mackerel, and carrying havoc into their ordered lines, you may notice occasionally a small white speck far up in the sky. It poises itself for an instant over a particular spot, then comes a flash as if a white rock had suddenly been dropped from above, then a considerable time after the splash and report you may notice the gannet or gander (Solan goose), Sola Bassana, emerging from the sea with the hooked bill firmly grasping the morning meal he had provided for his mate and the hungry progeny they recently raised.

The rarest fossils I discovered in the island were in that portion between the last named and Mareld River. One, now in the Redpath Museum, Montreal, belongs to the new genus Cyclocystoides, (Salter and Billings). This extraordinary family seems to be a connecting link between the star-fishes and extinct cystideæ. "The choice lies between them," was the final conclusion of these distinguished palæontologists. Their first impression was that they had undoubted evidence before them of the existence of circular star-fishes. At that time, however, the two-fold nature of many of the palæozoic organic remains was not generally accepted. I had no means of comparing mine with the two described previously; but as it was apparently unknown to Sir Wm. Dawson, I may infer it may be a new species. A star-fish, possessing the peculiarity of subdivided rays, and bearing a resemblance to the Maltese Cross, I unfortunately lost between Indian River and English Bay. A rough sketch of it was taken when I was staying at Macdonald's Cove, which may convey its general appearance. As the plates are not present, it can hardly admit of restoration, a circumstance the more to be regretted, as it differs so widely from all other palæozoic star-fishes figured or described.

Ice Beneath the Soil at Anticosti in Autumn.

During my stay on the island in 1885, a singular circumstance was brought to my notice by a gentleman who was sent from Quebec to replace some telegraph poles that had given way there. He informed me he found a solid ice sheet underlying the soil some six feet below the surface. Now the winter in Anticosti is less severe than in Ontario; cattle from a wrecked vessel have survived a winter's residence unattended and uncared for in the open air. Old residents assured me the frost does not penetrate more than twelve inches even when the ground is unprotected by snow. It may be rash to suppose it represents a survival of the great Ice Age.

FOSSIL PLANTS, HAMILTON, ONTARIO.

Read before the Geological Section, October 23rd, 1892.

BY COL. C. C. GRANT.

[*Supplementary Notes to a Paper read before the Association, October 8th, 1882.*]

Since I read a paper on the above subject I paid sundry visits to places in this neighborhood where these organic remains were originally obtained, and although not successful in obtaining others in better preservation than the ones submitted for examination by the members of our Association, I have a few more which may prove of some little interest to the Section.

From the lower portion of the Clinton beds, above the grey band, I secured fragments of the cord-like fucoid, possessing a striated appearance. This may be allied to, if not identical with, a form appearing in the Medina series. The plant in the latter, it is true, does not usually present the longitudinal lines or fluted aspect; however, in rare instances, I have remarked this peculiarity. The fucoid from the Niagara shale came from the quarry near Mr. Colbeck's. It seems very well marked; however, it may be only the detached branch or branches of a Buthotrephis. Its plant nature can hardly be questioned.

The small Clinton Licrophycus here produced does not come under the head L. Minor. The stem was more flexible and the tuft of branches more closely bunched at an acute angle. The plant at first sight would lead one to suppose it was of a soft succulent nature; this supposition may prove erroneous. Both stem and branches stand out boldly in relief on the surface of the flag, though difficult to reconcile with what I asserted as regards its flexibility. Altogether I think there are three small species or varieties represented in the Clinton beds, and one in the Medina grey band. In a specimen from the former, the main stem throws out a compact tuft, is continued and forms a second one higher up. It appears quite impossible that anything but a plant could have left this impression.

Another Clinton specimen obtained last week from the Medina quarry, near the reservoir, seems undetermined. The same may be said of a few more also from the lower series nearer the city, all of which are submitted for examination.

On a recent visit to Hamilton by Dr. Hall, of Albany, his attention was called to what the late Professor Billings remarks relative to that curious fossil figured in the second volume of the Palæontology of New York. The furrow of mine collected from the Chazy sandstone by Sir Wm. Logan, differs from the one in the Clinton rock. It does not run the whole length as in the latter. You may note while the distinguished palæontologist agrees with Dr. Hall in its classification as a portion of an Alga or Fucoid, he refrains from suggesting an explanation which may be permitted in a mere amateur. Instead of representing the seed pod of the sea plant, may it not have been a bladder-like expansion to keep the Alga afloat? Such are known to exist in the North Pacific at the present time. The Nereocystes Lutkeana, in the vicinity of Sitka, has a stem-like whipcord which terminates in an air vessel.

The Clinton specimens here at Hamilton occur in what I have called the alga bed; where found in other layers, the detached or broken-off bladders, may be imbedded in a higher bed. On one occasion I found six of them on a small piece of shale with a fragment of the stalk seemingly attached to a specimen.

FRAGMENTS OF PALÆOZOIC SEA-FLOORS FROM HAMILTON, ONT., AND ANTICOSTI.

Read before the Geological Section, February 26th, 1892.

BY COL. C. C. GRANT.

Some years ago I forwarded to an old correspondent of mine in Dublin, the late Professor Bailey, a small collection of fossils for the museum attached to the Irish Survey office. The greater portion was obtained near the city of Hamilton. In returning thanks for the donation, he expressed such warm admiration for a few Clinton, or May Hill, sandstone slabs enclosed in the parcel, that, in a subsequent contribution, I presented him with nearly all the like ones in my possession, and hunted up a few others also for his acceptance. "I consider the slabs of far more interest," he remarked, "than any of the single specimens we received from Ontario. One could learn more of the invertebrates, corals, bryozoons, thus accumulated, of the period, than from any number collected singly from beds bearing the very vague term, 'Silurian Series.'" He had never seen any of these instructive and interesting slabs either figured or described. Unfortunately, I have not been able since to replace many of them. I succeeded, however, in getting a few for the late Professor E. Billings and McGill University; as also some fragments for your inspection to-night.

Commencing with the Grey band, there is a thin sandstone bed resting on a slight parting of shale; about a like quantity of the same material overlies it. It was from this layer of the Medina that I obtained, in addition to several plant remains, specimens which enable me to increase the rather meagre list of fossils of the series, as given by Dr. Spencer, by the following unrecorded, I think, as yet: Stromatoporæ, 2; Tentaculites, 2; Athyris, 2, Athyris umbonata, Anticosti (Billings) 1; Fragments Trilobites, 2; Crinoid Stems, 2, both in Clinton also; Zaphrentis, 1, another described; Favosites, 1; small coiled shell, orifice concealed, 1. The latter occurs also in one of the massive layers, with a Stromatopora and an Orthoceras in the Redpath Museum. The fucoid Mr. Walker gave me for Sir

Wm. Dawson come from this horizon. It may prove to be a marsh plant; it differs from any I found, and may be a new species. As is the case generally, the fossils only occur in certain patches through the bed. This I ascertained through experience, and I mention it to guard you against disappointment. The specimens of this shallow water sea-floor in my possession now are exceedingly poor, in indifferent preservation, and their sole recommendation is, they may be considered better to display than nothing at all, to use an Irishism. I have on a previous occasion referred to the absence of organic remains in the red, green or mottled shales, and pointed out that the explanation sometimes offered regarding their being deep sea deposits offered no satisfactory answer, inasmuch as free floating shells must have been interred in the muddy sediment sometimes. For my own part I could never understand why the red Clinton shales, which, perhaps, owed the color to iron, were so fossiliferous, whereas the Medina ones underneath could only display the mere fragment of an alga, which, to the finder seemed doubtful. A red Orthoceras, forwarded to the late Professor Billings, unquestionably came from a gully below the capping of the Medina freestone band. Probably it was washed down from the Clintons overhead, filling up a natural void, and cemented by frost, which, from its position, could not be dissolved at an earlier period. Anyway I do not care to claim the discovery of an Orthoceras from Hamilton, Ont., below our local freestones. When Dr. Jas. Hall, of Albany, recently paid a visit to Hamilton, I asked him why the Medina shales were so barren of organic remains. His explanation coincided precisely with the views Professor Wilkins recorded at a late meeting of our Association. Both arrived at the same conclusion independently.

But why sea-floors? Does not every fossil embedded in rocks, shales, mud or sand, point to the same means of accumulations—the sea bed? Well, no, not exactly. The term is not applicable in many cases to the material or rocks enveloping fossils. Fresh water streams, bays and lakes, may also put in a claim to the contribution, not forgetting the ancient and modern marshes to which tides had or have merely occasional access. But doubtlessly in a general way the objection has considerable force. So I had better here explain that our fragments of sea-floors are merely selected slabs of ancient Palæozoic sea bottoms, thin layers of limestone, sandstone, etc., whose surfaces in nearly every instance were covered, perhaps suddenly, by muddy sediments that materially assisted in preserving the organic remains beneath in a somewhat better condition than usual. In my search for fossils in Europe and this continent, from the lower Silurians to the seas of Somersetshire, I have almost invariably found the most likely place to find them was a thin lime or sandy layer enclosed by shale or mud. And it seems quite natural also. Rivers, for example, when flooded, carry off and convey to the sea, large quantities of silt, depositing it over the sea bed. It not only covers dead shells, etc., but entombs living animals, also plants, bryozoons and such things as were unable to escape from its unwelcome advance.

You may excuse me for offering a remark you may deem rather outside the subject of my paper, but since I failed to elicit any satisfactory explanation in the matter, and cannot find it touched upon by others, I may be pardoned for alluding to it. Many, if not all, who have studied corals and coral reef builders, are perhaps inclined to accept Dana's reasons for the exclusion of corals in tropical seas—first, cold extra-tropical currents, secondly, muddy or alluvial shores, emptying of large rivers, for coral polyps require clear sea water, and generally a solid foundation to build upon. Such was not the case with regard to Clinton Favosites, popularly called Honey-comb Coral. I have obtained many from the silt beds *in situ*, viz: stile erect, ten inches in diameter at top, (the latter I underscored), for the term "shale" is frequently applied to far harder layers, and if I use the word "marl," it may express what I intend to convey as regards my meaning to some few, but it would certainly lead to one fact, that however the chemists may differ among themselves, all would unite in one respect, viz., abuse for anyone who borrowed, missapplied or misunderstood even the least of their immediate scientific belongings. Of three specimens of the chainpore coral, Halysites Catenulatus, two were discovered in a soft Clinton mud band. The Alcyonarian coral, Heliolites Interstincta, a Cambro-Silurian of Anticosti, occurs more frequently in the blue shales than in the harder limestone layers. You may see in the well preserved specimen from the island now produced for your examination, there is no point of attachment displayed. So it seems permissable to infer that the Palæozoic polyps were fitted to withstand and overcome conditions which would prove fatal to their modern successors. It is a difficult problem to solve, but we may leave the matter for wiser heads than ours to settle, while we resume our researches over the elevated sea-floors.

Leaving the grey band of the Medina series, close to the city, under the brow of the mountain, so-called, are a number of quarries, formerly worked for the valuable freestone beds. The base of the Clinton is there well exposed, as a good deal of worthless material for building purposes must be removed before the sandstone is reached. This was carted off or flung down the slope at the base of the elevated plateau. The mounds are noticeable still in many places, though in some cases the grasses have encroached and partly concealed them. Some twenty-five years ago, one had little difficulty in securing fine specimens, when the softer portion of the mud heaps was washed from the surface, and the thin fossiliferous layers were exposed to the weathering process. Now you could certainly have secured better preserved fossil slabs under such conditions than if you obtained them from their places *in situ*. But if you are unable to point out the exact position of the beds, I have ever considered it a serious drawback to the pleasure of collecting. The plan I adopt is this: Whenever practicable I trace the layer to its original place; sometimes the clay resting on it may conceal indications of organic remains, so it may be necessary to put them out on the roof of a shed for a year or two to weather. Some of the Clinton slabs submitted for your inspection underwent a process similar to this. You cannot fail to notice how remarkably well preserved some of the delicate Bryozoons are. I have so recently called attention to the plant-bearing beds of the Clinton and Niagara at a general meeting of our Association, that I think it unnecessary to allude further to this branch of fossil remains. The few specimens since then seen or obtained only strengthen the belief already expressed respecting their nature.

So I propose to request the members of the Geological Section to examine a few fragments of Silurian sea-floors derived from the Rosseaux Creek waterlime beds, Barton, concealed measures of Dr. Spencer, recently exposed in the Marshall quarry, a little above the Albion Mills. A portion of the series now known as our local Barton, may be found to be equivalent to the Waldron, Indiana, Niagara, of Dr. Jas. Hall. On comparing the organic remains they appear identical. The same opinion has also been expressed by my old friend, Mr. Walker, and his son, who has a remarkably fine collection he showed me a few years ago from this locality of the States. I was impressed also by the close resemblance the Barton fossils bear to the Guelph ones; several are identical. It was claimed by the late Sir Wm. Logan that his Guelph formation was distinct and constituted a well defined and separate zone from the rocks underneath. It is quite true the actual point of contact has not yet been discovered. I believe the groups merged into each other through the slow depression or sinking of the sea bed before the Guelph limestones were gradually deposited; I doubt if any break can be discovered. Trochoceras displanense, Barton, Niagara, (Waldron also) has been lately found by Mr. Townsend, in the Guelph, at Durham, Ont. I believe some of the Murchisoniæ also have their affinities in our shales On palæontological grounds they cannot well be separated. I cannot say what reason United States had for asserting the Guelph formation of Canada was merely the capping of the Niagara. I am disposed to acquiesce in this view. Many of the Silurian sea-floors in Anticosti present the organic remains in excellent preservation. The limestone layers are very thin, generally about one-half to three inches, with slight shaly partings. I retained a small number for personal study, because they displayed, perhaps, internal structure, teeth, hinge line or muscular impressions, with which I was not sufficiently acquainted. Some little time ago I alluded to the discovery on a mountain in Wales, 1200 feet above the sea, of shells still living in Arctic waters. I find the Duke of Argyll, regardless of ridicule, stoutly maintains they were left there by the Noachian deluge—I suppose he imagines they floated about like corks—and as the waters were drawn off and the tops of the hills arose to the surface, what was more natural than settling there just as they are found. That a baker's dozen or so of the clergy should adopt this idea, was not unexpected, but in exultingly pointing to this extraordinary fact which admits of no refutation, they unconsciously endeavor to show mankind existed on earth long before the time recorded in Jewish manuscripts. Taking everything into account, it must be admitted, the churches now display a better knowledge of geological matters than the Venerable Dean Cockburn, of York, who informed us some forty or fifty years ago in his New System of Geology, as quoted by Hugh Miller: "These creatures, Trilobites, (Molluscs) appear to have possessed the power of secreting from the stone beneath them, a living covering for their backs, and perhaps fed on the same solid material." They must have found the food the Dean supplied them with rather indigestible. And this pillar of the church proceeds: "When the newer Llandeilo slates were deposited some spawn arose above the flags and was warmed into existence. Their successors fed upon a newer deposit, from some deeper volcano (the Wenlock for instance) corresponding to our Niagaras. The learned have classed these shells under the names Terebratula, Orthis, Atrypa, Pecten. They are all much alike, only an experienced eye can detect any difference." Never tell me the Scot is devoid of humour. Hugh Miller, by simply incorporating Dean Cockburn's opinion into one of his works, The Footprints of the Creator, clearly proved he at least had a keen sense of the ludicrous. One is led to imagine His Grace of Argyll may have acquired his knowledge of geological matters from the Dean of York. I cannot show the Section a specimen of the Post-Pilocene sea-floor, referred to by the Duke, but the Museum cases contain a few of the same Pleistocene fossils, from the Leda clay of Anticosti.

MESOZOIC REPTILES: HAVE THEY LIVING REPRESENTATIVES?

Read before the Geological Section, April 22nd, 1892.

BY COL. C. C. GRANT.

I.

In answer to this question, "Decidedly not," was the reply of one of the greatest palæontologists of our age. "Surely, if they had, we must have obtained some remains in proof of their existence. Now, as regards the mythical sea-serpent, I hold that to be merely an optical delusion." Well, it may be so in some instances, but, taking all the evidence into account, are we justified in ignoring what has been urged in the affirmative?

We must not forget how modern naturalists contemptuously dismissed, as unworthy of credit, the dimensions of a cuttle-fish as given by the elder Pliny and others. Instead of exaggerating the size, it has been proved beyond any doubt that specimens of far greater magnitude are living yet in the North Atlantic, as was shown recently by Professor Varril and others. When Chevalier Bunsen, of Berlin, Ambassador to the English Court, clearly pointed out that the city of Memphis, in Egypt, was founded by Menes, pyramids erected and copper mines worked nearly four thousand years before Christ, the great German scholar was looked upon, in church circles, as a dangerous Teuton, who had imbibed the false chronology of the priests of Is[illegible]en a little later the English geologist, Godwin Austin, publis[illegible] work and adduced positive proof of man's extstence in the valley of the Nile, perhaps thousands of years before a stone of the great pyramid was quarried, (3229 B.C.) he was bitterly assailed for implying any doubt regarding the accepted belief in the truth of Biblical chronology. He called attention to the fact that when Egypt became a portion of the Roman Empire the Romans erected pillar stones to mark the inundation of the Nile; that in the 2000 years which elapsed since then only five feet of silt or mud had been deposited; that pits sunk at various points close beside them, at considerable depths, displayed broken pottery, rude stone and other implements, manufactured by human beings very little advanced in civilization. Specimens, quite numerous, were discovered between seventy and eighty feet below the base of an adjacent pillar. But previous to the Roman occupation probably the river brought down silt in greater quantity than since. That may be so, although not at all likely; I think we may strike a fair average from the accumulated deposit of the 2000 years. When Boucher de Perthes, about half a century ago, produced flint implements, arrow points, which he discovered at Abbeville, many were so blinded by prejudice as to assert that they were merely natural chips, which accidently assumed the appearance presented, and deceptive indications of antiquity.

I have, for many years, collected all the evidence obtainable respecting the great sea-serpent, or more or less allied sea-monster, because I was not satisfied that Owen and others were fully justified in rejecting its existence for the reasons adduced. There was, I admit, considerable force in the statement that the misty atmosphere of northern latitudes, coupled with excited fancy, possibly led the Greenland missionary, Egede, to suppose a ship's mast, in the rough state, or a similar object, was the thing he described as a frightful reptile, seen by him in 1734. The assertions of other divines, Græmius and Maclean, were considered as unworthy of credit for a like reason. Such an explanation, however, was not deemed by many quite so satisfactory in the case of *The Dædalus*, whose Captain McQuahæ reported he had seen an immense sea snake on the homeward voyage from India, on the 6th August, 1848. All the officers alleged there could have been no mistake in this instance.

When the famous scientist, Professor Owen, stated that "not a single bone of the great sea snake was to be found in any museum, neither can it be shewn that its body was ever washed ashore," he may not have seen the description of the sea monster found by a fisherman lying dead on the strand of one of the Hebrides only a few years previously. I do not know if any record of its dimensions is still in existence, but I am perfectly satisfied that no conger eel, for instance, was ever known to attain one-half its length; the largest came from the Mediterranean, and never exceeded nine or ten feet, if we can credit the fishermen there.

At the time the French settlers first occupied Quebec, the walrus was seen frequently in the Gulf of St. Lawrence. The tusks are exceedingly durable, but I doubt whether any museum on this continent possesses a specimen from that locality, Laval, perhaps, excepted. One was picked up on the shore of Anticosti several years ago, and, I was informed, was presented to a French clergyman. He may have given it to the Regents of that university, whose valuable collection reflects very great credit on the French inhabitants of the lower Province. It certainly is far ahead of any in Ontario, and the only thing we can urge in explanation is its longer establishment.

II.

Since Owen published his belief in the non-existence of the sea monster, much additional proof on the subject has been obtained. The London (Eng.) Spectator, Dec. 30th, 1874, furnishes us with this statement: "In the Straits of Malacca, the great sea monster, so often declared to be mythical, was seen recently and observed by competent witnesses. On the arrival of the *Nestor* at Shanghai, the master of the ship, John Keiller Webster, and the surgeon, James Anderson, made a statutory declaration before a magistrate that they themselves, passengers and crew, had seen a creature resembling a huge salamander or lizard, of the following dimensions: head, 12 feet; body, from 45 to 50 feet; tail, not less than 150 feet. It was first seen at 10.30 a. m. on the 11th of September, fifteen miles west of the North Sand lighthouse. In the straits the weather was fine, sea smooth, and air perfectly clear. The three saloon passengers, watch, etc., clearly saw it, and observed its movements. It travelled for a long time as fast as the steamer, appearing to paddle itself along by the help of an undulatory motion of its tail in a vertical plane. The Chinese on deck were terribly alarmed, and set up a howl. Both body and tail were marked by alternate bands, black and yellow, the head was immediately connected with the body, there was no indication of a neck. The surgeon states that the longer he observed it the more he was struck with its resemblance to a gigantic salamander or newt. Its back was oval in form, no eyes or fins were seen. It did not spout or blow like a whale. The greater part of the head was not observed, as it was under water." There appears to be no manner of reason for doubting the very express evidence so soberly given, adds the editor in conclusion.

The next account of a different sea monster was given by Captain Drewer, and is chiefly taken from the log-book of the bark *Pauline.* "July 8th, 1875, 5 deg. 13 min. north latitude, 35 deg. west longitude, Cape San Roque, N. E. coast, Brazil, distance twenty miles, at 11 a. m.; weather fine and clear, wind and sea moderate. Perceived black spots on the water, and a whitish pillar some thirty feet above them—breakers as I thought. The pillar fell with a splash, and another arose. They rose and fell alternately in quick succession. A good glass showed me it was a monster sea serpent coiled twice round a sperm whale. The head and tail parts, each about thirty feet long, were acting as levers, twisting itself and victim round with great velocity. They sank out of sight every two minutes, coming revolving to the surface. The struggles of the whale, and two other whales that were nearly frantic with excitement, made the sea in their vicinity like a boiling cauldron. This strange occurrence lasted some fifteen minutes, and finished with the tail portion of the whale being elevated straight in the air, then waving backward and forward, lashing the waters furiously in the death struggle as it went down head foremost." Allowing for the two coils the captain estimated the length at from one hundred and sixty to one hundred and seventy feet, and seven or eight feet in girth. In color much like a conger eel. "It is curious," adds the World newspaper, "that the whale, that lives on the smallest food of any fish, should itself be a meal for another monster." It seems more curious still perhaps to find the sperm whale, whose powerful jaws have frequently crushed a whaler into splinters, thus confounded with the ordinary whalebone whale, a far less formidable mammal. The female sperm is only half the size of the male (about thirty feet only), very little larger than the grampus, but rarely the latter has been known to attain seventy-six feet, if reliance can be place on the statements of our whaling skippers.

The worthy captain mentions that owing to various circumstances which he enumerates, the north-eastern shores of Brazil are but little frequented by ships, etc., either for business or pleasure. "I wrote thus far," he stated, "little thinking that I would ever see the monster again; but at 7 a. m., July 13th, same latitude, some eighty miles east of San Roque, I was astonished to see the same or a similar one. It was throwing its head and about forty feet of its body out of the water in a horizontal position, as it passed onward by the stern of the vessel and disappeared. I was startled shortly after by the cry 'there it is again to leeward.' On looking in the direction indicated we saw the great leviathan grimly watching the ship, with about sixty feet of its body elevated in the air. The occurrence was witnessed by the officers, half of the crew, and myself, and we are ready at any time to testify on oath that we are not in the least mistaken."

Captain Smith, of the steamer *British Princess*, on his arrival at Philadelphia May 14th, 1889, reports that May 4th, latitude 44 deg. longitude 42-40, he saw an enormous sea serpent. He and the fourth mate were standing on the bridge. On looking astern he saw, one hundred yards away, a large black object sticking out of the water in a perpendicular position, like a long spar or buoy. He seized the glasses to make it out more plainly, and saw it was alive. The head resembled in size and shape the top of a beef barrel. The body, though completely submerged, could be plainly made out by the disturbance of the water around it, and three hundred feet away from where the head and neck stood out of the water the monster's tail was beating and lashing the sea into foam. The first officer of the ship adds, that he had been previously a disbeliever in sea-serpent stories.

The instances above enumerated form only a portion of the evidence that can be produced, but an important communication from the Bishop of Adelaide cannot well be ignored. The Australian mail, within the last few months, brought news of the Bishop's discovery of the carcass of a sea serpent at Avoid Point, near Coffin Bay, South Australia. "While riding along the sea beach," he states, "I came across a dead sea serpent about sixty feet in length. It had a head five feet long, like that of an immense snake, with two blow holes on the top, no teeth in the jaws. The body was round, [the dimensions not given, unfortunately,] the tail like that of a whale. Now we may reasonably infer that the monster thus described must have come to the surface to breathe the atmospheric air. So it appears very extraordinary that it should have escaped observation heretofore.

REPORT OF THE BIOLOGICAL SECTION.

Session 1891 and 1892.

Read at the Annual Meeting of the Association, May 12th, 1892.

The meetings of this Section have been held regularly during the past year, and although formal papers were not presented at every meeting, the members have come together and exchanged notes, in this way promoting that good will which is so characteristic of scientific men, as well as advancing the interests of the Association in general, and this Section in particular.

The notable exent in connection with the Section's work was the Annual Field Day of the Association held at Queen Victoria Niagara Falls Park on Saturday, June 13th, when a large number of members of the Section were present, and spent a very enjoyable and profitable time. The place chosen was a rich one for the botanist, and though the time was that which field-botanists call an *off time, i. e.*, between the going of the spring flowers and the coming of the summer ones, the field-presses of the weed hunters were brought home well filled. The President, Mr. Alexander, and Mr. Morris had charge of this department, and several plants, not hitherto in our collections, were added thereto. The Section was much indebted to Mr. Cameron, the head gardener of the Park, who is himself an enthusiastic plant collector, for many useful hints as to the locations where certain plants were to be found, and for the personal help he gave in collecting the same. Mr. Cameron is making a collection of all the native plants found in the Park, and has very kindly offered us duplicates to place in the Association cabinet.

At the meeting held on March 4th, 1892, Dr. Mole read a valuable paper on the Origin and Development of the Horse. The paper was made very clear by the numerous illustrations used and the specimens of various parts of the horse's skeleton shown.

The Section had before them a communication from Mr. Adam Brown, enclosing a letter from Lady Blake, calling attention to the Marine Biological Station, proposed to be established in the island of Jamaica. Lady Blake and her husband, the Governor, are promoting the scheme. The Section, by resolution, approved of the idea.

During the season several hundred of specimens of British plants have been shown at the meetings of the Section, by the President. These plants have been collected and named by Wm. Hussey, Esq., of Salisbury, England, and Master William Rendell, of Whitchurch Canonicorum, Dorsetshire. The examination and comparison of these beautiful specimens has given the members of the Section a great deal of pleasure and information, and the Section feels under great obligation to these friends for their kindness. It is proposed to set apart a distinct portion of our Botanical Cabinet for this collection. About fifty distinct species of Alpine plants, collected by Miss Alexander in the Tyrolese Alps, during the summer of 1891, were also exhibited at one of our meetings.

In addition to these a fine collection of West India Ferns, comprising no less than about one hundred and fifty distinct species, was presented to the Section through Mr. Alexander by Mr. Adam Brown. The names of these beautiful specimens will be given in a subsequent report when they have been classified and the names verified.

We have also had pleasant and instructive seasons with Messrs. Turner, Chapman and Leslie, and their microscopes, revealing thereby to us the marvelous and beautiful which is hidden in the minute things of animal and plant life and structure.

A. E. WALKER,
Chairman.

THOS. WM. REYNOLDS, M. D.,
Secretary.

A FEW NOTES *RE* THE SEASON OF 1891.

Read before the Biological Section.

BY D. F. H. WILKINS, B. A., BAC. APP. SCI.

Headmaster High School, Beamsville.

The season opened early, after a short mild winter.

Crows were first seen February 6th.

Sugar making was begun March 4th.

A robin (not a resident) was seen March 10th.

Frogs first heard March 23rd.

Growth commenced March 28th.

Bulbs of Adder-Tongue Lily sprouting, and Scarlet-Cap Lichen abundant, at this date.

Hepatica and Spring Beauty in flower April 2nd.

Adder-Tongue Lily in flower April 4th.

Blood Root in flower April 6th.

Red Maple in flower April 12th.

Marsh Marigold in flower April 12th.

Dicentra cucullaria, also D. Canadensis, in flower April 15th.

True Anemone in flower April 16th.

Cuckoo Flower, Skunk's Cabbage and Cursed Crowfoot in flower April 15th.

Red and White Trilliums in flower April 20th.

Sugar Maple in flower April 24th.

Hooded Violet, Beaked Violet, Yellow Violet and Sweet Violet, White Birch and Water Elm, in flower April 24th.

Indian Turnip in flower May 4th.

First Golden Rod *(Solidago Canadensis)* in flower July 20th.

First Aster *(Aster lævis)* in flower July 20th.

Sugar Maples beginning to turn in color September 22nd.

Red Maples beginning to turn September 25th.

Maples in full flush October 10th.

White Oaks turning, also Red Oaks and Scarlet Oaks commencing, October 10th.

Maple leaves falling first November 4th.

The last Golden Rod (*S. Canadensis*) seen in flower, also the last Asters (*A. longifolia, A. pumicens*) November 17th.

Malva sylvestris in waste grounds, also Larkspurs (*Delphinium*) in flower November 27th. (*Note.*—These were growing under the shelter of some pine and fir trees.)

First (very light) frost September 21st.

First heavy frost October 11th.

First (light) snow November 17th.

First heavy snow (six inches depth) November 27th and 28th.

Ground not frozen on December 14th.

NOTES.

1. The dates of the arrivals and departures of the migratory birds, those of the crow and the robin excepted, are not given because not accurately recorded. The arrivals occurred, however, earlier than usual, the departures later.

2. The heavy drouth of May and June, succeeded by equally heavy rains and much evaporation in July and August, produced cool weather, much prolonging the season. The dry and warm weather of October and November served the same purpose.

3. In consequence of this, second crops of strawberries and wild raspberries were gathered, one farmer supplying a store with red raspberries (*Rubus triflorus* and *R. strigosus*) during the months of September and October. Second crops of black raspberries have also been reported.

GENERAL NOTES.

1. *Potentilla anserina* and *Vicia sativa*, now common in certain fields near the lake shore, were, prior to 1867, unknown in this locality. At this time it will be remembered that a third rail was laid on the Great Western Railway track in order to enable the wheat cars from the Western States to pass through to the East. From some of these cars were dropped at some time or other the seeds of these two plants, for the species were seen shortly after the spring of 1867.

2. The common Teazle (*Dipsacus umbellatus*) was introduced into this locality by the Mennonite settlers from Pennsylvania, their ancestors having previously brought the plant from Europe for the purpose, as is well known, of preparing wool for spinning and weaving.

3. The Black Cohosh (*Cimicifuga racemosa*) formerly common in this neighborhood, is now extinct. It is cultivated by several persons in the village of Grimsby and in the adjacent county, being regarded by many as a sovereign remedy for rheumatism.

4. In the Atlantic Monthly for October, 1862, was published an entertaining article by the late Henry D. Thoreau, the famous New England naturalist. The article is entitled "Autumnal Tints," and has been reprinted in a volume of miscellanous essays by the gifted author. While much of the article agrees with what is noticed in Ontario, the present writer, after many years' observations in different parts of the Province, feels that there must be a great discrepancy between some of the facts as given by Mr. Thoreau and the same facts as noted by himself. Thus, according to Thoreau, the red maple is the earliest tree to change the color of the leaves and shows the brightest tints, the average date for the change being September 22nd. The sugar maple does not follow for some two weeks, and is much less brilliant and varied in color. Then follow the elms, hickories and other trees, and finally the scarlet oak in November, showing a wealth of scarlet and crimson unsurpassed except by the red maple. The present writer, however, has noticed that the sugar maple displays the greatest wealth and variety of color, varying from lemon yellow to scarlet, blood-red and crimson; also that it is the earliest to change, its average date being about September 17th in the more northern parts of the Province, and September 24th to 27th in the more southern. The red maple, on the contrary, with a few exceptions, in its native haunts presents a dull red or even a brownish red color, and changes on or about October 2nd. The few exceptions referred to are some trees which show partly green, partly red colors in blotches, probably the most beautiful leaves of all. Again, too, the scarlet oak turns in color about October 6th, and the leaves fall before the end of the month; moreover, they do not present the brilliant red attributed to them by Thoreau. The present writer is not aware of any systematic attempt to ascertain the dates of the change of tint of our more common forest trees nor of any observations regarding the variability of the change. He is not aware whether anything has been published to show that change of color depends upon or does not depend upon soil, dryness of the season or surroundings of the trees. If any thing has been done by any other members of the Association it should be published.

5. The present writer is not aware that the following has ever been made generally known. On the Post-cænozoic clays (Erie and Saugeen clays of our Geological Survey) the pine timber grown is soft and easily workable, while that grown on the Medina clays is hard and brittle. It is the intention of the present writer to prepare a few slips of each for the microscope and to examine them. The most plausible view appears that the larger percentage of silica in the sandy soil has something to do with the state of the wood, but it were safer not to speculate until observations have been made.

NOTES ON BIOLOGICAL SUBJECTS.

Read before the Biological Section of the Hamilton Association, during the Session of 1891-2.

BY WILLIAM YATES, OF HATCHLEY, ONT.

I.

Scarcely a summer passes without offering something singular in the floral or vegetable world; and gardeners and tillers of the soil have many opportunities of detecting and making note of these freaks and deviations from the ordinary routine of plant growth. Several such instances of abnormality occured and were noted by me during the growing season of 1891, to wit :—A peculiar instance of the phenomenon called "Fasciculation," occurred in a garden in the township of Burford. The specimen was found amidst a large group of Sunflowers, *Helianthus annuus*, and what at first sight seemed a *single* head of unusual size, proved on further development to be a combination of *three* heads. The line of juncture was distinctly traceable by the green scales or sepals of the involucre, and also by the yellow ligulate florets of the ray forcing themselves distinctly into notice amid the florets of the disc, and in lines that bisected the circular outline of the usual sunflower head. This was done as accurately as if the same problem had been propounded to a student of Euclid.

The deviation from the ordinary growth of these flowers suggested the question to my mind whether this was an instance of a partial reverting to the ancestral type of the Helianthus? What would seem to make this supposition a natural one is the fact that a common *wild* form of the Sunflower is the species *divaricatus*, which we have often found growing in the woods not far from here; and florists know that by cutting back side shoots the vigor and bulk substance of many plants and shrubs can be concentrated in a single stem.

I may add that I had some reason to conjecture that the oddity of floral growth, that we have described above, was the result of an injury or bruise to the plant at an early stage of growth, as about that time the spot where the Helianthus grew was annoyingly trespassed upon and much trampled by a flock of turkeys.

II.

Another eccentricity in one of the wild, weedy growths that spring up so frequently in neglected corners of our fields, occurred last August in a plant of the the tall golden-rod, *Solidago Canadensis.* The stems of these plants are sometimes deformed by a peculiar enlargement or excrescence (balloon shaped). These enlargements are hollow and are almost always found to contain the larva or pupa of an insect, and are probably the result of a puncture by the parent insect.

The unusual circumstance noted this season was that the enlargements were at the very summit of the stem, and were of the shape and size of the egg of a bantam chicken instead of being turbinate in shape. The puncture, if such was the cause, seemed to have been made in the *axil* or point from whence the branches of the panicle divide off. These latter, which are perhaps more properly termed peduncles, were much shortened and seemed to grow at slight distances from each other out of the upper and narrow end of the ovate excrescence. A number of these peculiarities were seen this year and never previously. The other common species of golden-rod, *S. latifolia* and *S. ulmifolia*, have never been noticed to be deformed by those interferences.

As an instances of the imitative principle in vegetable growth, our attention was lately arrested by a form of parasitical development of, I think, the poison ivy *Rhus toxicodendron.* The plant had shed its leaves, therefore we could not take time to identify, but the general outline and form and color of the shrub, as it clung in hideous snake-like contortions of a venomous purple tint, to the tall trunk of a swamp-ash tree, suggested the abhorrent function and malignancy of an enormous *Scolopendra.* The innumerable radicating tendrils typified and suggested the myriad feet of the detested centipede! And the greyish-white bark of the victimized ash tree afforded a background that set off the outline and complexion of the vampire-like encumbrance with wonderful force and perspicuity.

III.

Many traits in the growth of climbing plants exemplify analogous principles and methods to be found in the life and habits of Ophidians. Notice the growth and function of the tendrils of the grape vine. At first straight and tender, but on coming in contact with a neighboring twig a spiral coil is immediately formed around the foreign support, and something similar to muscular contraction is noticeable, and the grip on the support or trellis is as tenacious and crushing as the constriction of the serpent on its prey. Even in the life and growth of the pea vine, or in that of the diminutive parasitic *dodder* whose tendrils, on coming in contact with the succulent stems of the wild balsam or with the soft new shoots of the raspberry, show a willfulness of grip that seems almost crushing and sanguinary, while from the tendrils of the dodder sharp root points pierce the substance of the victimized plant and leech-like imbibe therefrom life-sustaining fluids. Also when climbing plants have grown to the height of their supporting poles, the extension of the climbing stem is for a time continued into vacant space, and its graceful swaying motion when acted upon by a slight breeze, forcibly brings to mind the proceedings of our common snakes when making excursions among bushes and saplings in quest of living prey.

IV.

An incident that occurred in this locality a few years ago demonstrating the noxious qualities of the common purple centipede or thousand legged worm of the North American woods may, perhaps, be fitly recorded here.

A settler, who dwelt in a log house in the midst of his clearing, was appealed to early one morning by the alarming cries of one of his children, a boy nearly four years of age, who had just finished dressing himself. He complained that something was severely hurting the sole of one foot immediately after he had put his boot on. The boot was at once unlaced and removed, and on examination one of the purple centipedes, which appearances indicated had crawled out of the timber logs of the house during the night, was found inside the boot. On examining the child's foot a livid mark the size and form of the odious myriapod was distinctly imprinted on the skin, and remained for a number of hours.

Both the child and the father were well known to me, and I was told of the circumstance at the time of its occurrence.

V.

In the early part of the month of June last I had the pleasure of a jaunt through a district of Ontario entirely new to me, that is, from Elora through Fergus and on north-east to Bellwood, thence through Garafraxa, Eramosa and Erin townships. The weather was superb, and the fields and woods in the exuberance of summer garniture. After leaving the Grand River valley the topography is in marked contrast to the slightly undulating surface of Burford and adjoining townships. In Garafraxa and Erin vast irregularly shaped mounds of sand or fine gravel are of frequent occurrence, and in some hollows large groups of erratic surface boulders attract the notice of every passer by. There are but few swamps, and when such occur a growth of cedar instead of the black ash, elm, and swamp maple of other districts is here a well marked feature. The country is well cultivated and improved, stock keeping and root culture being a prominent line of farming.

A very marked feature of the district was the paucity of bird life. We had just left a region where the woods resounded with the music of the scarlet tanager and the hermit thrush, as well as that of innumerable small warblers, and where the meadows were musical with the notes of the bobolink, oriole, song-sparrow and meadow-lark; yet, in these townships of East Wellington, during two days' travel, we only saw about half a dozen individual birds! one being a shore lark, *one* swallow, *one* pewee flycatcher, *one* grackle and *a crow or two!!* The diminution in the number of birds became obvious after leaving the vicinity of Elora, as about that place there are many deciduous trees among the cedars and other conifers that are still found growing in and south of that locality. We were induced to surmise that the absence of the black ash, soft maple, and swamp elm trees, in the lowlands of these parts of Wellington county, might account for the paucity of the birds which are found in such profusion among that kind of vegetation elsewhere. As is well known, the hosts of summer warblers find sustenance on the insect larvæ that prey upon the foliage of the above-mentioned trees, the leaves of which are much disfigured and corroded every summer by the ravages of caterpillars; hence the warblers and insectivorous birds generally are a sort of corollary to forest garniture. Apple and fruit orchards are also more sparse northwards from Guelph than is the case in the south-western counties of Ontario, and it is well-known that to a host of birds of the thrush and warbler families, as well as the cuckoos and finches, the orchard is a natural habitation. Even the yellow-finch and the warbling vireos, so ubiquitous in other counties, were here conspicuous by their entire absence. The road-side herbage seemed also to be of a less varied character than that to which we had been accustomed. Even the blue-weed (*Echium vulgare*) which had in such large measure taken possession of waste places and railway embankments in so many places, had only just got a precarious footing here.

The Duke of Argyll remarked on the absence and assumed musical inferiority of the song-birds of North America. It seems to be admitted that our songsters are more shy and elusive than those of Western Europe or Britain. Is it not probable that such a condition of affairs may be attributable in part to the absence of hedges of hawthorn and other berry-bearing shrubs by which fields are all but universally fenced and surrounded, and which form such a conspicuous feature in the British landscape? Our song-birds are in number *legion*, and many of them have exquisitely melodious powers of song, but are only to be seen and heard in the most secluded recesses of forests and swamps; and years of residence and close observation are necessary to gain a familiar acquaintance with them. Food and shelter from hawks and similar predatory enemies are the necessities of existence to these, and it is possible that if the broad bosom of Ontario should ever be marked and adorned by growing fences and tangled thickets (as of the dog-rose and honeysuckle), warblers of many species would come in throngs to sing and enliven our dwelling places.

In the vicinity of Elora several species of plants, new to us and never met with in Brant County by us, were observed, *to wit:* On the sides of the rocky precipices about the river valley at Elora, one of the most interesting species of fern is the Rock brake (*Pteris gracilis or atropurpurea*). In its general aspect this does not much resemble the common ferns, but the fruit dots are borne on veins of the frond near the margin.

In the woods bordering the rocky chasm, *Aspidium acrostichoides* and *Asplenium thalicteroides* were common, and *Adiantum peda-*

tum was abundant in some spots. A species of *veronica*, very much like *Hederifolia*, was also very widely diffused, and the dwarf maple *Acer spicatum* we found very prevalent among rocky debris on the flats of the Irvine and Grand River, where also the dog's bane shrub was common; and we were also shown a rare species of primula (*P. Mistassinaca*), that had been found growing on the river flats, by Col. Clarke, of Elora.

In a cedar swamp bordering the same stream, the large purple cypripedium was just coming in flower, and that peculiar shrub which so frequently puzzles the inexperienced botanist, *i. e.*, the alder leaved buckthorn, (*Rhamnus alnifolia*), was as abundant as it is in some of the bogs of Brant county; although this shrub is classed in Polypetalæ, in this particular species the petals are wanting! and the branches are thornless! We also noticed a variety of Antennaria, nearly like, but not quite, *A. Margaritacea*, or pearly everlasting flower, the difference was in the remarkable angles of the stem and peduncles. In Brant and Oxford counties that pretty adventurer, the Snowy Campion (*Silene inflata*), has only begun to put in an appearance on some of the new railway cuttings, but it is a troublesome weed in the turnip fields about Elora, and although the blue iris (*Iris versicolor*), which so lavishly adorns the boggy spots in Burford and Brantford townships, and the dense growths of the cerulean vervain (*Verbena hastata*), which so attracts the eye in ill-drained hollows in Oxford county—are absent in these parts. A number of less showy interlopers are making good headway as the white melilot (*Melilotus alba*), which is becoming abundent in many places on the railway track about Fergus, and occasionally, that capparid, from the gravelly Lake Erie shore (*Polanisia graveolens*), and also the tufted vetch (*Vicium cracca*), and we were also informed that the yellow ox-eye daisy, (*Rudbeckia hirta*), was, in many places, proving troublesome.

Whilst rambling late in the afternoon with a friend along the wooded banks of the Grand River, below Elora, our attention was called to the continuous (with slight intermissions) song of a scarlet tanager. The bird was perched on the very highest branch of a tall maple tree, and, singular to relate, that was the only branch on the tree that was destitute of leaves; the singer kept turning slightly from side to side, with his glistening red breast facing the declining sun, as if showing off, with fuller effect, the gorgeous radiance of his plumage. We have noticed the same proceeding from the top of decaying trees by the same bird in Burford township. The blue bird also seems to have an æsthetic taste as regards colors, for we have several times found its nest with the lining interwoven with the brilliant blue feathers of the owner's wing. One may here remark that the brilliant ruby tints of the tanager's plumage seem to be like dove's neck lustres, very superficial, and like the peach bloom on the human countenance, a sign of high health and condition, and rarely preserved in cage confinement, in fact, a friend who had several tame tanagers tells me that in the second or third month his birds became of a bronze color.

REPORT OF THE PHILOLOGICAL SECTION.

Since its previous report to the Association the Section has held eight meetings, at which papers were read as follows:

May 28th.—"Peculiarities in Hebrew Grammar," as seen by a student accustomed to an Aryan language. J. F. McLaughlin, B. A.

September 17th.—"Metaphysical Theories on the Origin and Development of Language." S. A. Morgan, B. A.

November 19th.—"Phonetic Spelling." C. R. McCullough.

December 17th.—"The Versification of Chaucer's 'Canterbury Tales,'" with especial reference to the "Prologue." Chas. Robertson, M. A.

February 18th.—"The Supposed Etymological Value of Silent Letters," based on the words occurring in Skeat's Etymological Dictionary from from A to G. A. W. Stratton, B. A.

March 16th.—"Two Proposed World Languages," "Lingo Internacia" and "Anglo-Franca." H. P. Bonny.

April 27th.—"A Simplified Alphabet for the Deaf and Dumb." C. R. McCullough.

"A Revised Spelling," a plea for consistency with the slightest possible change. James Ferres.

The meeting of October 15th was devoted to a discussion of Mr. Morgan's paper, and on January 21st, owing to the absence of several members because of illness, no formal meeting was held.

Less work has been done during the past year than had been expected, partly because of the little time at the disposal of most of the members, but chiefly owing to the lack of suitable books of reference, which, while they are of little interest to the general reader, are indispensable to the student.

Reference must also be made to the heavy loss sustained by the Section in the death of its late chairman, Mr. Charles Robertson, whose interest in the work was unceasing, while his scholarship was probably unequalled in the city.

A. W. STRATTON,
Secretary.

H. P. BONNY,
Chairman.

METAPHYSICAL THEORIES ON THE ORIGIN AND DEVELOPMENT OF LANGUAGE.

Read before the Philological Section September 17th, 1892,

BY S. A. MORGAN, B. A.

It is no doubt evident to us all, that any principles we deduce concerning the origin and the nature of a primitive language must necessarily be of a theoretical character. When, however, we consider that the faculty of language, *i. e.*, the power of symbolically communicating our ideas by means of articulate sounds, is dependent on the possession by the individual of certain intellectual and physical functions, and must therefore follow their operations ; and when we further consider that science enables us to investigate both the nature of these necessary functions and their order of development, we are led to believe that any logical theories we may deduce in such an investigation will not only prove of interest in themselves, but will also tend to furnish some explanation of the variations in form and grammatical structure to be found in existing languages.

The few thoughts I shall offer in this paper may be arranged under the following heads :

(1). Definition of Language.
(2). Existing theories on the origin of Language.
(3). Offices of Language.
(4). Conditions of Language.
(5). Nature of first elements.
(6). Processes of development.

DEFINITION OF LANGUAGE.

All creatures, whether men or animals that possess the gregarious instinct, or tend to live in herds, being bound together by a common feeling, may be supposed to desire and seek after some means of communication. This instinctive desire, aided and developed by experience, has produced in man two forms of thought communication.

We all no doubt have seen that it is possible, by noting the variations in the tones of the cries of animals and man, or by observing the changes in their features and forms of gesture, not only to know what may be the dominant feeling at the time, but also to form an estimate of the character and disposition of the individual. Taken in its most extended meaning, language might include any such signs by which one intelligence is enabled to interpret the mental modes of another; and this form of thought or rather feeling expression is in fact often spoken of as absolute natural language.

In these cases, however, it will be observed that this visible element or sign, by means of which is formed an estimate of the present mental state, is not in any exact sense a representative symbol of the invisible spiritual mood. It is in fact an essential result of the latter which experience has taught us to associate with it as an ever present accompaniment. But beyond this there is another aspect in the communication of ideas, wherein the sign or symbolic element cannot be said to have any necessary connection with the communicated idea, but is simply an arbitrary or conventional sign for the same.

As an illustration of this distinction, we may suppose that (leaving out of consideration national peculiarities) there would be an equal softening of the eye accompanying the 'zōe mou sas agapō' of the Greek, or the 'Ich liebe dich' of the German, to that noticed in the like confession of our Saxon youth. In each of these, however, we find a wide difference in the conventional elements.

An explanation of these two forms of language may be found in a consideration of the nature of knowledge.

Feeling and thought are the primary or ultimate elements of knowledge. Feeling being a 'mental affection' resulting from changes in the physical organism, and, in so far as it is pleasant or painful, 'impelling to organic action,' it becomes evident that these organic movements will furnish an index to the accompanying mental state.

Thought, on the other hand, being the 'apprehension of relations' and objective in its nature, will lack these outward physical expressions. It will thus require other means of communication, which, for the same reason, must be of a conventional form. The one then may be said to be the language of feeling, the other the language of thought.

Another distinction must be made between the natural signs of articulate speech and the artificial signs of writing, etc. But spoken language being evidently prior to written, a fact which history herself teaches, and the language of physical expression, although an earlier form, admitting of no definite treatment, on account of its subjective and individual character, it necessarily follows that any investigation into primitive language must concern itself with the second of these forms. We shall, therefore, in this paper understand by language the representation of mental modes or ideas by means of conventional articulate sounds.

EXAMINATION OF EXISTING THEORIES.

The existing theories on the origin of language may be divided into the following classes:

1. The theory that man at his creation was endowed with a perfect language, which, as his knowledge grew through experience, he was enabled to apply for the purpose of fixing his acquired knowledge. This theory supposes that language may precede thought and exist without it. Experience teaches us that the very opposite to this is the case; for when thought is destroyed language must cease, whilst on the other hand, when the power of speech has been lost, thought may proceed by means of other signs. Moreover, granting the possession by the first man of such a language, his words would be to him but meaningless cries, and the formation of language proper would still remain to be worked out.

2. The second view, which goes to the opposite extreme, supposes language to be a human invention, adopted by mutual compact for the convenience of man. Such a view must err, however, in the fact that the ability to invent and adopt implies that the race had made considerable advancement, whereas, as will be seen later, thought can make no advance without some form of thought representation. Moreover, the very fact of a mutual compact implies the possession of some form of thought communication.

3. A third view looks upon language neither as a ready made gift, nor as a human invention in the strict sense of the word, but rather as a conscious growth accompanying and dependent on mental development. In other words, that the gift of intelligence implies a two-fold power, power of thought and power of thought expression. This theory, which seems the only one void of contra-

diction, is the one we shall accept and attempt to enlarge upon in the present paper.

OFFICES OF LANGUAGE.

Four distinct functions are set forth as belonging to language: (1) to preserve thought; (2) to analyze thought; (3) to facilitate thought; (4) to communicate thought. It must appear evident, and will be made even more clear, when we come to consider the psychological conditions of speech, that to suppose any of the first three to have been motives in its production would give an appearance of mechanical design to the origin of language wholly at variance with its physical nature and the mental conditions of the primitive race; since they would imply the exercise of the reasoning powers. But we shall there see that these must make use of symbolic representation in their very development. The last of these motives, however, being but an instinctive desire, implies but the lower stages of mental growth, which stages are not dependent on representation for their operations. But we shall here offer a theory somewhat at variance with that usually accepted. We hold that the motive power underlying the origin of language was no more a desire to communicate our own thoughts to others, than it was a desire on their part to interpret properly the thoughts and feelings of fellow-beings in whom they took an interest. As the reasons upon which this theory must rest will come up later; we defer its further consideration till that time.

CONDITION OF LANGUAGE.

It has been seen that the office of language is symbolic or representative. The elements of language, when used as such, are not in themselves real objects of attention, but representative symbols of objects of past experience. Thus the development of speech in the primitive race will imply the possession by them of the symbolic power or faculty with whatever other intellectual development appertains thereto. This consideration will necessitate a brief mention of the mental powers and their order of development.

The intellectual faculties—faculties of knowledge—are divided into three general classes:

1. Those connected with the acquisition of knowledge, including (a) sensation and (b) perception.

2. Those connected with the representation of knowledge, including (a) phantasy, (b) memory and (c) imagination.

3. Those connected with the elaboration of knowledge, including (a) conception, (b) judgment, (c) reasoning.

Sensations may be described as mental modes or affections resulting from the application of external stimuli to some part of the physical organism.

They are the primary elements of conscious life and of all knowledge. But being simply an affective or subjective state sensation does not in itself constitute knowledge. While however sensation does not constitute knowledge, it is seen to contain an element of knowledge; since in sensation there is a tendency to refer the subjective state to some non-subjective cause, which is thus brought into relation with the feeling self.

Perception, on the other hand, differs from sensation in being a constructive as well as an acquisitive faculty; for in this process the 'vague data of sensation' are first differentiated and recognized as belonging to different senses. Secondly, they are supposed to be at a distance from us, or given a position in time and space. Thirdly, they are united into a group, and supposed to have an existence independent of the perceiving mind.

These two faculties will give us a certain form of knowledge concerning present objects, brought into relation with the knowing self. But they will not in themselves lead to the formation of word signs; since they imply an ever present object on which the attention is fixed.

The interaction of these two faculties however will lead to an additional result. Although sensations are but vague sensuous affections, as states of pleasure, or pain they powerfully arouse the attention and direct it in search of an external cause. Perception of the non-subjective cause of the sensation having taken place, this feeling of pleasure or pain at once creates an interest in the external object. This done, there takes place what is known as the "transference of feeling" from the knowing mind to the known object. The sweetness is in the sugar not in my consciousness. The mind in this way looking upon the perceived object as a symbol of the subjective sensation, will have taken its first step toward mental representation. Word signs, however, differ from these in the fact that the association existing between the sign and the idea is in no way real or necessary. This fact will imply the introduction of still higher forms of mental growth.

This higher form of representation arises after the following manner. The mind now being able to obtain a definite perception of present objects, the accompanying subjective states become fixed modifications of the knowing self, and as such liable to recur in consciousness without the stimulus of the external object. In the first stage, which is known as phantasy, these ideal images, although arising without external stimuli, are supposed to indicate such a presence. A marked peculiarity of these ideal sensations, however, is their difference of degree, as well as their difference of origin. The process of attention working on these differences enables the mind to distinguish the ideal from the real. The mental activity now being able to distinguish ideal feelings as such, is further enabled through identity of modification to recognize the ideal state as having formerly occurred in consciousness. This aspect of the representative faculty is known as memory.

But attention now being able to fix itself on ideal sensations as such, acquires the ability to separate the qualities of an object in their natural state, and to combine them in new and arbitrary forms. This stage, which is known as imagination, would at once enable the mind to form the arbitrary associations seen in word signs.

The higher forms of knowledge must now be considered. The elaboration of knowledge takes place when the process of attention is able to bring any of its individual percepts together and establish a relation between them. Since, however, it is impossible for the mind to fix itself on two objects of immediate knowledge at one and the same time, it becomes evident that symbolic representation is not only possible but necessary before these higher forms of thought are reached.

It thus appears to have been on no unphilosophic ground that memory was represented by the ancients as mother of the muses; since she is not only a necessary condition of power of speech, the *sine qua non* of all progress, but also the forerunner of that imaginative faculty, by which have been produced the various art forms of use and beauty on which the highest skill and taste have been exercised.

Having now considered the various steps in the development of mind up to that stage where the creation of symbols seems possible, another important question remains to be answered. Though the primitive man may possess intellectual powers suitable for such a task, can we give any reason why this privilege will be embraced? Can we furnish any motive or end for the origin of symbolization?

Under pleasure and pain may be summed up all the motives or ends of action. These being but two aspects of our feeling states, it follows that the discovery of a motive will demand a consideration of the development of mind on the feeling side.

We have already noticed above that our states of feeling naturally fall into two broad classes. The sensation, as an affective state, produces pleasure or pain. This is sometimes spoken of as the primary form of feeling, being consequent on physical changes. We also noticed, however, that by the transference of feeling higher forms of emotional growth might be attained. Let us inquire then whether in these two classes (sensations and intellectual emotions) there exists a motive for the representation of our ideas.

It has been a prevailing idea that the desire for speech arose from the necessity of seeking aid to satisfy our bodily wants, such as food, help in distress, protection, etc. Though these desires may imply some emotional growth, you will see that they point to the sensuous element as a motive, an hypothesis which we cannot accept. We affirm and shall attempt to show that the motive lay in the development of the emotions rather than in sensuous feeling.

In order that we may be the better able to judge the respective claims of these two ends, we shall lay down what appear to us the necessary laws governing the motive or end, naming them as follows:

1. The Law of Sufficient Motive.
2. The Law of Frequent Recurrence.
3. The Law of Adequate Means.

By the law of sufficient motive is meant that, since language is a means of communication between individuals, there must have existed a mutual desire between the person communicating and the person interpreting the thought. It was to this we referred when we affirmed above that language did not come solely from the desire to communicate our thoughts to others.

The law of frequent recurrence affirms the principle that the motive must have been sufficiently frequent to remove any possibility of the loss of past steps in the symbolizing of thought through lack of having them fixed in memory by repetition.

The law of adequate means implies that the motive must be provided with such external accompaniments as will supply suitable means or characters for the symbolizing of the idea.

Examining the claims of sensuous feelings by these standards, we shall find :

1. That being individual and anti-social, they violate the law of sufficient motive.

2. That if the circumstances of the primitive races were such as to cause a sufficiently frequent recurrence of these bodily wants, it would be impossible for such a people long to maintain existence against such circumstances.

3. Being confined to single organs they do not cause that diffusion of feeling necessary to idea interpretation.

Passing to a consideration of intellectual feelings, we find :

1. Since they imply a universal interest in the external, they are social in their nature and therefore furnish a sufficient motive.

2. Being accompanied with a 'wave of excitement' which spreads over the whole organism and leads to bodily movement, they consequently supply adequate means of symbolization. The fact that they 'arise more slowly and subside more gradually' than sensuous feeling is another cause for the same.

3. Nothing, I think, need be said of the law of frequent recurrence when we consider the effect of a wide world of undiscovered relations on the void but plastic mind.

And now two further questions naturally present themselves to to the mind : 1st. What objects in nature likely awakened these emotional states in primitive man? 2nd. What symbols were likely made use of for their representation? These two questions we shall now consider.

THE FACTS OF KNOWLEDGE.

Having seen that language arose from an intellectual source, it will follow that such objects as are likely to awaken intellectual activity would be the first to be represented symbolically. These we affirm to have been acting things, or objects of perception in a state of motion. This is proven both by experience and by reason ; by experience through observation of the first signs of attention in children and in savage races, in both of which loud noises, bright and flashing lights, swinging and sounding bodies seem most suitable for arousing attention; by reason, since philosophy teaches us that every affective state is but the result of impressions on the senses from some moving body. We may thus suppose that in primitive man the more marked forms of motion would be necessary to impress the unplastic mind of such a state.

SYMBOLS OF KNOWLEDGE.

We saw in our consideration of the sufficient means of representation, that the emotions are accompanied with 'waves of excitement,' which spread over the organism, resulting, on the one hand in certain impulsive gestures, and on the other in the utterance of certain sounds. One or both of these would likely be employed. But the first being so much less subject to conscious control, while supplying a suitable symbol for the internal state, would naturally give way to the second for purposes of arbitrary association.

But it is evident that that these primitive sounds would be to a high degree impulsive, and for that reason, and further because in them the 'thought' element would be as yet but faintly apprehended, we may suppose that at this stage there would be an excess of the 'sound' element. Again, because they were long and for the most part imitative, they would possess the musical element as seen at the close of such sounds. Summing up, we may affirm of our first words: (1) They were impulsive and imitative. (2) They were long or polysyllabic. (3) Equivalent to whole sentences.

We now see that our first perceptions give but vague ideas of objects possessing emotional interest, consisting of acting things; and that to denote these we would make use of certain long sounds as symbols of both the object and its interest. These would consequently form one primary class. Such a perception however contains two elements, object and interest, and attention being aroused would lead to their division in the mind. Thus our primary class will give rise to two, viz: object class and interest class. The attention, now passing from the object to its interest, or activity, would lead to a further division of these activities into, accidental or molar activity on the one hand, giving rise to the verb; and essential or qualitative activity on the other, giving rise to the adjective. The whip would equal the striking thing; the sugar the sweetening thing. This would have given rise to our three principal parts of speech, noun, adjective and verb. And as these form the three essential parts of speech—the others being but conveniences of language,—we may suppose that they will show the earliest forms of grammatical development.

It was seen that attention, fixing itself on the vague and primary elements of knowledge, soon enabled the mind to classify them into the three above classes. But this attention, now bringing these classes into relation with one another, would lead to a further discovery of new relations, and a consequent desire of their representation. By what means was this to be effected? Existing languages show two methods for effecting this. 1st, by varying the form of the word whose idea is modified; 2nd, by position and symbolic relational words. The second of these methods would evidently be impossible at this stage; since all words would contain the sensuous element to such a degree that the mind would not be capable of that freedom of thought necessary to the use of symbolic words. Granting then that inflection is the primitive method of noting modifications, from what source did it take its rise?

We have seen that the general character of our primitive word was length of sound and vague intellectual reference. In this superfluous sound attached to the word would be found a ready means for the representation of these new relations. Any familiar word being often used in a certain relation, and having its final superfluous sound used for such a purpose, would soon by analogy set a type for all kindred words when used in a like relation. A strong proof in support of this theory is to be found in the fact that inflections always contain a musical element. For a marked characteristic of all inarticulate cries is that they generally end with a somewhat musical tone.

But at this point another result must be considered. We have noticed that the first words were long and intellectually vague, but that the elaborative faculties being exercised on these vague elements, would bring about an enlargement of their intellectual import, and an increased definiteness in the idea itself. But it is evident that the mind, fixing itself on the intellectual import of the sound, would, on the principle of undivided attention, decrease the flow of energy in the direction of the physical sound. This fact would at once produce a tendency to shorten these long sounds. In other words they would tend to become monosyllabic. Thus in cases where this shortening had taken place before the power of noting relations had been properly developed, other means of representing them would be sought. But as at this early stage the physical element would still be comparatively strong, the musical element would lead to the adoption of internal change or vowel gradation as an additional method.

Since, however, it is a universal supposition that inflections arose from another source, the relative claims of the two theories must now be considered. The prevailing theory has been that, since imagination and conception in their development produces the tendency of dropping from the mind the accidental qualities of an object of thought, and as this tendency enlarged will produce pure symbolic words, inflections may have had their origin by the addition of these to the word. That the former view, however, is more consistent must appear from the following reasoning :

1. The latter view supposes that the noting of relations was postponed until such intellectual propress had been made as would enable pure symbolization to take place. The history of symbolic words, however, shows them to be the product of an advanced state of thought.

2. The musical element in inflection points to its primitive nature as opposed to a symbolic origin.

3. All late developments, the result of linguistic revolutions are marked by analytic means, and never make use of flection, which fact would imply that flection was a characteristic of early developments alone.

4. Our view of the origin of flectional endings and internal change would be strengthened, if it were found that people whose early development showed a marked progress on the objective side made use for the most part of flectional endings.

For the *objective* mind directing its flow of energy toward the external matter would at once acquire great discriminating power. It would be intellectual, critical, an examiner of external nature. Such a mind would early require verbal distinctions to accompany this discriminating power, and would thus overtake these decaying final sounds and retain them for such a purpose. But the *subjective* mind, looking only within, is emotional, figurative and non-scientific, and thus lacking discriminating power, would be late in noting external relations, and must consequently make use of internal change.

Such a condition is found in the primitive Aryan languages as compared with those of the Semitic group. The first people being the critics, the natural philosophers and the explorers of ancient times, also make use of flectional endings. The latter being the egoistic, emotional and monotheistic races of antiquity are likewise found to use this secondary means.

We shall now conclude with a short note on what might seem an objection to the view that language arose from emotional development. It might be supposed that, since the inarticulate cries of animals are frequently indicative of pain, the sensuous element would furnish a more natural motive. But an investigation of the principles of emotional expression in the lower animals will show that these cries were also used for the purpose of attracting attention, especially between the sexes, and consequently would be associated with the highest forms of pleasure. It may be further noted, that it is in this form they possess the musical element, which has been seen to form and element in inflection. Thus everything seems to point to a natural and emotional primitive growth as the origin of both language and inflection.

A PHONETIC ALPHABET FOR DEAF MUTES.

Read before the Philological Section, April 27th, 1892.

BY C. R. M'CULLOUGH.

Nearly eighteen months ago the thought occurred to me that an adaptation of the phonographic characters invented by Mr. Isaac Pitman, of Bath, England, to the fingers, would prove an easy and interesting method in the instruction of my classes in phonetic shorthand. I accordingly set to work and found the experiment successful, the members of my classes reading the words spelt on my fingers with ease and accuracy. This led me to the consideration of the question, 'Why cannot this scheme be extended to assist the deaf and dumb?' Mr. A. W. Stratton, B. A., the secretary of the Association, to whom I mentioned the proposed method, requested me to present the matter before this section, which I do in the hope that merits and demerits may receive consideration and criticism.

In the sixteenth century Jerome Cardan, naturalist, philosopher, mathematician and physician, discovered the theoretical principle on which is based the education of the deaf-mute. "Writing," said he, "is associated with speech, and speech with thought; but written characters and ideas may be connected together without the intervention of sounds." This being true, what need is there for a phonetic alphabet in deaf-mute education? To this the answer may be made that though the deaf cannot hear, they can appreciate consistency, economy and speed. If a phonetic scheme cannot present to the mind of the deaf the sensation and appreciation of sound, it certainly will not offer those orthographical hindrances which our present unsystematic and difficult spelling places in the way.

The scheme advanced will, I believe, enable the operator to communicate his thoughts with one-fourth less labor than at the present time. This is to be accounted for by the fact that a phonetic system of spelling is nearly twenty-five per cent. shorter than the nomic or customary method.

Dumbness, in a large number of cases, is the natural consequence of deafness. To this class of persons, possessed as they are of the organs of speech, which need only training and exercise, a phonetic system of language representation would prove of great value. The ear is tutor to the tongue; render the ear incapable of performing its office and some substitute must be found to carry on the work of instruction. The discovery of *Articulation* introduced this class to spoken language, and it appears to me that an analysis of spoken language, easily indicated on hand and page, should prove of incalculable benefit to the practitioner.

In reference to the analysis I propose, the objection may be raised that the analysis of thirty-six sounds employed in phonetic shorthand is not sufficiently minute, in short, that a spelling based upon this classification might better be termed consistent than purely phonetic. The answer may be made that the refining process might be extended almost indefinitely, but for the average ear the analysis mentioned will prove ample. A reference to "Pronunciation," in my paper on "The Spelling Reform," in a former part of this journal, may be made by those interested in the subject of practical analysis. The thirty-six sounds analysis has, at any rate, some fifty years of usefulness to recommend it, and has proved equal to the demands made upon it, as can be seen in the practice of phonography.

The wide and increasing diffusion of a knowledge of phonetic shorthand, the growing importance of the subject, and the improvement in primary education along phonetic lines, as seen in the introduction of the "phonic method" into our common schools, must bring to our minds the belief that a new era is in store for language representation, in other words, that English will in due time take on a phonetic dress. If the manual herein presented shall have done nothing more than anticipate that event, it will perhaps have contributed in some degree to the cause of usefulness and advancement.

There are to-day hundreds of thousands of persons throughout the English-speaking world who are familiar with the analysis I have employed; ninety per cent. of these are acquainted with Pitmanic shorthand. These, under the plan promoted, could be brought into touch with the deaf and dumb with so little trouble as to be practically insignificant. Phonographers could learn the handed manual in fifteen minutes' time, for the simple reason that the symbols employed in shorthand writing find their exact representatives in the characters described by the fingers of the deaf and dumb.

If great progress has been made in primary education through the employment of the phonic method of instruction, and a large portion of the child's time has been saved to him, over the old method, why should not the same principle, substituting the hand for the tongue, the eye for the ear, when employed in deaf-mute instruction render the acquisition of knowledge more readily accessible to the silent student?

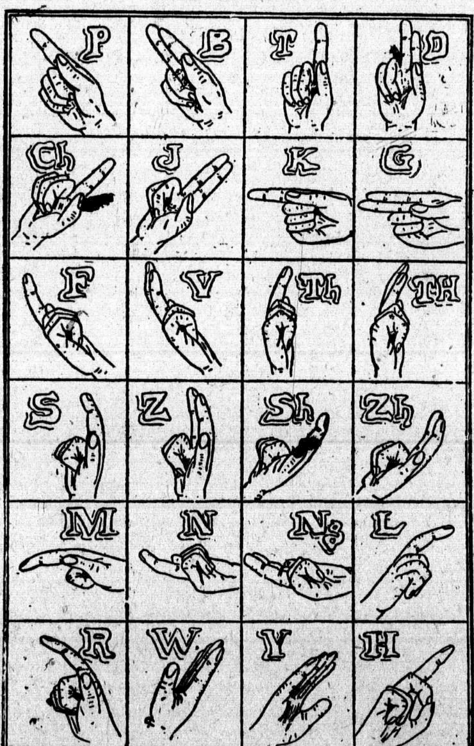
By careful training and practice the deaf-mute is able to read the lips of a deliberate speaker, or even of his non-speaking brothers. This is, however, a slow process, and requires considerable care on the part of the speaker and much acuteness on the part of the student to obtain anything like satisfactory results. When we consider that slight variations in lip positions for the different sounds, variations which, let us remember, become more indistinct as speech analysis proceeds, it will be seen that the labor of distinguishing the positions must be very great. Give him, however, a manual in sympathy with the lips, and approximately correct, and the labor is greatly diminished. I say approximately—throw away the neutrals, retain the principals.

As regards the man who has been born deaf, and who has never learned to use his vocal organs—he, with the man whose hearing has become destroyed, has no guide to assist him in the utterance of sound. The one learns to speak by imitation, the other automatically utters the sounds, or their approximates, heard in earlier life. Both are liable to error and variation in articulation. Let the sounds uttered by the organs of the voice have their counterparts in the characters made by the fingers—let the fingers be so many indexes to vocal positions—and the deaf speaker will have a monitor that will in some degree compensate him for the loss of the hearing faculty.

Anyone familiar with the shorthand alphabet well knows the simplicity of the characters employed to represent the different consonants and vowels. These are arranged in a natural order, in short are scientific. The thin sounds are indicated by thin or light strokes, the thick sounds by thick or heavy strokes. The consonents are arranged for the greater part in pairs, the one being the thick or voiced sound of the other. It is to be remembered that the phonetic alphabet does not commence in the ordinary way, but is arranged in an orderly manner, the consonants, forming as they do the frame-work of the language, come first, the vowels follow.

THE CONSONANTS.

As seen by the Observer.



The names and values of the consonants are:

EXPLODENTS: **P** (pee) as in *p*ut; **B** (bee) as in *b*ut; T (tee) as in tell; **D** (dee) as in *d*ell; *Ch* (chay) as in *ch*oke; ***J*** (jay) as in *j*oke; **K** (kay) as in *K*ate; **G** (gay) as in *g*ate.

CONTINUANTS: **F** (ef) as in *f*at; **V** (vee) as in *v*at; Th (ith) as in ba*th*; **TH** (thee) as in ba*th*e; S (es) as in *s*eal; **Z** (zee) as in *z*eal; *Sh* (ish) as in fi*sh*, offi*c*ial, etc.; ***Zh*** (zhee) as in plea*s*ure, u*s*ual, etc.

NASALS: M (em) as in *m*eat; N (en) as in *n*eat; **Ng** (ing) as in th*ing*.

LIQUIDS: *L* (el) as in *l*ed; *R* (ar) as in *r*ed.

COALESCENTS: ***W*** (way) as in *w*ell; *Y* (yea) as in *y*ell.

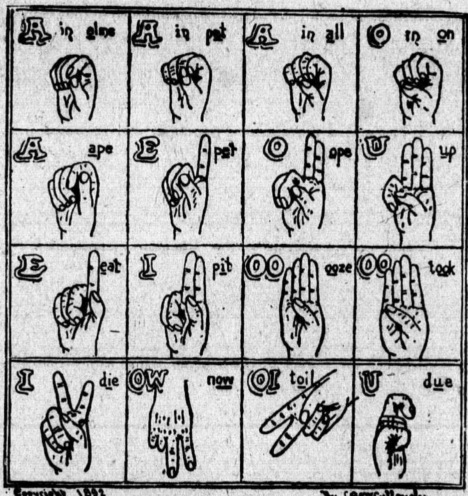
ASPIRATE: *H* (hay) as in *h*ill.

It will be observed that the consonants are written in four positions, and, except R, W, and H, sounds made by the same organ of the voice are written in the same direction. These directions are:

(1) Labials: P, **B**; F, **V**. (2) Dentals: T, **D**; Th, **TH**; S, **Z**. (3) Palatals: *Ch*, ***J***; *Sh*, ***Zh***; *L*, *Y*. (4) Throat: **K**, **G**; and the Nasals: M, N, **Ng**.

THE VOWELS.

As seen by the Observer.



There are twelve vowels, six long or heavy, six short or light. The long vowels are : (1) A as in *a*lms ; (2) A as in *a*le ; (3) E as in *ee*l ; (4) A as in *a*ll ; (5) O as in *o*pe ; (6) OO as in f*oo*d. The names of the preceding are : Ah, Eh, EE, Aw, Oh, OO. The first three are made by pressing the tip of the thumb against the top, middle or base of the first finger, according to the vowel required, the last three by pressing the third finger in like manner.

The short vowels are : (1) *a* as in *a*t ; (2) *e* as in *e*ll ; (3) *i* as in *i*ll ; (4) *o* as in *o*n ; (5) *u* as in *u*p ; (6) *oo* as in f*oo*t. These are made by employing the second and fourth fingers in the same way as with the long vowels. The short vowels' names are : a, e, i, o, u, oo.

For the sake of convenience four diphthongs are introduced ; (1) I as in *i*ce ; (2) OW as in *ow*l ; (3) OI as in *oi*l ; (4) U as in d*ue*. These are known as eye, ow, oy, you.

To the practical teacher of the deaf and dumb, there may appear shortcomings in this attempt to present a scheme to assist deaf-mute education. I have had no opportunity of putting into practice the system promoted in this paper other than that mentioned, in connection with stenographic classes in a business college. I shall, therefore, cordially welcome advice and assistance from those engaged in deaf-mute instruction, or from any who may take a general or particular interest in the "children of silence." In conclusion let me say it will afford me pleasure to render any information in my power to those who may desire to give the scheme a careful test.

NOTE.—Since reading my paper before the Philological Section of the Association, and while these proceedings are in the printers' hands, I received, through the kindness of Mr. R. Mathison, Superintendent of the Ontario Institution for the Deaf and Dumb, Belleville, Ont., to whom I wrote briefly outlining my scheme, a copy of a work by Mr. Edmund Lyon, of Rochester, N. Y., entitled "Lyon's Phonetic Manual," published by the American Association to Promote the Teaching of Speech to the Deaf. From a hasty examination of what appears to be a most excellent work, I learn that the system is based on the analysis known as "Visible Speech," the invention of Professor Melville Bell.

REPORT OF THE PHYSICAL SECTION.

Read at the Annual Meeting of the Association.

The Physical Section was organized in November, 1891, and has since met regularly on the second Saturday of each month.

The only papers read so far have been:

December 12th.—"The Phonograph," by J. T. Crawford, B. A.

After the reading of the paper, several tests were made.

Januuary 9th.—"A Brief History of Electrical Discoveries," by J. G. Witton, B. A.

At the other meetings informal discussions have been held. Some difficulty has been experienced in obtaining papers, but that is likely to be overcome as we get together the apparatus we hope to have. We have also to regret the loss of our Secretary, Mr. J. G. Witton, who is now living in Vancouver, B. C.; his absence has somewhat interfered with the work of the Section, but we hope to see it continued next Fall.

GEO. BLACK,
Chairman.

REPORT OF THE PHILOSOPHICAL SECTION.

Read before the Hamilton Association, May, 1892.

At a meeting held on the 23rd November, 1891, it was resolved to organize a Philosophical Section of the Association, and a chairman and secretary were elected. The remainder of the evening was taken up with a general discussion on the sources and the methods of psychological research.

Since then four meetings of the Section have been held, and the following subjects discussed :

December 5th.—"Psychology," an inquiry into the dual character of the conscious self as subject and as object, by Sanford Evans.

January 16th.—"An Analysis of Experience, Part I," by S. A. Morgan, B. A.

February 20th.—"An Analysis of Experience, Part II," by S. A. Morgan, B. A.

March 19th.—"Sense-Perception," Idealism versus Materialism, by S. B. Sinclair, M. A.

The determination to form a Section in this branch of science was not carried into effect without some misgiving as to the probable result. We feel, however, that the outcome of the experiment thus far warrants us in predicting a useful future awaiting this Section of your Association.

S. A. MORGAN,
Secretary.

S. B. SINCLAIR,
Chairman.

REPORT OF THE PHOTOGRAPHIC SECTION.

Read at the Annual Meeting of the Association.

The Photographic Section beg to submit the following report:

On the evening of April 18th, 1892, a meeting was held in the Museum to form what is now known as the Photographic Section of the Hamilton Association. At that meeting a Chairman and Secretary were appointed in the persons of Mr. S. Briggs and Mr. White. At a further meeting held on Tuesday evening, April 26th, 1892, additional officers were elected, as follows: 1st Vice-Chairman, Mr. A. T. Neill; 2nd Vice-Chairman, Mr. Robert Moodie; Chairman of Executive, Mr. J. W. Grant; the Secretary being appointed Treasurer.

The object of the Photographic Section is for the general research and advancement of photography among its members by holding monthly meetings on the last Tuesday of every month, when all work done during the month will be on the table for examination and criticism.

To become an active member of the Section and enjoy the privileges of the use of the dark-room, it is necessary for the life of the Section that an annual fee of fifty cents be charged; the Section has also placed lockers in the room, for which a yearly rental of fifty cents is charged.

WILLIAM WHITE,
Secretary.

SAMUEL BRIGGS,
Chairman.

HAMILTON ASSOCIATION.

Statement of Receipts and Disbursements for the Year ending May 11th, 1892.

INCOME.

Balance, 1891	$343 06
Proceeds, Sale of Books *re* Birds	15 00
Government Grant	400 00
Rent of Hall	12 00
Members' Subscriptions	110 00
	$880 06

EXPENSES.

Rent and Gas	$158 00
Printing, Stationery and Postages	321 46
Lecture Expenses, Com., Caretaker and Sundries	94 95
Allowance to ex-Secretary, per resolution	50 00
Balance	255 65
	$880 06

RICHARD BULL,
Treasurer.

Have examined vouchers and found them correct.

GEO. BLACK,
Auditor.

May 12th, 1892.

THE

JOURNAL AND PROCEEDINGS

OF

THE HAMILTON ASSOCIATION

IS SENT TO THE FOLLOWING:

I.—AMERICA.

(1) CANADA.

Canadian Institute........................Toronto.
Natural History Society of Toronto.......... "
Department of Agriculture.................. "
Library of the University.................. "
Geological Survey of Canada ....Ottawa.
Ottawa Field Naturalists' Club.............. "
Ottawa Literary and Scientific Society......... "
Royal Society of Canada.................... "
Department of Agriculture .... "
Department Arts, Agriculture and Statistics .... "
Entomological Society.....................London.
Kentville Naturalists' Club................Kentville, N. S.
Murchison Scientific Society................Belleville.
Natural History Society....................Montreal.
Library of McGill University .... "
Nova Scotia Institute of Natural Science.......Halifax.
Literary and Historical Society of Quebec .....Quebec.
L'Institut Canadian de Quebec............... "
Natural History Society of New Brunswick.....St. Johns.
Manitoba Historical and Scientific Society .....Winnipeg.
Guelph Scientific Association ....Guelph.

(2) UNITED STATES.

Kansas Academy of Science.................Topeka, Kan.
Psyche ....Cambridge, Mass.

American Association for Advancement of Science.......... Salem, Mass.
National Academy of Sciences.......... Cambridge, Mass.
Museum of Comparative Zoology.......... " "
American Dialect Society.......... " "
United States Department of Agriculture.......... Washington, D.C.
Biological Society of Washington.......... " "
Philosophical Society of Washington.......... " "
Smithsonian Institution.......... " "
United States Geological Survey.......... " "
American Society of Microscopists.......... Buffalo, N. Y.
Buffalo Society of Natural Sciences.......... " "
California Academy of Sciences.......... San Francisco, Cal.
California State Geological Society.......... " "
Santa Barbara Society of Natural History.......... " "
University of California.......... Berkely, Cal.
Academy of Natural Sciences.......... Philadelphia, Pa.
Minnesota Academy of Natural Sciences.......... Minneapolis, Minn.
Academy of Sciences.......... St. Louis, Mo.
Missouri Botanical Gardens.......... " "
American Chemical Society.......... New York City.
American Astronomical Society.......... " "
American Geographical Society.......... " "
New York Academy of Sciences.......... " "
Torrey Botanical Club.......... " "
Central Park Menagerie.......... " "
Cornell Natural History Society.......... Ithaca, N. Y.
Johns Hopkins University.......... Baltimore, Md.
Kansas City Scientist.......... Kansas City, Mo.
Wisconsin Academy of Science, Art and Letters, Madison, Wis.
Society of Alaskan Natural History and Ethnology.......... Sitka, Alaska.
Agricultural College.......... Lansing, Mich.
Colorado Scientific Society.......... Denver, Col.
Museum of Natural History.......... Albany, N. Y.

(3) WEST INDIES.

Institute of Jamaica.......... Kingston, Jamaica.

II.—EUROPE.

(1) GREAT BRITAIN AND IRELAND.

England.

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

Scotland.

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

Ireland.

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

(2) AUSTRIA-HUNGARY.

Anthropologische Gesellschaft .... Vienna.
K. K. Geologische Reichsanstalt .... "

(3) BELGIUM.

Société Géologique de Belgique .... Liège.

(4) DENMARK.

Société Royal des Antiquaires du Nord .... Copenhagen.

(5) FRANCE.

Académie Nationale des Sciences, Belles-Lettres
et Arts .... Bordeaux.
Académie Nationale des Sciences, Arts et Belles-
Lettres .... Caen.
Académie Nationale des Sciences, Arts et Belles-
Lettres .... Dijon.
Société Géologique du Nord .... Lille.
Société Géologique de France .... Paris.

(6) GERMANY.

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

(7) RUSSIA.

Comité Géologique .... St. Petersburg.

III.—ASIA.

(1) INDIA.

Asiatic Society of Bengal .... Calcutta.
Geological Survey of India .... "

(2) STRAITS SETTLEMENT.

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 .... Cape Town.

V.—AUSTRALASIA.

(1) AUSTRALIA.

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

(2) NEW ZEALAND.

New Zealand Institute .... Wellington.

(3) TASMANIA.

Royal Society of Tasmania .... Hobarton.

LIST OF MEMBERS

OF THE

HAMILTON ASSOCIATION.

HONORARY.

1881 Grant, Lt.-Col. C. C., Hamilton.
1882 Macoun, John, M. A., Ottawa.
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1885 Fleming, Sanford, C. E., C. M. G., Ottawa.
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1886 Small, H. B., Ottawa.
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CORRESPONDING.

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1881 VanWagner, P. S., Stony Creek.
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1884 Bull, Rev. Geo. A., M. A., Niagara Falls South.
1885 Frood, T., Sudbury.
1889 Yates, Wm., Hatchley.
2889 Wilkins, D. F. H., B. A., Bac. App. Sci., Beamsville.
1889 Kennedy, Wm., Austin, Tex.
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1892 Baker, C. O.
1885 Baker, Hugh C.
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1881 Bowman, Wm.
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1891 Brown, O. J., M. A.
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1891 Carpenter, H., B. A.
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1890 Cloke, J. G.
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1891 Evans, W. Sanford
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1880 Forbes, A. F.
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1880 Foster, W. C.
1892 Garrett, A. D.
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1882 Gaviller, E A., M. D.
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1892 Grant, W. J.
1887 Green, Joseph
1883 Grossman, Julius
1888 Galbraith, W. S.
1887 Hancock, Wm.
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1889 Herald, Joseph
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1890 Lees, Thomas
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1880 Leslie, James, M. D.
1880 Littlehales, Thomas
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1880 Lyle, Samuel, Rev., B. D.
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1891 McCullough, C. R.
1857 McIlwraith, Thos.
1890 McInnes, Hon. Donald
1884 McLaren, Henry
1890 McLaughlin, J. F., B. A.
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1887 Mills, Geo. H.
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1890 Moore, Henry E.
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1891 Morgan, S. A., B. A.
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1890 Staunton, Geo. Lynch
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1890 Stratton, A. W., B. A.
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1892 Sweet, Harry
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1892 Thompson, R. A., B. A.
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1892 Turner, W. J.
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1892 White, Wm.
1888 Williams, C. J.

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1881 Williams, J. M.
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1891 Witton, J. G., B. A.
1884 Young, Wm.

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