JOURNAL AND PROCEEDINGS

OF THE

Hamilton Association

FOR SESSION OF 1893-94.

NUMBER X.

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ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF THE

Hamilton Association

DURING THE

SESSION OF 1893-94.

THURSDAY, NOVEMBER 9th, 1893.

OPENING MEETING.

The President, Mr. A. Alexander in the chair.

On account of the popular nature of the evening's programme the regular order of business was dispensed with.

The meeting opened with the President's address, outlining the recent discoveries in the scientific world. Mr. Alexander closed his address with a strong plea for a more hopeful confidence on the part of scientists in the perfection of the cosmic economy. At the conclusion of the President's address the meeting was given over to a display of the characteristic work of the various sections. This included biological, geological, botanical and photographic specimens. Through the kindness of Mr. J. E. P. Aldous, B. A, a musical programme was presented during the evening

Over two hundred members of the Association and their friends availed themselves of this opportunity of viewing the work of the various sections.

THURSDAY, DECEMBER 21st, 1893.

The President in the chair.

The Curator reported the donation to the museum of a number of valuable specimens. One application for membership was received.

After the transaction of business, Mr. H. B. Witton, Sr., read his paper, entitled "Early Printing, Printers and Books." After giving an account of the different men for whom had been claimed the honor of inventing the printer's art, the essayist gave a full outline of the remarkable work accomplished by our own countryman, Caxton.

Coming down to more recent times, the paper called attention to the enormous growth of literature, and the consequent advance given to religion, science and sociology. The paper was supplemented by numerous fac-similes of the work of these early artists.

A brief discussion followed.

THURSDAY, JANUARY 11th, 1894.

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

Mr. F. Hansel, D. D. S., was elected an ordinary member of the Association. One application for membership was received.

The Vice-President then called on Mr. W. Lash Miller, B.A., Ph. B., of Toronto University, to read a paper entitled, "The Kinetic Theory." Beginning from the time of the discovery of what is known as "Boyle's Law," the lecturer traced through its various phases the development of the modern theory concerning the composition of matter, and further illustrated the mathematical calculations by which scientists have worked out many interesting results as to the size, weight and number of the individual molecules. A discussion followed.

THURSDAY, FEBRUARY 8th, 1894.

President Alexander in the chair.

Mr. Wm. Mitchell was elected an ordinary member of the Association.

Mr. McCullough then read a short paper contributed by Mr. Yates, of Hatchley, in which were given many interesting facts concerning the amount of game at present obtained in that locality.

The Chairman next introduced Prof. Maurice Hutton, of Toronto University, to read his paper entitled, "The Antigone of Sophocles." After giving a brief outline of the dramatic plot, the paper next pointed out how this illustrated the poet's conception of the mystery of life. From these data two lessons were learned:

First—The value of moderation and humility in working out the problem of human existence; Second—That no character or creation, however excellent, is without its inherent defect which will eventually lead to decay.

A brief discussion followed.

It was announced that the Photograph Section would furnish the programme for the regular meeting in March.

THURSDAY, MARCH 8th, 1894.

President Alexander in the chair.

Four applications for membership were received.

After the transaction of ordinary business the meeting was given over to the members of the Photographic Section, who gave an exhibit of lime-light views of local and foreign scenery, mostly work of members of the section.

The display concluded with a number of Southern views, the work of Mr. B. E. Charlton.

THURSDAY, APRIL 12th, 1894.

Vice President T. W. Reynolds, M. D., in the chair.

The Corresponding Secretary reported the receipt of a number of exchanges.

The Curator announced a number of donations to the library and museum.

Miss Louise McConnell, Miss Blanche Burns, Mr. Robert Campbell and Mr. Geo. Crawford, were elected ordinary members of the Association.

Mr. J. E. P. Aldous, B. A, then read a paper, illustrated with suitable experiments on "The Theory of Sound," with special reference to its application in music.

An interesting discussion followed on the various points set forth in the paper.

THURSDAY, MAY 10th, 1894.

The President, Mr. Alexander, in the chair.

The Corresponding Secretary announced the receipt of the usual exchanges and Government reports.

The Curator announced a number of donations to the museum.

The Recording Secretary then read a short paper, contributed by Mr. Wm. Yates, of Hatchley, containing notes on Biological subjects.

A short discussion followed.

The annual meeting was then held, and the following reports read:

Report of the Council, by the Secretary.
" " " Treasurer, by Thos. Morris, Jr.
" " " Curator, by Alex. Gaviller.
" " " Geological Section, by A. T. Neill.
" " " Biological Section, by H. S. Moore.
" " " Philological Section, by W. H. Elliott, Ph. B.
" " " Photographic Section, by Wm. White.

The following officers were elected for the ensuing year:

President,	S. Briggs.
First Vice-President,	A. T. Neill.
Second Vice-President,	T. W. Reynolds, M. D.
Corresponding Secretary,	W. McG. Logan, B. A.
Recording Secretary,	S. A. Morgan, B. A.
Treasurer,	Thos. Morris, Jr.
Curator,	Alex. Gaviller.
Asst. Secretary and Curator,	Walter Chapman.
Auditor,	H. P. Bonney.

Council: James Ferres, A. E. Walker, Rev. J. Long, M. A., L.L. D., P. L. Scriven, W. H. Elliott, Ph. B.

A vote of thanks was tendered the retiring President, after which the meeting adjourned.

REPORT OF THE COUNCIL.

The Council takes pleasure in submitting the following report for the session of 1893-4.

Since its last report your Council has held nine meetings, of which due record has been kept in the minute book of the Council, open to the inspection of the members of the Association.

Six general meetings of the Association have been held during the present session, at which the following subjects were discussed:

1893.

Nov. 9th.—"Recent Discoveries in the Scientific World," A. Alexander.

Dec. 21st.—"Early Printers' Printing and Books," H. B. Witton, Sr.

1894.

Jan. 11th.—"The Kinetic Theory," W. Lash Miller, B. A. Ph. B., (Toronto University.)

Feb. 7th.—"Biological Notes," Wm. Yates, Hatchley, Ont.

Feb. 7th.—"The Antigone of Sophocles," Prof. Hutton, (Toronto University)

March 8th.—Lantern Slides, Photographic Section.

April 11th.—"Sound," J. E. P. Aldous, B. A.

Six ordinary members have been added to the Association and three have withdrawn.

The Museum has received a number of valuable donations during the year, and the demand for additional accommodation is constantly forcing itself upon the members of your Council. As yet, however, we are unable to suggest any definite solution to the difficulty.

The Council would again call the attention of the members to the fact that the Museum is open every Saturday afternoon, and that the contents of the Library and Museum are at all times accessible to the members of the Association.

Although in point of number of meetings and papers read this year may not equal the record of some previous ones, we feel cer-

tain that the quality of the work done has in no way deteriorated from that of former years.

In conclusion, we would place on record or sense of the deep loss sustained by the Association in the removal from the city of Mr. S. B. Sinclair, B. A. As a member of your Council and general Association, and as Chairman of the Philosophical Section, Mr. Sinclair proved himself a valuable aid to the work, and his loss is deeply felt by the members of the Council and the Association.

All of which is respectfully submitted.

A. ALEXANDER, F. R. S.
President.

S. A. MORGAN, B. A.,
Secretary.

EARLY PRINTING, PRINTERS AND BOOKS.

Read before the Hamilton Association, December 21st, 1893.

BY H. B. WITTON, SR.

Who invented the art of printing with movable cast metallic types, and the kindred enquiry where that art was first carried into actual use, have long been and still are, attractive subjects of investigation. Few questions have been debated more zealously, for so long a time, or by more disputants. For nearly four hundred years, quest of the truth as to where, when, and by whom this great art of the fifteenth century was introduced; and what beyond cavil are the particulars of its parentage and infancy, has been persistently made: and in all parts of the civilized world searchers have joined in pursuit of evidence. Of books written on this subject, the titles alone fill a volume. The works themselves constitute a library. At various times, chief honors have been claimed for different cities where early printing was done, and on behalf of several of the early printers. Recent controversy on this subject has scarcely gone beyond the claims of Coster and Haarlem on one side, and those of Gutenberg, with his associates Fust and Schoeffer, and Mainz on the other. Former competitors have been withdrawn from the contest, and discussion is narrowed to the merits of these claimants. The dispute is also further condensed, as both sides now ignore, as rubbish worthless to serve the cause of honest criticism, documents of questionable authenticity that formerly obtained credence.

Von der Linde, Madden, Blades, Hessels and DeVinne are but a few of the authors who, of late years, have written on the subject of early printing. These writers are specialists of acknowledged merit, whose opinions are the outcome of diversified technical knowledge of typography, and of prolonged study of original fifteenth century documents upon which the principal evidence concerning the invention of printing rests. On this subject all these authors have written at considerable length. As each has pursued his studies in his own way, their books are marked by strong national

and individual characteristics; and their conclusions differ as much as do their methods of investigation. Von der Linde unhesitatingly pronounces for Gutenberg, and ridicules all claims for Coster as legendary and fictitious. Hessels, in 1871, translated Von der Linde's book, "The Haarlem Legend of the Invention of Printing." At that time translator and author were in agreement, but after studying for three years, the chief original documents bearing on the subject, Hessels' views changed, and he has since become Von der Linde's strong antagonist. Mr. Hessels' faith in the validity of Coster's claim strengthened as his belief in Gutenberg waned. In 1882 he wrote the book entitled "Gutenberg; Was He the Inventor of Printing?" and in 1887 he issued a smaller work with the pronounced title "Haarlem, the Birthplace of Printing, not Mainz." In his exhaustive article on early typography, written for Vol. XXIII of the Encyclopædia Britannica, Mr. Hessels concludes as the case stands, "there is no choice but to credit Coster with the invention of printing with movable types at Haarlem about the year 1445." Blades, Madden and DeVinne have contributed original information to the controversy, but their books echo more or less distinctly the stronger utterences of either Von der Linde or Hessels. In the works by these two authors, the leading facts relating to early printing are forcibly stated: new light is thrown into some of the dark corners; and if from either standpoint a finished picture is not at present a possibility; nevertheless good sketches in firm outline are presented by both.

In his essay on Jean Paul Richter, Carlyle says: "Actual facts are nowise so simply related to each other as parent and offspring are; every single event is the offspring not of one but of all other events prior or contemporaneous." Fortunately the truth, somewhat oracularly asserted by Carlyle, is powerless to disturb men's minds. Brevity of life and limitation of human faculties make it impossible to trace even the greatest events through more than a few steps of their entangled unrestricted relationship. To that rule the invention of printing is no exception. Its kindred arts are dimly seen through the mists of the past, and immediate details of its origin are imperfectly recorded. Block books, pictures of saints, and ornaments stamped on textile fabrics and church vestments, if not the direct progenitors of printing, are near relations, were close

forerunners of that art, and give the best clue by which its history can be traced. They are legitimate next of kin to the art of printing books; seals. and brands for identification of cattle, slaves and felons, are but poor and distant relations. These are the oldest and only kindred to printing Europe can boast. The far east has cognate arts of great antiquity and interest.

Among the saint pictures—*Helgen* or *Heiligen*—which helped to pave the way for printed books, the engraving of St. Christopher, found in 1769, by Heinecken, inside the cover of a manuscript at the Chartreuse Convent of Buxheim, in Suabia, stands first. It is a print from a knife engraving, cut in wood used plank-wise; and after the outline drawing was printed, it was colored by hand or stencil. It is one of the treasures of Earl Spencer's collection, lately bought at a cost of nearly a quarter of a million pounds sterling for the whole library by the widow of Mr. John Rylands for presentation to the City of Manchester. Mr. W. J. Linton gives a facsimile of this print, as a frontispiece to his great work "The Masters of Wood Engraving." It is the earliest dated wood engraving known. Under the picture is engraved the date, 1423, and a Latin couplet, near the date, gives the beholder assurance:

Christoferi faciem die quacunqe tueris
Illa nempedie morte mala non morieris.
"That day thou Christopher's face shall see,
No evil death shall happen thee."

Apart from its historical worth, this print has a charm from the naive manner in which the devout old artist tells the legend of St. Christopher. More than twice the stature of common men, he was bound to serve the most powerful ruler on earth. On the advice of a holy man, he undertook to carry pilgrims across a certain stream. One day a child came to be carried over. The gigantic ferryman was surprised that the weight of the little one should be so heavy a burden; and on looking up to learn the reason, he is told that the child borne on his shoulders is the Lord of All, and receives His blessing. The rude picture is full of life. The great strength of the saint is seen at a glance from the palm tree he used as a staff. His immense stature is evident by comparing him with the hermit at his shrine, of whom even the timid rabbit is not afraid; or with

the miller, taking grain on his ass's back to the mill with the quaint old water-wheel ; or with the burly peasant, carrying on his own back from the mill a sack of meal to his distant cottage. The benignity of the infant Saviour who carries the world in his hand, and the fear, humility and astonishment on the upturned face of St. Christopher, are admirably expressed.

Block-books, Xylographs as they are called, were the immediate heralds of printing with types. For the most part they were printed with a brownish-grey ink, in which there was little or no oil ; and in a similar way to the saint pictures. Some of the block-books had no text ; others had no pictures ; but most of the copies known have both text and pictures. Some of them are tinted with colour, after the manner of the St. Christopher, others are uncoloured. The Spencer Library contains fourteen block-books ; and Mr. Hessels says twenty of German and ten of Netherlandish origin are known. One of the largest block-books, that of the *Apocalypsis*, or revelations to St. John, has fifty leaves printed on one side only. The *Biblia Pauperum*, the best-known of these books, has forty leaves, on which are one hundred and twenty pictures illustrating as many dramatic scenes from Bible history. Verses of scripture and skeleton sermons make up a printed text on each page. Although called the Bible of the poor, it is said, the book was designed to aid the less learned of the clergy, and was really the *Biblia pauperum predicatorum*.

In museums and great libraries, a few playing cards, pictures of saints, and block-books have been preserved from times prior to the middle of the fifteenth century. Competent authorities report that these are imprints from pictures and writing engraved on blocks cut plank-wise or parallel with the grain of the wood ; and were taken on paper pressed with a roller, or by friction, to receive the print, just as an engraver takes trial proofs of his work to-day. They were no doubt the work of monks or of professional scribes ; for so far as classical writings were preserved at all, they were preserved by monastics ; and monks also furnished manuscript books of amusement, instruction, and devotion, to the few who could profit by their use. Whether we have had left to us full record of the tentative stages through which the art of printing passed during the first half of the fifteenth century is more than doubtful. As D'Israeli, the

elder, in almost the exact words of Daunou, suggests, we may be too far from the invention of printing ever to know the details of its discovery, and too near to predict with certainty what will be its future results.

The early printed book of most general interest is the *Bible Mazarine*. Singularly enough that Bible had been forgotten until De Bure, little more than a hundred years ago, found a copy among the books formerly owned by the Cardinal Mazarin. Fifty years after De Bure's discovery twenty copies were known, and at present thirty copies are known to exist. Mr. Quaritch, the London bookseller, says that ten copies of the Mazarine Bible have been sold in England since the year 1847, and that at different times five of these were in his own possession. For Sir John Thorold's copy, sold in 1884, Mr. Quaritch paid £3,900. There are two copies in the Library of the British Museum—one printed on paper, the other on vellum; for although paper was known to civilized Europe at least two hundred years before the invention of printing, it was not made in large quantities, and vellum was preferred by scribes and illuminators for their rarer and costlier purposes. It is estimated that three hundred sheep skins were used for a single copy of the Mazarine Bible. In the British Museum copy, the titles to each book, chapter, and psalm, and all the large initial letters, were rubricated by hand. That was often done in incunabala—as books dating from the infancy of printing are called—and as illustrators of books in those days were not all scholars, a director or small letter was often printed to show what initial should be painted in the space left. A Mazarine Bible in the Bibliotheque Nationale at Paris, contains a note stating that Henricus Cremer, Vicar of St. Stephen's at Mainz, finished illuminating and binding that book on August 24th, 1456; a memorandum which incidentally helps to fix the date when the Bible was printed. The British Museum Official Catalogue describes the Mazarine Bible carefully in these words: "It contains six hundred and forty-one leaves "printed in double columns, with forty-two lines to the column. It "is probably the first large book, if not the first piece of printing of "any size, executed by movable metal types. Between 1450 and "1452, Gutenburg is believed to have made experiments which "resulted in the invention of printing with movable metal types

"The printing of this book probably commenced in or about 1452, "on the completion of Gutenberg's invention. Whether we are "justified in treating it as printed throughout by Gutenberg himself, "or should regard it as printed wholly or in part by Fust, who had "lent money to Gutenberg for the purpose of his invention, or by "Schoeffer who printed a *Donatus* with the same types, is a question "not yet fully answered, nor perhaps likely to be answered. There "are documents of the fifteenth century in which the invention is "ascribed variously to one or other of these three."

Next in importance among early printed books is a Bible containing two hundred and forty-one leaves more and six lines to the column less than the Mazarine Bible; and the first Mainz Psalter. The thirty-six line Bible, sometimes called the Pfister Bible, is scarcely less famous than the Mazarine Bible; and the Mainz Psalter, printed by Fust and Schoeffer in 1457, is the first book printed with a date. Of the Pfister, or thirty-six line Bible, not more than ten copies are known. Twenty-one copies of the Mainz Psalter are known. Nine are dated 1457 and twelve are dated 1459. Only a few are perfect; Brunet says the most beautiful copy is in the Imperial Library at Vienna. These psalters were sumptuously printed. Initial ornamental letters of many early-printed books were painted by hand. Those of the Mainz Psalters were printed; and for beauty of design, delicacy of colour, and careful printing they are said by artists and printers hardly to be surpassed in our times. Until lately they were thought to be wood engravings; but Mr. Linton combats that opinion, and says the ornamentation of the initial letter of the first psalm, the letter B covering a space more than three inches square, has a purity and delicacy of outline convincing to him that it was engraved on metal, and not on wood; and that it is beyond the wood engravers art of that day. The Mainz printers, besides their large books, also printed some smaller papers in the first years of their art. The list of their minor works accepted as unquestionably genuine hardly exceeds some Papal indulgences, a *Mahnuug* against the Turks, a calendar, and copies from five or six editions of the favorite Latin primer of the day, called *Donatus*, after its author, a Latin rhetorician of the fourth century.

The half-dozen books and few documents left from the first

decade of the art of printing were produced from at least four different kinds of types. Experts differ in opinion as to how these types were made, as much as they do in regard to who made them. Some believe with Fournier—a typefounder and engraver—that the Mainz Psalter was printed with wood letters; others equally competent to judge agree with DeVinne that "no book was ever printed "in Europe with small types of wood." And there seems to be a balance of probability that these types were of metal, cast from pattern letters of wood in sand or clay, after the manner of working jewelry and trinkets at that time, and, that after being so cast, they were trimmed and finished by hand. In the Mainz Psalter different impressions of the same letter of the alphabet exhibit variations of form, readily detected by the practised eye. Such variety of form in the same letter may be inadequate proof the types used were wood or metal; but it does show that the making of types with a steel punch, and copper matrix to serve as a mould for type metal fusible at a lower temperature, was a step further on in the progress of ihe art.

Inscriptions—colophons—formerly placed at the end of books, used to give readers the information now printed on title-pages at their beginning. Of the books printed at Mainz, in the first decade of the art of printing, some have colophons informing the reader where they were produced and by whom; and that they were printed, and not written with reed, stylus, or pen. Of the inventor of the art of making books by such new method, nothing, however is said; on that point the oracles are dumb. The invention was hedged around and the art carried on with a view to secrecy; of that there is little ground for doubt. Publicity would have imperiled control of the new art, and might have reduced the monetary value of books produced in so innovating a manner. Early printed books were facsimiles of carly manuscripts in every day use, and could hardly be distinguished from them. Mr. Blades relates that a few years since an English book-seller of experience and reputation unwittingly sold for half a crown, as an old manuscript, a book printed by Caxton, worth its weight in gold. Popular belief that Fust sold in Paris some of his early-printed Bibles as manuscrips, may not have been altogether without foundation. Be that as it may, name of producer, place, and details of origin were

omitted from the first printed Bibles; and none of the earliest printed books gives any indication as to who invented the new art of printing.

It is disappointing that the first promoters of the art of printing books said so little concerning the novel inventions that brought their calling into existence. Some of the old printers were devoted to their craft; many of them were fond of learning; and their calling was to them an estimable means of livelihood. They were an inner circle, and knew more of the early stages through which the art of printing passed, and by whom its essential processes were invented than the outer world did. But the lips of the earliest craftsmen were sealed; and if those of the second generation told the history of their art, they told it so badly, and each so eagerly pointed out his own favorite as the true inventor, that their assertions are less satisfactory than the reticence of their predecessors. On this subject even John Schoeffer equivocates. The books produced from his press during the twenty years he was a printer are double-tongued witnesses telling two versions of this story. John Schoeffer succeeded to the printing business of Fust and Schoeffer at Mainz. He was son of Peter Schoeffer, Fust's partner, and his mother was Fust's daughter. According to report she was given in marriage to Peter Schoeffer by Fust to consolidate the interests of the Mainz printing firm, and as an appreciative token from Fust of Schoeffer's services. Related as he was by ties of marriage and blood to Fust and Schoeffer. and as their immediate successor in business, John Schoeffer was likeliest of all men to know the respective inventive services of his predecessors to their common art, and of all men was in duty bound to see that his books said nothing about the invention of printing at variance with the exact truth. In 1505, soon after his father's death, in the dedication of his German edition of Livy to Maximilian, he says printing was invented at Mainz, "firstly by the ingenious Johann Gutenberg in 1450, and thereafter improved and made permanent by the diligence, cost and labors of John Fust and Peter Schoeffer"; yet, in some of his other books, he says the author and inventor of the art of printing was his grandfather, John Fust. The words used are: "John Schoeffer, cujus Avus primus Artis impressoriæ fuit inventor et auctor."

Official records of the time throw but a glimmer of light on the early history of printing. There is, however, record of the fact that Fust lent money to Gutenberg in 1449, and made a second advance three years after that date; that as surety for his loan he held claims on certain effects; that in November, 1455, he sought to recover with interest the monies advanced, and that the case was adjudged in his favor. The record of the suit refers to vellum, paper, ink, tools, the book, and workmen's wages. The chroniclers who wrote accounts of the doings of that day, content themselves with narrating concerning printing what was verbally told them by some of the German printers, who, after the siege of Mainz in 1462, carried their art throughout Europe. One of these most interesting paragraphs of hearsay evidence comes from William Fichet. He was not only a good scholar who had been elected rector of the University of Paris, but was an astute man of the world, whom Louis the XI employed in important negotiations, and who received credit for concluding peace with the Duke of Burgundy. He was an earnest patron of the new art of printing, and through his influence Gering, Krantz and Friburger, three German printers, established an office in Paris within the walls of the Sorbonne. In one of the early books from their press put in operation in 1470, there is printed a communication from Fichet, who says the friends of literature will be benefited by these new sort of printers, who, like warriors from the Trojan horse, are scattered abroad. And he adds; "In France the story is that a certain John Gutenberg, not far from Mainz, was the first inventor of the printing art by means of which books are made, not with a reed as of old, nor with a pen as in our days, but with metal letters, and that rapidly, evenly and elegantly."

The Cologne *Chronicle* contains a similar but more specific account. In a narrative comprising eighty lines of his book, the chronicler states that John Gutenberg, who was born at Strasburg, was the inventor of printing, at Mainz, in 1440; that after ten years experimenting and preliminary work, he commenced, at Mainz, in 1450, to print a Bible in Missal types; that while the art of printing in common use was invented at Mainz, a first prefigurement of that art was invented in Holland, in the Donatuses, formerly printed there; and though many wrongheaded men may say books were

printed in former times, what they say is untrue, and that no books printed in former times can be found in any country. The Cologne *Chronicle* bears the name of John Koelhof, Burger of Cologne; but the writer is unknown. It was written in 1499, and the writer enhances the interest of his account by stating that Ulrich Zell, who brought the art of printing to Cologne, and was at that time still a printer there, told him by word of mouth the beginning and progress of that art. Koelhof was himself a printer of note, and is credited with being first of the printers to introduce on each finished sheet the use of printed in lieu of written signatures as a guide for bookbinders. He commenced to print in Cologne in 1472, and as Zell arrived there from Mainz about ten years before that date, it is probable that Koelhof learned the art of printing from Zell himself. Other evidence of great volume, but much of it less tangible and direct, is adduced to sustain the contention; that the art of typography was first invented by Gutenberg, and was first practised at Mainz; that capital for carrying out Gutenberg's plans was furnished by Fust: that, tired at Gutenberg's delay, Fust took suit against him for the money loaned and gained judgment; and that the art was further completed and perfected by Schoeffer, who became Fust's partner.

This paper is not controversial; neither can it add aught by way of fact or argument to a dispute around which cluster the accumulated truths and prejudices of centuries. Its aim is but to cast a passing glance at the present phase of a controversy concerning the origin of an art, which, judged by its utility and results, is perhaps greatest of the arts found out by man. A controversy that has interested each succeeding generation from the sixteenth century till now; which retains its interest undiminished for more readers to day than ever before, and which bids fair to carry over a considerable remainder of unsettled particulars as an heirloom to the next generation; deserves attention, and is worth the trouble of looking at through the murky atmosphere surrounding both sides of the dispute. Uncertainty concerning the origin of printing is explained by the doubt surrounding discoveries made in this century. In inventions of chemistry, metallurgy, optics, and in those of the mechanical and industrial arts, the names of contesting inventors of our day are legion. Besides in medieval times, inventive genius in following up

certain branches of research, had cautiously to grope its way well nigh in the gloom and seclusion of necromancy; but in the nineteenth century scientific societies, patent offices, public companies and the ubiquitous journalist, instantaneously photograph the daily work of the world, and its workers in every branch of science, art and industry.

On the Haarlem side of the question no books of Dutch printing, bearing name and date, between 1450 and 1460, can be produced. Some of the Dutch towns have preserved books printed at their presses in 1472-74; but the oldest dated book printed at Haarlem, is said to be one printed by John Andrea in 1483. There are books and fragments of printed books, said to be of earlier production than these, and which are pointed to in proof that Haarlem is the true birth place of printing; but, like some of the early productions of the Mainz press, they bear no name, place, nor date.

Numerous narratives of events, and statements of a minor kind, were collected by Meerman, and have been quoted by later writers in aid of the claim of Coster. Among these is the genealogy of the Costers, in the Town Hall at Haarlem; a history of printing, said to have been written by Van Zorn and lost in the Haarlem siege; and a statement from an Italian who had lived some years in Holland, that Gutenberg stole the art from Coster. But the most explicit and circumstantial claim for Coster and Haarlem was made in a work called, after the ancient name of Holland, Batavia, which was written by the Dutch savant Young, or Junius, as he was named, after the Latinizing fashion of the times. The Batavia was a posthumous work, published in 1588, thirteen years after the death of Junius and one hundred and thirty years after the production at Mainz of the psalter of 1457. The notable part of the statement by Junius is: That one hundred and twenty-five years before he wrote, Coster printed on paper for his grandchildren some letters cut from the bark of a beech tree; that, contemplating greater things, with his son-in-law's aid, he made an ink more glutinous than common ink, and printed with it the *Speculum nostrae Salvationis.* He then changed his types of wood for leaden types, and these were afterwards changed for types of tin; and, his business prospering, John, one of his servants—supposed to be Fust

—became his partner. This servant, after being taught, under oath, the secrets of the printing art, one Christmas Eve, when the Coster family were all at church, stole the whole of his master's printing apparatus, fled to Amsterdam, thence to Cologne, and finally established a printing office at Mainz, where he printed with his stolen types a grammar called *Doctrinale Alexandri Galli*, and the tracts of Hispanus. Junius adds that he writes what aged people worthy of credence told him; and that Galius, his tutor, and Taresius, who, it seems, was some time secretary to Erasmus, also informed him that one Cornelis, a bookbinder of Haarlem, eighty years old, also told them the same story. Few statements are on record for which such an array of names could be cited in censure or in commendation; and its appraisal runs the complete scale from historical fact to idle fiction. The records of Haarlem show the name of Cornelis, a bookbinder of that date, and two different families have had thrust on them the honor of Coster's lineage. The first Laurence, an innkeeper, it was found, died in 1439. His claim has been given up; but since 1870 the career of another Coster, of Haarlem, has been found to fit in part into the account by Junius, though Mr. Hessels admits some parts of that account are yet to be explained.

Chief interest in the Junius statement centres in the book Coster is said to have printed; and in the two books Junius says Coster's servant printed with the stolen types. The *Speculum Humanae Salvationis*, credited to the Coster press, as its name implies, is a mirror shewing the Fall and Redemption of man. There are four early-printed editions of this book, two in Latin and two in Dutch. There is but little difference in these four editions; each contains a short introduction and fifty-eight leaves of wood cuts and text, printed only on one side of each leaf. Each engraving forms two pictures, comprising in all more than four hundred figures. The picture takes up the upper half of each leaf, and the text is printed in two columns beneath it. In one edition, twenty-four pages of both text and pictures are engraved; otherwise the engravings are on wood, and the printing is from movable metallic types. All the engravings are printed with brown ink, but in three of the four editions the text was separately printed in black ink. In all four editions the types are the same. Of the books said to have been printed with the stolen types, as yet no copy of the Hispanus Tracts

has been claimed by the Costerians; but from the same types four editions of the *Doctrinale* mentioned, and six editions of the small Donatus grammar have been found. With subtle but somewhat strained reasoning, Mr. Hessels endeavors to show that altogether forty-seven Dutch printed books, or fragments of books, have been brought to light that were printed with the same types used for printing the *Speculum*, or with types so near akin as to be inseparable from them, and of these there are twenty-one editions of the Donatus grammar. It is further argued, these books are more archaic than the early Mainz books; and are a necessary link between the rudely-cut letters of the block books and the superb printing of Fust and Schoeffer. Moreover, these Donatus grammars printed with movable types like those used in the *Speculum*, are, it is urged, the veritable books spoken of in the Cologne *Chronicle* by Zell, in which prefigurement of the art of printing was first invented in Holland.

This point of the discussion necessarily hinges on the question whether the forty-seven books and fragments of books printed with type and in a manner more archaic than German type and printing, are older than the Mainz *Indulgence*, of 1454, and should, therefore, be historically placed before it. Waiving for the time positive affirmations pro and con, the answer of Wm. Blades—a friendly witness for Haarlem—made shortly before his death in 1890, is worth quoting. He says: "Honestly speaking, I think the direct "proofs insufficient; but if we study the typographical evidence by "the light of the Cologne *Chronicle*, the probabilities seem to me "quite on the side of the *Costeriana*. * * The evidence on "each side may be enlarged in the course of years, but so far as it "goes at present it is strongly in favor of the first rude invention of "moveable types in Holland by some one whose name may have "been Coster. The claim of Gutenberg upon the respect of posterity "rests on his great improvements—so great as to entitle him in a "sense to be deemed the inventor—foremost in excellence if not "first in time."

On behalf of Mainz it is contended that the Dutch school grammars which were the prefigurement—*vurbylding*—of the Mainz invention, were Xylographic or Block-book Donatuses; and to construe the reference in the *Chronicle* to them, to mean they were printed

by movable types, is to stultify and make meaningless the whole account given by Zell of the invention of printing. It is further urged, the art of printing with movable types could not have been practised in Holland without eliciting comment from artists and cultivated men of that time. Among other notables, Caxton and Erasmus both lived in the Low Countries during a good part of the latter half of the fifteenth century; and both credit Mainz with being the birth-place of printing. Yet Erasmus was a Hollander by birth; Caxton lived in Bruges a quarter of a century, and both were on such terms of personal intimacy with the printers of the time and were such admirers of the printing arts, that the invention, in Holland, of movable types could hardly have escaped their knowledge. It is admitted that no Block-book Donatus is known; perhaps school books of that day were more perishable than they generally have been, and now are. More diligent search than ever before will be made, and fifteenth century bindings and all likely lurking places will be ransacked for them, the types of the forty-seven Costeriana will also be subjected to systematic examination by experts, and by these and kindred means the enlarged evidence, considered by Mr. Blades necessary before passing final judgment, may yet be found.

By the year 1500 printing presses were at work throughout Europe in two hundred cities and towns. Jenson, Aldus Manutius, Koburger, Colard Mansion and Caxton are but a few of the more enthusiastic men whose names are on the bead roll of fifteenth century printers. Koburger, at Nuremburg, kept at work twenty-four presses and a hundred men. He printed twelve editions of the Latin Bible; and an illustrated German Bible said to be his masterpiece. Aldus Manutius followed close on the heels of Jenson at Venice, and made it a work of his life to spread a knowledge of the Greek classics. So well did he succeed in his task, that he sold a pocket edition of Greek authors at a price equivalent to fifty cents a volume; whereas, only thirty years before, the King of France, Louis XI., according to old bibliographers, had to pledge plate in security for a borrowed volume, and an Italian nobleman sold an estate to buy a Latin copy of Livy. What the Aldine printers did for Greek, the Elzevirs, at a later day, did for Latin literature. In Holland, chiefly at Leyden and Amsterdam,

fourteen members of the distinguished Elzevir family were printers and booksellers; and during one hundred and thirty consecutive years their presses sent forth twelve hundred editions, nine hundred and sixty-eight of which were Latin classics or modern authors who wrote in Latin.

But none of the old printers stands in such intimate relationship to English literature as William Caxton; and to English readers his name and books have charms exclusively their own. Caxton learned the printing art on the Continent, probably at Cologne, soon after the year 1471. Although direct testimony is lacking, it is probable that Veldner, Colard Mansion and Caxton worked together at Cologne in the same office, but under what master-printer is conjectural. Biographies of Caxton have, within a few years past, been written by Charles Knight and by Mr. Blades. To both the work was a labour of love, and both were printers who wrote with the enthusiasm of craftsmen for their art. Charles Knight was a pioneer in opening up the treasures of good literature to the masses, and was so advanced a printer, publisher and author as to be called the Caxton of the nineteenth century. His Cyclopædia, issued in penny numbers half a century ago—one of his many enterprises to popularize knowledge—cost for literary labour alone £40,000. Mr. Blades, in his life of England's first printer, has traced out and studied the productions of Caxton's press with a pious care unsurpassed by that of a Brahman for his texts; and his book, as it deserves to be, is already a classic. But Caxton left neither letters nor journals, and but scanty materials of any kind for a biographer to work upon; and his life is best known by his works, and by such glimpses of his contemporaries and his own personal experience as are given in the delightful introductions he wrote to his books. The date of Caxton's birth is usually stated to be 1412, but Mr. Blades thinks he was not born before 1422. His place of birth was in the weald of Kent, and, he says, there he studied English, where he doubts not is spoken as rude and broad English as in any place in England. He went to school; but whether in London or in a country school is not known. In the prologue to his Life of Charles the Great, he expresses his gratitude to God for the simple cunning according to which his translation has been made, adding: "I am also bounden to pray for my fader

"and moder's sowls that in my youthe sette me to scole, by "which I get my living I hope truly." After his school days Caxton was apprenticed to Robert Large, a London mercer of reputation, who was Lord Mayor in 1439.

Troublesome times in Caxton's youth were in store for England. Abroad, war with France; at home, starvation and want among the people; a fierce struggle between the nobles; deadly strife for the crown between the Houses of York and Lancaster; and to complete the list of national woe, there were faint, distant mutterings of that storm of religious persecution which in the future would burst upon the nation. Strange sights, foreign to modern life, arrested Caxton's attention during his London apprenticeship. For three alternate days, a dame of high degree, barefoot, taper in hand, clad in a sheet, and followed in procession by Mayor and civic dignitaries, walked the public streets, from the Thames to St. Paul's, in penance for sorceries with the witch of Eye; heads of Kentish "risers" were stuck on poles on London Bridge; and an aged vicar of eighty years was degraded from his priesthood and burnt on Tower hill for Lollardism. Large died before Caxton's apprenticeship ended; and the apprentice was sent to finish his term in the service of the Mercers Company, at Bruges. The London guilds whose names remain to occasionally flit by as spectres from the past, were, in Caxton's day, vigorous promoters of English commerce. Under title of Merchant Adventurers, the English guilds jointly obtained rights by charter, to supervise and control practical working of the commercial treaty made between the Duke of Burgundy and England. Their charter gave them power to elect governors having authority to supervise and control English merchants trading with Burgundy; and to make all trade regulations that were reasonable and within treaty rights. No goods could leave Bruges for England without the seal of the Governor of the Merchant Adventurers Co., who received two pence for each parcel sealed. He appointed packers, as merchants could not pack their own wares, lest prohibited goods should be included; and he had power to call to his aid twelve merchants and mariners, who collectively settled all commercial disputes.

Caxton was at first member, then Governor of the Company of Merchant Adventurers. During his Governorship the commercial

treaty long existing between Burgundy and England ended on November the 1st, 1465. Shortly before expiration of the treaty Caxton and an English diplomat were appointed Royal Commissioners to secure its renewal. They were unsuccessful, and the treaty lapsed. Philip of Burgundy refused to pass another treaty; English cloths were excluded from his dominions; and the English Parliament prohibited the importation of Flemish goods into England. For a time the merchants of both countries saved a part of their trade by smuggling goods indirectly through adjacent countries; but after a year the Earl of Warwick instructed Caxton to see that the act of the English Parliament forbidding English traders from buying goods in Burgundy was carried out. Philip, however, died in 1467, and his son Charles the Bold succeeded to the Dukedom. Edward the IV, of England, adroitly negotiated a marriage between his sister Margaret and the Duke. The wedding ceremonies were held at Bruges in 1468, and Caxton and his company soon after succeeded in obtaining a new commercial treaty.

It was in March, 1468, busy year as it was for him, that Caxton commenced his translation of the "Histories of Troy." When he had translated five or six quires the work was put aside, with no intention to resume it. But after a lapse of two years the Duchess Margaret sent for Caxton to speak with him on divers things, and he told her Grace of the translation he had begun. She bade him shew her what he had written, and, after reading it, she criticized his English, advised him to amend it, and commanded that the work should be finished. Accordingly Caxton's translation into English of the Histories of Troy, which he began at Bruges, and continued at Ghent, was finished at Cologne in the year 1471. At the end of the third book, he writes that his pen is worn and weary, eyes dim, ardour to work lessened, and that age was beginning to make his body feebler. As his book was promised to friends and others as soon as possible, he adds:—"I have "practised and learned, at my great charge and dispense, to ordain "this said book in print, after the manner and form as ye may here "see; and it is not written with pen and ink as other books have "been; to the end that every man may have them at once." The Troy-book was the first book printed in the English language. As forerunner of English printed literature, it will remain a sacred heir-

loom with the rarest treasures of English speaking people. It contains 351 printed leaves, and is nominally a history of the Trojan wars; but mixed up with that history are love stories, myths, and tales of knight erranty, written by Raoul le Fevre, chaplain and secretary to Philip Duke of Burgundy. These stories were popular at the ducal court. Blades says copies of Caxton's Recuyell of the Histories of Troy are in fourteen libraries besides those of the British Museum, Oxford, Cambridge, Sion's College, and the College of Physicians, London. In 1812, the Duke of Devonshire paid £1,060 10s. for a copy of the Troy book.

The early printers made their types to resemble the manuscripts from which they printed, and the Histories of Troy were printed in a text similar to the handwriting of the time preserved in the records of the Mercers' Company. A manuscript written by Colard Mansion's own hand is in the Paris National Library; and an expert says "it is in exactly the same character as the types of Caxton's book." Colard Mansion was a fine manuscript writer at Bruges, and a member of one of the guilds for transcribers. He learned the art of printing about the time it was learned by Caxton, and without doubt he founded the types used by them both for printing their earlier books. The manufacture of manuscript books employed many craftsmen before the invention of printing. These formed themselves into guilds called after St. John, St. Luke, and other appropriate names. One of these guilds was called "Les Fréres de la Plume." Their work found its way into the homes of cultivated nobles, and into all the courts of Europe. Philip, the Good, was fond of learning, and the best artists of Europe found their way to Bruges. His library was considered to be the richest in Christendom. It consisted of nearly 2,000 volumes, chiefly in vellum. They were most tastefully written and illuminated, and were kept in rich bindings, studded with gems and decorated with clasps of chased and jewelled gold. Many of these Ducal books are yet in the Royal Library at Brussels.

Caxton left his Governorship of the Merchant Adventurers, and for a time was a paid attache in the suite of the Duchess Margaret. From about 1472 to 1476 the Troy Book and the Chess Book, it is thought were printed at Bruges, by means of Mansion's technical skill, and Caxton's translations and money. Blades concludes that

Mansion, afterwards without Caxton's co-operation, printed in French the "Troy Book," "Jason," and the "Meditacions," with similar types used for Caxton's two books. About 1476 a new font of types of slightly different character was brought into use by Mansion, and before Caxton took them with his printing outfit to England, they were tested by printing with them "The Quatre Derrenieres Choses." A year later Caxton had established an office in England. The "Dictes and Sayings of the Philosophers" were printed by him at Westminster in 1477. It is the first book in which Caxton directly and plainly gives time and place of printing, and many think it is the first book he printed in England. Caxton's advertisement of "pyes," or guides to the Easter Feast and Saints' Days, has been preserved. It was issued soon after his arrival in England. In modern spelling it reads: "If it pleases any man, spiritual or "temporal, to buy any 'pyes' of two or three commemorations of "Salisbury use, printed after the form of this present letter, which is "well and truly correct, let him come to Westminster in to the "Almonry of the Red Pale and he shall have them good cheap.' The words "Red Pale," beyond doubt, refer to the sign at his printing office; as their heraldic meaning is a vertical red band painted down the middle of a shield a third of its width, and many of the early printers took some heraldic device for a sign.

From 1476 till his death in 1492, for fifteen years, Caxton translated and printed books in England. Including his work on the Continent, he was engaged in printing less than twenty years. During that time, according to Knight, he printed sixty four books; but Blades, with fuller information, places the number of his works, including reprints, leaflets and small books at ninety-nine, without reckoning two or three that are doubtful. Many books printed by Caxton have no doubt been lost. Of those remaining, seven are fragments; and of thirty-one, but a single copy of each is left. "The Polychronicon" and "The Golden Legend" are the two books from Caxton's press less rare than the rest; of these, thirty copies of the one are preserved and thirty-one of the other. The British Museum possesses eighty-five Caxtons, more, as is seemly, than are in any other collection; but twenty-five of these are duplicates, and the fifty-six Caxtons collected by Earl Spencer are held to be the best and nearest complete collection made. After patient

investigation, Mr. Blades concludes that Caxton printed his books, come down to our time, from eights fonts of types, of five separate cuttings, made after three somewhat different styles of letters; for chronological convenience, in his life of Caxton, they are designated by numbers from one to six. Twelve of Caxton's books bear the imprint of his device and initials The device was formerly thought, by a fanciful arrangement of Arabic numerals, to designate the year 1474; but similar characters have been found on the tomb of a member of the Mercers' Guild, and among the contraction symbols used in Doomsday Book. The seal used by him during his mercantile Governorship at Bruges likely suggested its use, and may have resembled it.

Of Caxton's chief printed works, besides the Troy and Chess Books, may be named:—The Canterbury Tales of Chaucer; Boethius; Reynard, the Fox; The Fables of Æsop; Chronicles of England; Higden's Polychronicon, and the Golden Legend. Altogether he printed in England, excluding his work at Bruges, 18,000 pages, most of them of folio size; and of these 4,500 pages were translated by his own pen. In his will Caxton bequeathed for the benefit of his parish church fifteen copies of the Golden Legend. These sold at an average price of six shillings and eight pence a copy, a sum equivalent to about $13.00 of modern money. That was not an exhorbitant sum for a large illustrated book printed—as each of his books was—in a small edition. A luxurious edition, limited to 300 copies, of the same book as originally printed by Caxton, has been recently printed at the Kelmscott press of the poet Mr. William Morris. The price for the set of three volumes is £10 10s.

Caxton understood the French, Dutch and Latin languages, and wrote crisp, vigorous, idiomatic English. As first printer of English books, his work has received frequent comment, fair appreciation, and some criticism. In his address on history, Gibbon expresses regret that Caxton, forced to comply with the vicious taste of his readers, printed mawkish stories for the idle, and superstitious legends for the credulous; that the world is not indebted to England for a single first edition of a classic author; and that when the father of printing gave his patrons a work on history, instead of printing Higden's Chronicle in Latin, as he should have done, he only ventured

on the English translation by Trevisa. Such criticism from Gibbon startled his readers, but did not change regard for Malory's Legends and Chaucer's Tales. It is singular that Gibbon should have underestimated Caxton's contributions to English literature, or the relative importance of his mother tongue. But the brightest mirror has some fleck, the human eye itself has its tiny blind spot; and Gibbon, to whom the secrets of the past stood revealed, so dimly foresaw the future of his own language, that, but for Hume, he would have written his history in French and not in English. The literary taste of our day is not that of the time of Gibbon. Our censors and guides think it singularly fitting that Caxton preferred his mother tongue, and did not turn his back on the perfect portraiture of English life and character furnished by Chancer's Canterbury Pilgrims. German, Italian and French printers surpassed Caxton's work in mechanical niceties of the printer's art; but his shortcomings in those particulars were more than made up by special merit in other branches of his calling. He worked with persistent varied industry; and his books, printed in the everyday speech of the people, have become the corner stone of the foundation for a great literature. When his services are fairly appraised, none of his contemporaries in the printing art will be found to surpass him in merit. His name is interwoven with his country's history; and in his own words: "Other monuments "distributed in divers changes endure but for a short time or season; "but the value of history diffused and spread by the universal world, "hath time, which consumeth all other things, as conservatrice and "and keeper of her work."

In the 126 years from the time Caxton printed the Troy Book to the year 1600 there were 365 printers in England and Scotland, or foreign printers who supplied England with books. During that time they printed ten thousand distinct works, an average of nearly 80 books a year. But the acorn, if slow to germinate, became a sturdy oak. The art "which has conferred immortality on the works of man" has grown with the spread of knowledge, kept in perfect touch with industrial invention, and has made art, chemistry, and mechanical science its handmaidens, ministering to its progress. In 1892, six thousand two hundred and fifty-four works were published in England; an average every four days of the number issued each year of the XVIth century. In the great libraries of the world books are

aggregated in such numbers that trained men are puzzled to care for them, to catalogue them, and make them accessible to readers. Special investigators of each branch of art, natural history and other sciences, have had for convenience sake to establish collections of books pertinent to their own pursuits. Brunet's Manual, a guide to only the best and rarest printed books, fills seven closely printed volumes of nearly 1,000 pages each; and the general trade catalogue of Mr. Quaritch, the bookseller, makes six full volumes, and sells for £12 12s.

Step by step, with increasing readers, the press acquired influence, and has become a great power permeating the entire ramifications of civilized life. Free institutions and crass ignorance are antagonistic. They cannot long subsist together, and for safety of the commonwealth popular governments dare not overlook the duty of public instruction. In discharge of educational functions, books play an important part, and books have few enemies in free countries. But no mere facility of reading books glibly can make men for truth, bravery, and devotion to duty, better than their more unlettered ancestry. Many a man with but little book learning has led a blameless life, and conferred untold benefits on his fellows, while thoughtless, selfish and depraved men, have made literature an instrument for their own destruction, and a stone of stumbling and cause of evil to others. No graces of genius countervail against the evils of a bad book, and exhalations from the moral filth of the world are more noxious to the soul than emanations from the deadliest plague centres are to the body. Books, like all blessings enjoyed by mortals, may be perverted and become a bane. Yet the harm fairly attributable to a free press, compared with its service, is but as a drop to the ocean. He who has access to a good library holds a key, which used aright, will open caskets of richer treasures than are stored in the jewel chamber of an Eastern prince. No human agency has done more than has been done by books to make the world better, and none has added more to the sum of human happiness. Books are faithful untiring monitors, who, if consulted in a right spirit, will yield endless information in regard to the world we live in, give some conception of the great cosmos of which this world is but a part, and reveal truths of highest moment concerning the history, capabilities, responsibilities and destiny of man.

THE KINETIC THEORY.

Read before the Hamilton Association, Jan. 11th, 1894.

BY W. LASH MILLER, B. A., PH. B.

In the middle of the seventeenth century, twenty years after the death of Galileo, Robert Boyle, an Irish gentleman of means, one of the founders of the Royal Society and a man in many respects much in advance of his times, was engaged in improving the newly discovered air-pump. Some experiments on the expansion and compression of air, made in this connection, he published under the title, "Experiments on the Spring of the Air," and the fact then established, viz; that the volume of a given quantity of air, at any given temperature, is inversely proportional to the pressure on its containing envelope, a rule shown by subsequent investigations to hold good for other cases, formed the foundation on which the special theories of the constitution of matter were afterwards built. This paper did not however attract much attention at the time, and the achievements of Newton, a youth of twenty when the "Spring of the Air" was published, monopolized for a time the attention of the scientific world, and gave an impulse and direction to the study of physics which have lasted down to our own day.

Influenced, no doubt, by his great contemporary's recent success in the fields of astronomy and optics, Daniel Bernoulli, one of the more celebrated mathematicians of the time, endeavored by means of a mechanical hypothesis, to account for the behavior of gases and more especially for the relation between pressure and volume discovered by Boyle. Air, being invisible and known only by the resistance it offers to moving bodies, its weight and its other properties, might, in the absence of any direct evidence on the subject, with equal right be regarded either as filling uniformly all the space occupied by it, as water seems to fill a glass, or on the other hand as consisting of a number of small particles separated by

empty space, something like a heap of sand in a vacuum. Bernoulli pointed out that such a heap of invisibles and whose grains were endowed with the property of mutual repulsion, would resemble air in occupying all accessible space and in pressing against the walls which hindered its expansion: as an alternative to this assumption of the otherwise unknown "negative gravity" he suggested that the same phenomena might be accounted for by supposing the gas particles or "molecules" (literally "little heaps") to be endowed with rapid motion, it can easily be seen that the pressure caused by the bombardment of these bodies against the walls containing them would be *caet. par.* greater the more of them there were in a given space, and Bernoulli actually succeeded in shewing that "Boyle's law" would hold for a gas built on this plan, by means of a mathematical investigation of the properties of a system of (perfectly elastic) bouncing balls.

Of these alternate hypotheses the latter only has proved capable of further development, and under the name of the "Kinetic Gas Theory" (from a Greek word signifying *motion*) has played a great part in the physics and chemistry of the present century. Important as this theory was destined to become at a later date, for almost one hundred and twenty years it remained practically without fruit, most people finding it easier to take for granted the simple relationship discovered by Boyle than to accept the existence of a devil's dance of unseen molecules offered as its explanation. During this time however the increased use of machinery was daily attracting its owners' attention to the fact that wherever two parts of a machine rub together they are apt to get hot; this formation of heat by friction, though familiar enough to-day, seemed then so strange that at the beginning of this century the King of Bavaria, his minister, Count Rumford, and a score of notables, watched for over two hours, with ever increasing interest, the signs of heat generated by grinding a blunted borer against the metal of an unfinished cannon in the Arsenal at Munich, and when some water placed in the cannon tube finally began to boil their astonishment and delight knew no bounds. Letters were at once despatched to England (where Sir H. Davy had been for some time engaged in similar work) and elsewhere, informing the world of this wonderful experiment, which, once fully confirmed and rightly interpreted, was fated to overthrow the 'material' theory of heat, till then generally accepted.

This experiment having destroyed the prevalent theory of heat, was naturally looked to for hints as to a new one, and about the middle of this century a number of physicists almost simultaneously suggested that the heat which is formed when motion is hindered, might itself be considered as motion of some sort. Bernoulli's gas theory was eagerly seized upon as affording the necessary basis for re-construction, and from the day that heat was "explained" to be the "energy of molecular motion" may be dated the modern revival of the Kinetic Theory.

It was now easy to see why the pressure exerted by a gas should increase when the gas was warmed, for if the molecules flew faster (and that was the new explanation of the rise in temperature) they could not fail to strike harder on the walls of the prison. A calculation of the rate at which these bodies must be moving, if the pressure of about 15 pounds per square inch exerted at ordinary temperatures by one ounce of air confined in a space of one cubic foot is to be accounted for by the bombardment of its molecules against the walls, gave 525 yards per sec. a result which was not only surprising in itself but which seemed to conflict with well known facts. Ought not the perfume of a plant or the noxious odours of a chemical laboratory to spread with incredible swiftness across the small space of a room if the molecules of the gases composing them were really moving at so unheard of a rate? This discrepancy was, however, soon seen to be the result of a misunderstanding; the motion of the molecules might well be very swift and yet their progress in a straight line—hindered as it must necessarily be by the numerous collisions of one against the other—comparatively slow. A mathematical investigation of the question showed that, in order to reconcile the calculated velocity of the individual molecules with the observed rates of diffusion of one gas into another, the "mean free path" or space through which an air molecule may hope to travel before running against a neighbor must be extremely short, on the average about half a millionth inch, or in other words, in a second it must undergo between four and five thousand million collisions and as many changes of direction.

The chance of a collision is, however, obviously greater, the greater the diameter of the particles (imagining them for simplicity's sake to be spherical in form), and an enquiry into the whole subject

by the methods of the mathematical theory of probabilities (whose success in solving the practical problems of life insurance may be cited as evidence of its reliability), has led to the conclusion that the molecules in one cubic inch of air, if spread out side by side in a single layer, would cover a surface of thirty-five square yards.

In the meanwhile a careful repetition of Boyle's experiments on the compression of gases, had shown that his "law" was to be regarded merely as an approximation to the truth, neither air nor any other gas behaving strictly according to its requirements. This discovery which seemed at first sight to remove the whole foundation from the Kinetic Theory, directed attention to the fact that in the earlier calculations of Bernoulli no note had been taken of the space filled by the gas molecules themselves, and it was found that the deviation of air from the strict letter of the law of Boyle could be accounted for by assuming that the molecules in three thousand cubic inches of air actually occupy one cubic inch, the two thousand nine-hundred and ninty-nine cubic inches being the "empty space" whose quantity varies inversely with the pressure. Thus by adding a little to the precision of the theory, its annihilation by experiment was avoided, or as its enthusiastic champions put it facts which seemed at first to threaten the very existence of the theory, proved in the end but a means of penetrating still further into the secrets of the molecular world.

Once given the actual volume of the molecules in one ounce of air and the maximum area they can be spread over, a simple process of division is all that is necessary to find the diameter of each individual and another to arrive at their total number and the weight of each. The diameters and weights turned out, as might be expected, very small—17×10^{-9} inches and 10^{-21} grains respectively; the total number very large about 3×10^{20}.

In this short sketch I have purposely avoided attempting anything like a full account of the modifications and applications of the theory (such for example as its prediction of the specific heat of mercury vapour), my wish being merely to give some idea of the means by which the various "molecular dimensions" have been arrived at. Some general information on this point is important because there has always existed a large class of admirers of this Kinetic Hypothesis, who not knowing how these values had been

obtained, held it a most wonderful thing and a conclusive proof of the "truth" of the hypothesis and of the "real existence" of molecules, that from the molecular diameters it was possible to calculate the rate of diffusion, from the molecular volumes the variation from the law of Boyle, etc. etc., calculations which obivously are a mere retracing of the steps by means of which these quantities themselves were originally deduced.

Such vagueness of thought with respect to a scientific matter is due no doubt almost entirely to the fact that the development of the conception from the days of Bernoulli down has been in the hands of professed mathematicians, men whose writings are unintelligible to all unfamiliar with the infinitesimal calculus, and lest we should deem it strange for men to take an interest in and even to hold pronounced views on a subject which from its very nature they could but unperfectly master, it is well to consider how few could be found in a large city capable of giving a satisfactory account of the grounds on which the prevalent views on the solar system are based, though fewer still perhaps doubt their substantial accuracy. The conceptions of the Kinetic theory were insensibly and vaguely extended from the case of gases (for which alone they were first developed) to include all state of matter: for do not liquids and solids expand on heating? are not phenomena of diffusion as common among liquids as among gases: and should not the same process in the different cases be explained by the same mechanism? At the same time a certain enthusiasm on the part both of the developers of the theory and of their audience, added to the inability of most of the latter from want of a mathematical training, to take active part in the discussion, gradually led the teachers to teach and the hearers to accept the hypothetical premises of the theory as established facts; the molecular world became a world of realities, and in striving to reduce all physical phenomena to the interaction of the laws of motion and of attraction the Kinetic Theory posed as "the Astronomy of the infinitely small." Tyndall's book was entitled "Heat as a Mode of Motion." O. E. Mayer, after much warning against "mere uncertain hypotheses," says it is "proved beyond all doubt" that heat is a kind of motion. And now in Canada in a book intended for the instruction of youth in our high schools in Ontario we find the conception of "molecules" introduced in the first

chapter, not based on the historical foundation of the behaviour of gases but as following almost by necessity from the fact that sugar will dissolve in water. In 1847 the Royal Society rejected the first modern article on the Kinetic Theory (by J. J. Waterston) with the curt judgment "nonsense." In 1892 the paper, discovered in a pigeon hole, is published with apologies; the hypothesis itself is accepted by perhaps the majority of scientific men as a fundamental "fact" underlying all chemistry and physics, and the story of the molecules is appointed to be said or sung in universities and high schools throughout the land.

Now if there is any one thing that the history of science teaches, it is that as soon as an hypothesis forsakes its proper sphere and becomes enthroned as a dogma, trouble is sure to ensue. In this case as in others the first signs were noticed in the obstinate resistance offered to any modifications in detail by which the hypothesis might be accommodated to newly discovered facts. The behavior of matter in dilute solution (in water, etc.,) resembles in many respects that of the gases we have been considering, but all attempts to bring the molecular hypothesis into shape to account for these phenomena were long resisted by the large majority of chemists; instead of rejoicing that that their 'only true' faith had conquered another world, every effort was made to discredit its recent extensions,—as if the very life of a theory did not depend on its adaptability to newly discovered classes of facts!

A marked change, however, has recently come over the attitude of the more prominent scientific men with regard to this subject, and perhaps what has hastened it most is the recent rapid growth of of Thermodynamics, a science which, recognizing no special theory of matter, has succeeded in arriving at the most varied quantitative relations among physical phenomena merely by following to their logical conclusions a few experimentally discovered natural laws. These laws (more especially the two so-called "main principles") and the consequences deduced from them have been found to apply as well to the most complicated chemical processes as to the simplest physical changes (of the melting of ice and the boiling of water), and the complete qualitative and quantitative identity of chemical and physical phenomena has thus been clearly manifested. Now although this identity had long been preached by chemists and others, it was

mostly in abstract general articles and in the prefaces to their books; in the works themselves a very sharp line of demarcation was commonly drawn between "physical" and "chemical" processes, and the Kinetic theory had contributed to popularize this erroneous distinction in the same way that it had added the growth of correct views on other matters, viz., by offering a plausible "explanation" in molecular language. Thus in O. E. Meyer's "Kinetic Gas Theory," after an enumeration of the various possible movements of the molecules and of their constituent atoms, we find him developing the idea "that physics busies itself mainly with the mechanics of the molecules, chemistry with the equilibrium of their parts." We can of course reject this distinction, which is in no wise a necessary consequence of the fundamental assumption of the theory, but we have still to meet the indubitable fact that the gas theory is very often unable to account for relations now well established experimentally, which Thermodynamics had foretold in advance of experimental evidence. To this it may be added that just as modern geometers can demonstrate the certain failure of all attempts to square the circle or twist an angle by means of the methods of Euclid, it is gradually becoming clear that the Kinetic hypothesis in its present form, representing physical phenomena as the reaction of a purely mechanical system, can hardly hope to arrive at the results involving the "Eutrophy principle" of Thermodynamics, and, for instance, as the mutual dependence of vapor pressure and heat of vaporization, the connection between the freezing point of a solution and the latent heat of fusion of the solvent, between the minimum heat given out in an electric battery and the temperature co-efficient of its electro-motive force; relations which to-day form the framework of chemical energetics.

This recent progress has of course sadly shattered the belief in the all-sufficing nature of the Kinetic Theory, and will in time restore it to its proper position as an hyhothesis, to be employed so long as it proves useful and capable of alteration and modification to suit newly discovered facts, at some future date to share the fate of all Hypotheses, when, recognized at last as merely the symbolic representation of a part of the truths of some larger more general conception it will be thrown aside without a regret, its duty done, its usefulness at an end.

In the meanwhile the language of the Kinetic Theory is almost indispensable in teaching Science, and probably for a long time yet the song of the molecules will continue to be sung; but more stress than at present customary should be laid on the fact that this theory is *merely* a theory, an hypothesis, a metaphorical representation of nature—bearing the same relation to the truth that a power diagram does to a steam engine,—and that it is not in any sense to be regarded as a "discovery of the inner life of matter."

SOME PHENOMENA OF SOUND.

Read before the Hamilton Association, Thursday, April 21, 1894.

BY J. E. P. ALDOUS, B. A.

Before proceeding to the special consideration of sound as it appears in music, it will be well to consider the property of sound pure and simple. Years ago a friend of mine, who was addicted to suggesting perplexing conundrums for his own amusement and the confusion of his friends, made the statement to me that sound does not exist, unless some one is present to hear it. Now, it depends on what you mean by sound whether or not this is true. Every one has heard the vibration of a violin string or piano string when it has been set in motion by bow, hammer or finger. Were it not for the sounding board, very little sound would be heard from such vibrating string; but, a suitable sounding board being provided, the vibrations are communicated by the string to the sounding board, which gathers them up, amplifies them, and transmits them to the surrounding atmosphere, where they go on circling out and out, like the ripples caused by a pebble thrown into water, until they reach something that prevents them going further, or till they disappear through attenuation. If these vibrations reach the drum of an ear, a sensation is conveyed to the brain and we say we "hear a sound," *i. e.*, the brain is conscious of certain air-vibrations having impinged on the tympanum of the ear. So, if by "sound" you mean the sensation of vibration, my friend's statement was true; if by sound you mean the vibrations of the air, they exist under the circumstances that excite them, whether any person is present to perceive them or not.

A short while ago Dr. A. Wilford Hall, of New York, propounded a theory that sound was not a wave or vibration affair at all, but is a substantial something that is communicated from whatever generates the sound through the medium of the air to the person who perceives it. As our time does not allow us to fully

consider two different hypotheses, we will confine our attentions to the results of the investigations of the most renowned scientists who have worked on the subject.

Let us, at the outset, establish a distinction between musical tone and mere noise. Noise is sound in which the vibrations are irregular and uneven; tone, that in which the vibrations are regular and uniform.

Air-vibrations can be started by the vibrations of (a) a string, (b) a metal or wooden tongue, and (c) a jet of wind leading to the air contained in a pipe open at one end or at both.

To illustrate the vibrations, consider a row of boys standing one behind another; if some one pushes the last one, that sends a pressure from him to the next, and on to the next and the next and so on until it reaches the last one, who, having no one else to push, goes over. As each push goes on to the next boy there will be an almost imperceptible pull-back or reaction, just as a pendulum pushed to one side will swing back past the stationary point. The push of the boys we call a "condensation" or closing up, which leaves behind it an "expansion" or stretching, which will be seen in the action of the air inside an organ-pipe. As soon as the wave of condensation has passed out at the end of the pipe the reaction behind it has prepared the way for a new wave to begin. To consider the row of boys again: If the boy at the end of the row is facing a wall, he will not fall over, but will push at the wall; thus a reflex wave of push will be sent back along the line. So, if the organ-pipe has a stopper in the end of it, the air of condensation cannot get out, but is turned backwards, and there is no room for a new wave to begin until the first one has reached the mouth again; in other words, each wave has to travel the length of the pipe twice if it is a "stopped pipe" I shall have occasion to show that by an instrument called the Siren we can prove that any sound has twice the number of vibrations of the sound an octave below; hence we derive the fact that a stopped organ pipe sounds an octave below an open one of the same length.

The larger number of pipes in an organ are of this flue kind, the principle being precisely that of an ordinary whistle, where the vibrations are started by a jet of air being thrown against a sharp edge, across which it vibrates like a flexible tongue.

While speaking of the organ we will next take up the "reed" section—that is, the starting of the vibrations by the action of reeds or metal tongues. To describe this, take (in fancy) a small reed or pipe; shave off one side of the stopped end until an aperture is made; put a tongue of thin wood or metal over this opening and fasten it to the end farthest from the end of the pipe. If you try to blow into the end the air will have difficulty in getting through the aperture, and the spring of the tongue will start a vibration which will produce a note determined by the number of vibrations made. If the tongue is wide enough to lie on the edges of the aperture it is called a "striking reed," if it is narrow enough to pass through to and fro it is called a "free reed." Most organ reeds are striking reeds, as the clarionet, oboe and horn. The orchestral oboe and bassoon are on a somewhat different principle, or rather different adaptation of the same principle. The entrance to the pipe is almost filled up by two thin tongues (called reeds) which meet together and spring apart again under the influence of the current of air which is striving to enter the pipe. In all the cases mentioned the vibrations started would have very little effect if they were not caught in a tube or sound-box of some kind, so as to be amplified before being transmitted to the surrounding atmosphere.

We will now consider the starting of sound by means of a stretched string or wire. If a wire is stretched tightly between two points it will, if disturbed, start a vibratory motion that will gradually diminish until it returns to rest. The number of vibrations will depend on the length of string, its thickness, and the tightness with which it is stretched. When it is tight enough to make sixteen or more vibrations per second, it becomes a musical note. It will, however, make but little sound unless it has a sound-board or resonance chamber in connection with it. The same applies to the tuning fork, which forms tone by vibrations of the prongs, and is barely heard until the base of the fork is applied to a sound-box of some kind.

Several interesting and instructive experiments can be made by the aid of the machine called the Siren, which help to establish many facts in connection with sound and its action. Imagine a pipe conveying a current of air or steam; this pipe is opposed to the flat surface of a disk (metal, wood or cardboard) which revolves on

a centre; in the circle described by the spot where the pipe meets it are perforated a certain number of holes; and the mechanism for twirling the disc is such that you can tell exactly how many revolutions it makes, however fast it may be going. When the current of air is turned on and the disc revolves, at first nothing is heard but detached puffs as each hole passes the end of the pipe and allows some air to go through; the puffs get more rapid until the untrained ear can count them no longer, and soon they develop into a low hum of a decided note; the quicker goes the wheel the higher goes the note until a high velocity produces a perfect scream. By this it is proved that musical tone is nothing more than a succession of regular vibrations above a certain speed; that the lowest number perceptible as tone by the average ear is 16 per second; also that double that number makes the sound an octave higher. In a modern piano the lowest A has 27½ vibrations per second; each octave doubles that until the top A has 3520. How much music there is in these very high notes is an open question. These numbers, however, are proved with mathematical exactitude by this ingenious contrivance.

Having briefly considered the various means of starting musical vibrations, we come to the consideration of their transmission through various media, taking air as the first. Recognize, to begin with, this definition with regard to musical air waves: The pitch of sound (*i. e*, its acuteness or gravity of tone) is dependent on the length of the waves in the direction of their travel; the loudness of the sound is dependent on the amptitude or width transversely to the line of travel. The instrument which initiates the tone establishes the pitch (which remains unaltered) and, to a certain extent, the loudness too, though that will be materially altered by the medium through which it has to pass and the distance it has to travel. The pitch will sometimes be slightly altered, as a piano will sometimes sound out of tune when heard through a wall.

Sound travels through air of ordinary temperature at about the rate of 1140 feet per second—380 yards. The colder the air the slower the travel, warmer air faster travel; a difference, roughly, of one foot of speed for each degree of heat or cold. Light travels at the rate of 200,000 miles per second. So, as this means that all terrestrial distances are covered by light practically instantaneously,

the knowledge of the speed of sound enables one under certain circumstances to measure distances. You see the flash of a distant gun and some seconds later you hear the report—the number of seconds, 380, gives the number of yards distance. You see a flash of lightning and you count the seconds following—4⅘, or call it 5, seconds tell you that the storm is one mile distant and you are safe for the present.

The amptitude of loudness is dependent on the density of the atmosphere in which the sound is started, not on that in which it is heard. The atmosphere on the top of Mount Blanc is about half the density of that on the level. Two guns of equal calibre fired one on the summit and one on the level would have very different effects. The one fired in the dense atmosphere below would most likely be heard above; but the one fired in the lighter air above would start such feeble vibrations that they would be very unlikely to travel far.

An interesting experiment can be shown by suspending a bell in an air pump with an attachment by which you can ring the bell. As the air is withdrawn the ringing sounds fainter and fainter until it becomes inaudible. If hydrogen gas is let into the bell it does not help the sound, because it is such a thin and very elastic gas that the air vibrations get no support to travel on. If the lungs are filled with hydrogen and the subject attempts to speak, the resultant voice is a mere squeak. Whether this is because the vocal chords starts vibrations in the light hydrogen and therefore sound weak, or the hydrogen is unable to excite more than a feeble vibration of the vocal chords is a matter to be decided by the laryngoscope.

The velocity of sound in water is more than four times its velocity in air; its velocity in iron, 17 times; its velocity along the fibre of pine, 10 times. The reason is that the elasticity of these substances as compared with their respective densities is vastly greater than the elasticity of the air compared with its density.

As we have more experience of the travel of sound through air than through any other medium, we will consider the different conditions of air and their effect on the transmission of sound. As before noted, sound travels more quickly in warm air than in cold, the difference being, roughly, about one foot for one degree Fahrenheit.

It is a frequently expressed opinion that foggy atmosphere is adverse to the transmission of sound. Experiments have proved that the reverse is the case; sounds travelling not only further but with greater volume in misty air. It has been proved, however, that there are what are technically called acoustic fogs, viz.: strata or sections of the atmosphere which are almost impervious to sound though conveying to the eye no indication of any difference in quality from the surrounding air. Many experiments at the various gun and signal stations on the coast have given curious and interesting results in this connection.

A vessel approaching the shore heard a fog signal (a 10-inch steam whistle) distinctly at six miles distance; when it reached a distance of three miles the sound vanished and was not heard again until within a quarter of a mile of the signal.

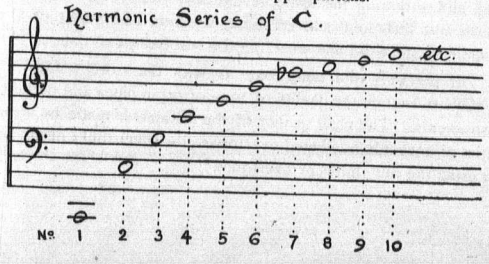
Signals are often heard at a great distance in one direction, while in another are scarcely audible for a mile. This is not the effect of wind, as the signal is frequently heard further against the wind than with it. Difficulties with fog signals arise from the fact that they seem to be sometimes surrounded by a belt of varying thickness of non-homogeneous air from which the sound appears to be entirely absent. This action is common to all ear signals and has been observed at times at all signal stations, at one of which the signal is situated on a bare rock 20 miles from land and with no surrounding objects to affect the sound.

Experiment and observation lead to the conclusion that these anomalies in the action of fog signals are to be attributed mainly to the want of uniformity in the surrounding air, and that snow, rain, fog and wind have much less influence than has been generally supposed. It is on record that at the Battle of Gain's Farm, in Virginia, two men watched the battle from an opposite hill about one and a half miles distant; the day was a mid-summer day of perfect clearness; they saw the musket-fire of both sides and the flash of guns; they watched all the proceedings for two hours of a battle where 50,000 men were engaged and 100 pieces of field artillery *without hearing a single sound.* In the intervening valley was a swamp and on each side of it a clearing, part cultivated and part not, giving conditions capable of providing several belts of air varying in the amount of watery vapour and arranged at right angles to the travel of the acoustic waves.

We will now consider the actions of vibrating strings. If a string (or wire) is stretched tightly between two points and then twanged, it will give a certain fundamental note dependent on the thickness, tightness and length of the string. If it is bisected by a fixed point each section will give a sound one octave higher; if divided at one-third of its length, it will give a note a twelfth higher (*i. e*, an octave and four notes); and it can be proved that a sound an octave higher vibrates with twice the speed of the fundamental note, that the twelfth has three times the speed, and so on, giving us the rule that the number of vibrations is in inverse proportion to the length of string. Again, the number of vibrations will vary inversely as the thickness of the string. So it is evident that in stringing an instrument like a piano, which has strings ranging over seven octaves of pitch, it is a matter of the nicest calculation to grade the wires in thickness, from the heavy covered wires of the bass to the thin wires of the treble, so that the tone may be evenly graded throughout.

If a stretched string is lightly touched at some section, half, third, quarter, or some definite fractional part of its length the rest of the string divides itself into sections of similar length, and this is proved by the fact that small pieces of paper perched on the string at these sections (or nodes as they are called) retain their places when the string is vibrated by a bow, while others placed midway are thrown off immediately.

The observance of nodes, or partial vibrations, found in vibrating strings bring us to a most interesting part of the study of sound, namely, harmonic sounds or overtones. We are apt to think of sounds as just of a certain pitch and certain quality. Now it is ascertained that with every fundamental tone there coexist a number of higher tones called overtones or upper partials.



The number of any note in the harmonic series gives also its number of vibrations by multiplying those of the fundamental tone. These overtones can sometimes be detected by the ear unaided, but they can be plainly brought out by resonators tuned to the notes which are wanted to be detected.

It is the presence of these overtones in varying quantity and power that makes different qualities of fundamental tone. We all know the different qualities of tone of pianoforte, violin, horn, flute, to say nothing of the human voice; and it has been proved that these shades of difference are all due to the presence (with the fundamental tone) of varying strengths of different overtones. One man's mouth and throat differs in quality and shape from another's in various minute ways, which tend to reinforce different overtones in different voices, and produce in that manner the different quality or distinguishing "timbre" of each voice.

It has been discovered furthermore that vowel-sounds are nothing more than different qualities of fundamental tone produced by the same conditions. This has been proved by Helmholz, the great scientist, by an experiment made with flute pipes and tuning-forks of different pitch, representing the various notes of the harmonic series, which are needed to join with the ground tone to make the vowel-sound desired.

Experimenting with tuning forks for the first eight members of the harmonic series, the results were briefly as follows: The prime tone sounded alone gave a dull U sound—duller than possible in speech. The second and third sounded feebly in addition became more like OO. A fine O was produced by making the fourth strong, the second, third and fifth weak, and the prime tone somewhat subdued. O, as in *not*, by making fifth, sixth, seventh, eighth loud and subduing the rest. A passably clear A by making the fourth and fifth loud and subduing the rest, and a sort of E by reinforcing the third and sounding the rest feebly.

In precisely the same way as with the vowel-sounds it is possible to imitate the quality of tone of organ pipes and orchestral instruments. The nasal quality of the clarionet is made by using a series of unevenly numbered overtones; the softer tones of the horn by using the full chorus of overtones.

RESUME.

1. Sound is the result of air vibrations being transmitted to the brain by the ear drum.

2. Musical sounds are the result of regular vibrations, noise of irregular.

3. Air-vibrations are started by vibrating string, reed or fork, but need reinforcing by sound-boards or resonance chambers in order to travel far.

4. Organ-pipes stopped at the upper end sound an octave lower than pipes of the same length open.

5. Pitch of sound depends on length (or frequency) of air waves; loudness or amptitude, on width of waves; quality, on the presence of overtones in varying strength; or, in other words, on the shape of the waves.

6. Sound travels, roughly speaking, 1140 feet per second, a mile in nearly five seconds; light at 200,000 miles per second.

7. Sound travels feebly in varied air or light gas such as hydrogen.

8. Sound is not hindered but rather assisted by fog or dampness.

9. Strata of unhomogeneous air will destroy the carrying power of sound.

10. Sound travels four times as quickly in water as in air, 17 times as quickly as in iron, 10 times as quickly along pine fibre, because the elasticity is much greater in proportion to their density.

11. The Siren proves that the pitch of a sound depends on the frequency or number per second of its vibrations. A sound makes twice the number made by a sound an octave lower.

12. The lowest note audible to the human ear has about 16 vibrations per second; the highest 38,000.

13. Vowel-sounds are merely varieties of quality or "timbre," and as such depend on the presence and varying strength of certain overtones.

REPORT OF THE BIOLOGICAL SECTION.

Read at the Annual Meeting of the Association, May 10th, 1894.

We beg to submit the Annual Report of the Biological Section of the Hamilton Association :

Only five regular meetings were held during the past year, but these were fairly well attended and enjoyed by the members.

Our meetings consisted mostly of informal discussions on subjects Biological, and no prepared papers were read.

On January 12th Mr. Dickson gave a talk on Diatoms, using his microscope to show the beautiful variations in form of the different species.

Our good friend Mr. Yates, of Hatchley, sent us several series of notes on animal and plant life, which always proved interesting and instructive.

In November the Section received, through Mr. Alexander, about 400 species of flowering shrubs of Australia from Rev. Thomas V. Alkins, M.A., LL.B., of Campbelltown, New South Wales. Part of these were exhibited last fall at the opening meeting of the Association.

Mr. Walter Chapman, who is now in tropical Florida, sent us, through Mr. Morris, a box of kumquots or Japanese oranges, which are the size of a plum and are eaten skin and all.

Few additions were made to the Herbarium of the flora of this district; but this season we are giving especial attention to filling up the vacancies

At our Annual Meeting on May 4th Mr. Dickson was chosen Chairman and Mr. Moore Secretary for this year.

All of which is respectfully submitted.

J. M. DICKSON,
Chairman.

H. S. MOORE,
Secretary.

NOTES ON BIOLOGICAL SUBJECTS.

Read before the Hamilton Association.

BY WM. YATES, HATCHLEY, ONT.

I.

The exceptionally warm and fine autumn of 1893 has been attended with corresponding effects on bird-life and on vegetation. The heat and dryness of the month of August and of the first half of September parched many of the meadows and pastures, and many springs and rivulets failed to afford their customary water supply. Seemingly from this cause, the large meadow larks and also the shore larks deserted many of their accustomed haunts hereabouts, and only returned when the autumnal rains had somewhat replenished the ditches and water courses. A great number of small birds and quadrupeds are attracted by a spring or rivulet for bathing and other advantages, and of this fact the predatory hawks and shrikes are well aware and pass much of their time on the upper branches of any convenient tree that commands a view of these indispensible resorts of their victims, and it may be an allowable conjecture that the absence of the larks for nearly two months, as referred to above, is to be accounted for by the bird exigencies requiring the presence of large streams and therefore causing migration to an unfailing water supply.

A greater number than the average of days in October were characterized by warm sunshine and a serene atmosphere, and on some of these autumn festivals the gossamer spiders, in woods and bordering shrubberies, appeared day by day in vast numbers—literally in myriads—and their silken, flossy, waving and floating attenuated threads seemed to invade the whole lower atmosphere. Some gossamer fibres seemed loose from any point of attachment and would rise or fall with the slightest breathings of Aeolus. The minute fabricators of these gauzy fibres could be seen moving, as if with balloon powers of ascension, upwards from one spray or branch-tip of an evergreen to another, and the supporting line being only

visible just when a sun ray struck the same at a particular angle, the little spinners seemed to rise by mere levity, or by an effort of will. My brother, who has good eyesight, and who was watching these insects most attentively, declares the gossamer spider to be of a yellowish colour, and in shape and size like a diminutive sheep tick, and that in moving along their wavering threads they plied their legs with great rapidity and nimbleness, reminding him of the deft motion of the fingers of a skillful human knitter.

Those marvelously designed webs of the geometer spider are most frequently met with earlier in the summer. On one calm and bright morning at the beginning of the month of June, 1892, the weather for a number of days previously having been quite rainy, our roadways, as well as the borders of fields near fences, were bestrewn with these ingenious structures; concentric circles of fine thread lines, intersected at symmetrical distances by diverging radii; precision of the angles of junction, and exact mathematical repetition of the various parts and patterns, compelled admiration. The whole of these fabrications had been produced during the hours of darkness, for there was not a vestige of these snares for entrapping the two-winged victims of Arachne that one could observe at sundown the previous evening. The webs of the more common spider of dwellings and barns are woven on a more common-place design; but great intelligence and sagacity is shown in their localization. The innumerable hosts of dipterous insects seek a dimly-lighted or darksome retreat wherein to pass the hours of rest, aware that when daylight returns their intended prey will dart straight for an aperture or knot hole where light is admitted. The discerning spiders select invariably such positions across which to stretch the gauzy network through which the doomed blueflies and buzzing mosquitoes are unable to enforce passage, and so, after violent efforts, die and serve as food material to the ingenious and sanguinary insect weavers.

On one of the many Indian summer-like days which have been interspersed through the present month of November, we were impelled to take a six or seven mile walk through the fields and woods to a spot where some samples of the wildflower known as the *closed gentian** were reported to have been noticed. The weather

*G. Andrewsii.

was bright and serene, and as one passed by the borders of a cedar swamp, the roadside waste was aglow with the profusely clustered scarlet berries of the Canadian holly (*Prinos verticillata*) These vied in colour with the dense-growing adjoining bushes of red osier (*cornus stolonifera*), which also lend a charm to the shrubbery of swampy wilds at this season of the year when deciduous forests are bare of foliage. The brilliancy of colour of the Prinos berries and their great abundance would attach great interest to this shrub were the foliage evergreen and of a more permanent character; perhaps by dipping the fruit-bearing twigs, ere the fall of the leaf, in some gummy or glue-like solution, the great beauty of this shrub for decorative purposes, in floral wreaths and on Christmas and New Year festivities, might be advantageously utilized.

As we passed along by the swamp's edge, bluejays from time to time vehemently screamed a note of alarm, or probably of warning, to their feathered confreres. The jays seemed to be in family parties of fours or fives and interspersed at varying distances along the forest's edge. In one place we saw them regaling on the fruit (or "hep") of the swamp rose (R. Carolina), which here grows in some abundance and has this year blossomed very freely. One of the bluejay's cries bears a close resemblance to the so-called "mewing" of *the hen hawk*, so much so, that only a practised ear is able to detect the difference. But the jay's varying modulations of voice are extensive, and are all indicative of the varying moods or emotions of the vocalizer. The jays have a keen eye for fruits of a pronounced or gay colour, as we see that they quickly espy from a distance the bright red of a withered apple or two that sometimes remain on orchard trees all winter. They, like most of the crow tribe, are nearly omnivorous, and when they alight on an apple tree in winter they search all along the branches, under the folds and fissures of bark for beetles and moths, and are as quick as woodpeckers to detect the hiding-place of any of the insect tribe, and a good beechnut year or a season productive of acorns is, to them, a period of opportunities. They also have a partiality for corn, and a few stalks of corn left exposed in a field will bring groups of them regularly to partake of the bounty in winter time. (A boy resident near here not long ago boasted in the hearing of the present writer that he had trapped twelve or thirteen jays in a steel trap set in his

father's corn crib last winter.) They also are carnivorous, and the frozen carcasses of animals exposed in the woods is sure to be regularly visited by jays in the wintry frost and snows. These birds are amenable to treatment at the hand of an educator. They can be taught what seem to be apish tricks, and in many accomplishments, vocal and otherwise, as will repay the trainer for his pains and trouble, as do the parrot, canary or bullfinch species.

As we came near the hemlock thicket where the gentians were growing, a flock of yellow finches flew from tree to tree, and ere long the terror-stricken cries of an individual finch were heard, as if proceeding from one in the throes of death. Probably a marauding shrike, of which tribe numerous individuals are now perpetually scouring the locality, had seized one of the twitterers and was fulfilling its sanguinary instincts.

The flocks of the yellow finch and of the pine siskin frequent the borders of our thickets where cone bearing trees are found, and make frequent visits to weedy corners or woods or gardens where tall weeds of the compositae or chenopodiaceae order show above the snows of winter time.

But of all the feathered tribe none make themselves so familiar with the haunts of men as the chicadees. These are now beginning to come to the front and revisiting their accustomed food resorts of last February. Their fearlessness and confidence in the friendship of man is one of their singular traits. They are well known in times of intense frost and deep snow to linger around the lumberman's camp, and we are told of their alighting on the shoulder or knee of the woodcutter when eating his *al fresco* dinner; and will even seize a piece of cheese or fat pork when offered to them, as one lumberman said to the undersigned, "nearly as large as the bird itself." The crashing sound of a falling tree in the forest in winter time is suggestive to these and other hardy species of birds of an abundant supply of food, for among the debris of broken branches, denuded bark and decaying wood a varied assortment of coleopterous chrysalid and larval sustenance is provided, and in the winter morning no sooner has the woodcutter struck a few blows of the far-resounding axe than specimens of the nut hatch, downy woodpecker or chicadee will make their voices heard in the immediate vicinity.

On turning to go homeward the gentians were found according to

description, but chilled, and flowers and leaves embrowned with the night frosts of late fall ; but a few roots were dug up and carried away in hope of a future successful growth. Soon afterwards, on crossing a pasture, a shore lark arose in front of us and alighting on a rail fence near by poured from its throat its few rather monotonous, but not " incisive " chirrups (some one has compared the notes of the shore lark to the sound made by the rapid working of the two blades of a pair of scissors.) On a clay hill a short distance from the bog where the itex prinos grew, were seen some low trees of the Hawthorn (C. Coccinea ?) On these the haws were ripe more than a month ago and only a few more remained on the branches. In the adjoining bog another shrub closely resembling the hawthorn, was once very abundant, but seems likely soon to become extinct in this locality. The shrub here alluded to is a *Spiræa prunifolia** ; this and crategeus seem to form the point of contact in the two genera. It has been said that in the natural arrangement, two species, one of each of the two adjoining genera should be *in touch*, and from this point divergent species may *branch* off with gradually increasing differentiation, but still with some affinities of the ancestral type (as in this instance the Rosaceous characteristics.) There are many noted examples of this close, almost merging, kinship in some of our *distinct* (according to technicologists) genera of wild plants.

Whilst gathering our apples this fall my son pointed out to me a small deserted bird's nest. The nest was very small, seemingly not much too large for a humming bird's ; it was probably the summer home of one of the small fly-catcher's, most likely of " Musicapa Zuticilla," as that species was frequently noticed in the environs in the summer months. The nest was in good preservation and seemed fresh and new. The external workmanship was so perfect that the nest was difficult to perceive, unless by the closest scrutiny, that there was a bird nest there at all. The form seemed to be only a slight lump or swelling of growing woody substance on the fork of a lower small branch of the apple tree on which the nest was situated,—the architect had with much pains and good taste (!) placed bits of linchen and gray moss among the interstices of the plaited grass fibres which composed the external portion of the structure, and the work put one in mind of the efforts of a painter who imitates in ochre and

*In recent books this is classed as Pyrus arbutifolia.

other pigments the beautiful graining and shadings of oak wood or mahogany on an ordinary pine door or board. The bird had an evident wish to deceive and to ward off alien and hostile influences by an effort to make believe that there was no bird nest there at all. The pieces of linchen were of the same size and were "stuck in" at the same distances as the same growths on the tree branch. The unities and harmonies had been so well maintained and conserved that one would say that the same mind that conceived the tree conceived and formed the nest, only working by different agencies and instrumentalities.

The imitations in nature are all but innumerable. Not long since, my attention was directed to what at first sight appeared to be a diminutive tree toad, or frog. The marking of the batrachian were all accurately representated, even to the orange colored tinting at the flank and sides. The phenomenon was a moth, with partly closed wings, reposing during day time on the door of a stable. Another common moth bears on the upper surface of its wings, when folded, the perfect representation of a Roman cross in black on a ground of fawn color, and the gilt resemblance of the Greek letter "Gamma" upon the two wings of one of our common moths most people are familiar with.

There has been an unusual number of bland sunny days during the present autumn, with genial temperature continuing well on into the middle of the present month of November. On the 11th day of said month, the piping of the "Nyla" frog was heard repeatedly among the sedges of morassy places, singing in the afternoon sunshine; and the flowers of the dandelion, and in the woods, the blossoms of the late blue violet, (probably "V. Canina, Var. Sylvestris") were common in some places, and asters (A Uundulatus), and late solidagos, and the may-weed, (Maruta Cotula) were seen in flower. Upon returning homeward, towards evening, groups of the dancing, or *gyrating tipulæ gnats*, were seen enjoying themselves on the wing in the calm feeble rays of the rapidly declining sun. These social insect parties move in the most intricate mazy figures, and the assemblages seemed to be at least a hundred in number, and no collisions or jostlings could be detected, although the whole host would suddenly move upward or downward as if by simultaneous impulse. Some aver that a slight buzzing

sound attends these rhymic pastimes of "the gnats at eventide," so that it is probable that these atoms of life are made happy with melody as well as with the grace and freedom of orchestral movement.

II

This winter is proving so far an exceptional one. We here have experienced no pinching cold and we have not noticed our thermometer lower than twelve above zero. We had, however, seven or eight inches of snow in the beginning of December, but blizzard like winds have absented themselves so far, to the great comfort of farm animals as well as to that of their owners. There was a bland atmosphere on the 23rd of December, and on Christmas Day we had genial breezes and a light thunder storm, and during the week following frogs of two or three kinds were seen in the flowing ditches, and the tree frog was seen hopping amongst the leaves in the woods and a garter snake was noticed sunning itself at noon one mild, clear day near a fence by the roadside: and I have been told by some rabbit-hunting boys that woodchucks had positively been above ground, as their tracks from their burrows were noticed on the thawing snow. This seems to me all but incredible.

One of my acquaintances caught (shot) a fine fox about half a mile from my place beginning of December. It weighed twelve and a half pounds. By report fifteen pounds is said to be about the weight of the largest and fattest foxes here.

A Hatchley fur buyer named Powell—our local storekeeper—two weeks ago told me that he has bought during the present winter 2,400 muskrat skins, 400 racoon skins, 670 skunk skins, 450 mink skins, and upwards of 50 fox skins and two skins of the pine marten. These (the pine marten), it is said, were captured in the Muskoka district. The man told me that many of the fox skins were not in prime condition owing to the very warm fall weather, and they are said to immediately become first-class, in the quality of the fur and pelt, by the advent of frost and snow.

III

The past winter season on the whole has proved a very mild one, and characterized by an absence of violent and cold winds; the month of January was unusually bland with very light snowfalls, and even the big snowstorm of February was accompanied by a

violent wind that had a much higher temperature than the average blizzard, *i e*, about 22 degrees, whereas high winds at as low a temperature as zero are not infrequent during our average type of winters.

Our place was visited on the night or evening of the last 12th of February's snowstorm, by a very large flock of snow-buntings. These, in fact, were a very interesting feature of the storm, and seemed to swirl and career around our hay and straw stack as if their best time of revelry was when the buffeting wind and circling snow eddies were at their maddest fury. Although one cannot help thinking that the flocks of snow-buntings lend a most charming feature to the snowy landscape on one of our calm mid-winter days, the romantic sentiment is intensified when we listen to their concerted, icy chirrupings in regular time-keeping with the gusts and pulsations of the arctic storm. They evidently share and partake of the atmospheric excitement, and, like stormy petrels, give forth demonstrations of revelry at such junctures ; these scenes, on the date just mentioned, were observed by others than the writer of these lines, and make an impression that is not easily obliterated.

On the night of February 23rd, there occurred a very brilliant and extensive display of the aurora borealis, which was noticed and talked about by many people ; in fact this was the most remarkable display noticed here during many years ; the night was clear, but extremely cold (about two below zero here), and it had been observed that mild weather had set in immediately thereafter ; on the nights of the 21st and 22nd of February there had also been weaker displays of the aurora borealis.

On the 26th February weather became mild, and early migrant birds were expected, but the mildness continuing, the first bluebirds were observed here on Sunday, 4th of March, and the first robins were noticed in our garden on the morning of the 6th, and on that date a number of people hereabouts "tapped" their maple trees with favorable results. The mildness continuing, the first frogs were heard piping by my son and others employed in the woods on the 10th of March, which is about two weeks earlier than last year ; meadow larks sang in the sunshine on the 4th of March. Pheasants were heard drumming for the first of the season on the 8th March, have continued since (indicating mating time), the first grackles were

noticed on the 9th, also same date eight or nine wild geese were seen flying westward. The making of maple sugar had by the 9th of March become general, and the whole of the month of March up to date has been abnormally warm, though with occasional frosty nights, and there was thunder on the 5th and on the 17th. The song sparrow was heard singing on the 11th, which is unusually early, and the twittering of numerous shore larks has been a familiar sound all winter.

The pewit fly catcher promptly made their appearance at dawn of day on the 18th,—they were certainly not here at dark the evening previous and the same day the thermometer got up to 66 degrees in a shed that had a northern exposure open.

The kill-dear plovers generally appear some days in advance of the cranes whose advent we have not been apprised of yet, but the plover's scream was heard on the morning of the 12th and has been frequent about the pools of water in hollows of pastures and meadows since the date indicated.

Reddish butterflies emerged from their wintry retreats as soon as maple trees were tapped, and with numbers of dark-colored moths hovered about the sap vessels, attracted by the saccharine odors in sugar bushes. I think it is obvious that the first arrival of bluebirds are pioneer males, who fly northward to the limits of the warmer area, and are rarely seen to alight in their exploration, but a few days afterwards females are seen, and then many courtship rivalries are noticeable; in fact, for days past, robins combatting like game cocks has been an every day phenomenon.

In the course of our employment, when cutting and hauling logs in the woods during the past winter, several ruffled grouse came near to the littered hayseed that had become scattered on the surface of the snow where our horses had been fed on bundles of clover and timothy in the noontide hour, and these birds showed considerable acumen in being willing to come to such a spot when the horses were unattended, but exhibited much wariness and shyness when human beings approach; we have noticed the same trait about these birds when we have been cattle hunting in the woods in summer time; for on going silently and with much caution towards the browsing catttle, a party of pheasants have been sometimes seen scratching among the dried leaves near the bovines without show-

ing apprehension of alarm, and the same observation applies to hawks, bluejays and crows, as well as to some other species of the feathered tribes. The ruffled grouse's fondness for scratching among chaff seems to point to a close relationship to the barndoor fowl (Gallinacean), they own a sort of fellow-feeling with the ferræ naturæ, but are aliens in the presence of humanity.

On one occasion, during last February, an acquaintance of the writer went quite early with his team and sleigh to the snowy woods, and on beginning to load the pieces of cordwood on his sleigh was startled by the violent uprising of a fine ruffled grouse out of the deep soft snow close to his feet; in its fierce rush skyward, the man said that the cap on his head was jostled by the fluttering wings of the bird which seemed to have bivoucked on the spot, under its snowy coverlet. A few days after the events just narrated a little collection of the rejectments of a bevy of quail was noticed one wintry morning near a lumberman's bush road where the bird party had evidently reposed during the night. And on a second occasion a few days subsequent to the above incident, another similar testimonial was observed a few yards distant on the edge of the same trail, the quails having found that the sleigh-frequented track afforded security to the group from the nocturnal bird enemies. It may be here noted that there was a willow thicket in proximity to the sleigh road where the quail party was frequently seen feeding during daytime.

The young of all wild animals do not seem to have an instinctive or inherent mood of distrust or wariness; this trait sometimes, or rather often, seems to be acquired from the tuition of seniors. Young crows, when first leaving the nest, are easily captured, and young foxes when two-thirds grown, having a fondness for gamboling, are not very difficult of approach when sporting together on a fine day near the entrance to the burrow, and old maternal birds show great consternation at the lack of timidity in their fledglings when an enemy threatens.

Mice (either field or house mice) seem an exception to this rule, for during the past winter we admired the acute and agile, mental and corporeal behaviour of some of these very juvenile rodents, the sharp penetrative and apprehensive glance that these bestow on an intruder in their domain, and their almost lightning-like

scuttle to cover, shows how accurately they size up the amount of danger, when their size might suggest that they should be tugging at the maternal breast.

An individual of our acquaintance, at the beginning of this winter, noticed among a large flock of English sparrows two black individuals among the flock, and soon, on the lot paying a visit to his barn, captured the pair of blackamoors. This was at the Town of Norwich, and was talked of as a supposed freak of "melanism," and a few days ago I had the curiosity to walk to the town to interview the so-called rarities; when on entering the doorway of the room, at one end of which hung a cage containing the birds, the oft-repeated and well-known call of the cow-bunting met my ear, for to this species the dusky prisoners belong. Possibly they have been accustomed previously to cage confinement and had been turned out too late to sort with congeners and had taken up with sparrows' society. At any rate, they seem familiar with all the food and other conveniences of a wire cage, and live, thrive and sing as the days go by.

On Sunday, 10th of March, the weather was warmer than ever and the thermometer got up to 68 in a northern exposure, and on this day my neighbor's bees were seen to return to the hive in the evening loaded with pollen. This proves that the skunk cabbage has come up and expanded its flowers. This occurred this eighteen days earlier than was the case last year.

One of my neighbors was somewhat puzzled on finding about ten days ago a forked fragment of the thick rhizoma of the water or pond lily (perhaps *Nuphor Advena*) stranded on a piece of lowland near the border of a creek that runs through his farm. I have been to look at the strange, odd-looking piece of vegetation, and it seems not a bad imitation of a young alligator thirty or thirty-five inches long, having a very scaly appearance. The man said that had the fragment moved when he first saw it he would certainly have ran away or started for his gun. I have years ago heard of saurian or chedonion monsters being observed in beaver meadows by children who mistook these large roots as they undulated in the swollen streams for reptiles of the above-named tribes.

REPORT OF THE PHILOLOGICAL AND LITERARY SECTION.

Read at the Annual Meeting of the Association, May 10th, 1894.

Since the last report to the Association the Section has held four meetings. At three of these general discussions took place on subjects bearing on the department. At the meeting in March was presented the only formal paper of the year. This was read by S. A. Morgan, B. A., on the subject "The Mental Basis of Poetry." The discussion on the paper elicited so many thoughts on the constitution and nature of poetry that it was decided that Mr. W. J. Sykes, B. A., prepare a paper on "Expression in Poetry." It is expected that this will be read at the regular meeting of the coming week.

The interest in the Section during the past year has not been as strong as desired, but it is hoped that by attaching the literary element to the philological, the Section may add to its membership, awaken enthusiasm in the study of language and thereby increase its usefulness as a factor in general culture.

An unfortunate circumstance occurred in the printing of the proceedings of the last year, viz.: the omission of a paper on "Graduation of Vowel Sounds," by W. Connor, B. A. It is to be hoped that the mistake will be rectified by having the paper incorporated in the proceedings of this year.

All of which is respectfully submitted.

H. P. BONNEY,
President.

W. H. ELLIOTT,
Secretary.

GRADATION IN VOWEL SOUNDS.

Read before the Philological Section.

BY J. W. CONNOR, B. A.

When I accepted your Secretary's invitation to contribute a paper to one of your meetings I hoped to be able to command enough spare time to prepare something worthy of your attention. In this I have been disappointed, as well as of the hope of attending your meeting in person and not only profiting by your discussion of my paper but of being cheered by personal contact with men interested in the same great and humanizing study. This latter disappointment has forced me to write on a subject that I had not at first chosen, one however requiring less in the way of oral and black-board illustration. These remarks are offered in excuse for the elementary nature of the subject on which I am writing, a subject, however, which is somewhat akin to one discussed in one of your last year's meetings and one which at least affords another illustration of the fact that a principle in science is often found to lie at the root of phenomena, apparently most unconnected. Perhaps, therefore, those to whom much or all of what I shall be able to adduce is familiar, may feel some satisfaction in seeing phenomena so apparently isolated as the Teutonic ablaut, the Sanskrit guna, the Sanskrit 'Stamm abstufung' and the irregularities of Latin and Greek declension and of certain Homeric forms all explained by the one great principle of gradation.

It would be a waste of time to describe to your section the immense impetus given to philology by the study of Sanskrit grammar, or to point out how later researches into the relations of vowel sounds have been hampered by a lurking disposition to look upon Sanskrit as showing in all essential points the primitive Indo-European type. Yet after all, this was in kind though not in degree much the same error as that which excites Prof. Skeat's wrath, the deriving of English words from High German. For no one dialect, no matter how early its records, can present in all respects the

primitive type from which others have varied. Least of all can the Sanskrit vowel system, which has confounded under the dull sound of *u* in "gun" the three short vowels *a*, *e* and *o*, and has suffered corresponding mutilation in its long vowels and diphthongs, be taken as the starting point in explaining the richer and, as it now appears, far more primitive vowel scale of Greek or even of Teutonic. Accordingly the guna-theory invented by the sharp-witted grammarians of Panini's school left the vowel system of European languages a maze without a plan. Here it will not be possible to do more than state the two discoveries that have led to a more satisfactory explanation. The first is that of Karl Brugmann, viz: that not only do *r* and *l*, as recognized in Sanskrit grammar, assume under certain conditions the functions of vowels, indicated by the characters transcribed as dotted *r*, *l* (Greek *ra*, *ar*, *la*, *al*, Latin *or*, *ol*, Teutonic *ru*, *ur*, *lu*, *ul*), but so also do the nasals under precisely the same conditions, *n*, for example, when deprived of its vowel becoming a "sonant nasal," as Brugmann calls it, written (n̥) and appearing in Sanskrit as *a* or *an*, in Greek as *a* or *an*, in Latin as *en*, in Teutonic as *un*. The other, needed to show the full significance of Brugmann's was that of Verner, apparently incidental to his celebrated "Law," but really far more wide-reaching in its consequences, viz: that the Vedic accent system was in essentials that existing before the "Dispersion," in other words is *pre ethnic*. These facts, together with the changes undergone by the Velars or back gutturals, show that the Sanskrit vowel system, instead of being primitive, was only a blurred copy of a more finely painted original—an original preserved with marvellous fidelity in the Greek vowel scales and in some measure by those of the Teutonic languages. Starting from these premises we can give a tolerably clear explanation of the "Ablaut," which, so far from being as Earle only five years ago represented, a discovery of the primitive Gothic community, is a fundamental law of Indo-European conjugation, declension and derivation.

We all remember the lists of related words given in the chapter on derivation in our grammars or spelling books such as, bless, bliss; feed, food, fodder: bite, bit, bait, bitter, beetle; and the question whether verbs come from nouns or nouns from verbs settled by *a priori* argument or by a quotation from the infallible Horne Tooke.

Now excluding merely fancied resemblances like *bliss* and *bless* or Earle's connecting the adjective *sheer* with the verb of similar sound, and cases like the derivation of *feed* from *food* by 'mutation' or 'umlaut,' or such as '*bait*,' which, though cognate, show a foreign vocalism, or like *rood*, *rod* are examples of the acting of diverse forces on the same word in different uses. We have left a very important residuum, explicable only by gradation. These words fall into several classes of one of which we find types in the words *bite*, *bit* and *abide*, *abode*. These words are particularly well worth consideration, as they show the manner in which derivation is illustrated by conjugation, and as their cognates throw light on the nature of gradation.

We must begin, however, by tracing the history of their vowel sounds. The vowel sound of *bite* and *bide* the simple form of *abide* now a diphthong was, as you know, a simple vowel in Anglo-Saxon, and that simple vowel in turn was a reduction of an earlier diphthong, for as Brugmann lays down, primitive *e* becomes *i* in the Teutonic languages before an *i* in the same or the following syllable e.g. *thrí* (our three) Goth *threis* (*i. e. thris*), = *treis* Skr. tráyas ; stíg-an = *steich-o*. Again the *o* of abode A. S. *a* represents a primitive *oi* Teut. *ai*, as shown by wot, A. S. wât Germ. weiss = *Foida* (*oida*), hence the A. S. conjugation.

bite (1st sg. pres.) *bât*, pl. *biton*, pp. *biten*,
bíde, bâd, " bidon, " biden,

represent an earlier

1st sg. pres. **beito*, pret. **boit*, pl. **bitum*, pp. **bit(e)no*
pres. *beido, pret. *boid, pl. *bidum, pp. *bid(e)no.

With the latter compare its cognate, *péitho*, pf. *pé-poith-a*, pl. ppf. *e-pé-pith-men*, and the verbal (though differing in suffix) *pis-tó-s*, and we see that the short forms *bid* and *pith* belong to the plural and the passive participle whether the suffix is *-tó* or *-no*. The reason for this becomes clear if, keeping Verner's discovery [A] in mind, we compare :

Pres. *bíte*, pret. *bât*, pl. *biton*, pp. *biten*, or
pres. *beito, pret. *boit, pl. *bitum, pp. *bit(e)no

with its Sanskrit cognate (using the future instead of the present, which has a different formation)

bhet-sya-mi, pf. *bibhéda*, pl. *bibhid-ima*, pp. *bhin-na*,

where we see that the forms with the short vowel are those before an accented suffix -mà and -nà; whereas the diphthongs (Sanskrit ê is generally for *ei* or *oi*) are under the accent.

This is the secret of the difference between *bat*, *bibheda*, *bád*, *pépoitha* on the one hand, and *bit-on*, *bebhedemá*, *bidon*, *e-pe-pith-mén* on the other; in other words, here gradation is a result of accent difference. This conclusion is absolutely certain, being vouched for by Verner's success in explaining by it such differences as:

A.S. weorthan, pret. wearth, pl. wordon, pp. -en.
O.H.G. werdan, " ward, " wurtum, " worten.
O.Fr. wertha, " warth, " worden, " worten

But can we explain the difference between *beid-e* and *bád*, *peith-o* and *pé-poith-a*? Would it not be a natural supposition that this also is due to difference of accent? This, some writer, Mœller, I think, asserted some fourteen years ago in Kuhn's Zeitschrift, and later on Mr. Sweet has adopted without hesitation. He says, "There are three accents in Sanskrit, raised = acute, unraised = grave, and 'swarita = circumflex. The acute is the emphatic accent, and was either a rising or a high level tone. The syllable immediately following an acute is always circumflex—that is probably a falling glide tone—unless an acute follow. Every syllable before as acute or after a circumflex is grave. And again, in parent Aryan every vowel had a different form under the various accents. The most important of these is the *e/o* series, which is evidently a modification of original *a*. Under the acute accent *a* became *e*, under the circumflex, *o*, and under the grave it was dropped altogether. This would account for *méno*, *memona*, *mémamen* for *memnmen*, and with like treatment of the vowel-element of the diphthong *peitho*, *pépoitha*, *epe-pith-men*, *e-pé-pith-més*, the vanishing of the *e/o* leaving *i*, just as the loss of *e* in *en* (for, as Gustav Meyer says, it is unmethodic to deny the term diphthongs to such terms as *en*, *em*, *el*, *er*, parallel as they are in pathology (so to speak) with *ei* and *eu*) leaves *n*, which, between two consonants, must become the sonant nasal represented in Greek by *a*. So in *binde* (for *bende), pret. *band*, pl. *bundam*, pp. *bunden*, the *un* of the pl. and pret. is the Teutonic representative of the same sonant nasal.

This explanation presupposes that the vedic accent, *bibhĕda* for instance, is not original, but that originally the reduplication as

the distinctive element in the word had the accent. This would be only parallel with the undoubted fact that the augment had the accent no matter how many syllables followed it, as in *ácicarat* reduplicated *aor.* of CAR. But as resting on an hypothesis, we can hardly deem it absolutely certain like that explaining the vowel-difference between *bât* and *biton* or *biten, pépoitha, epepithmen, pis-tó-s.* Here we may observe that the Sanskrit guna vowel is really only the strong form under the acute accent or the so-called deflected form under the resulting circumflex.

Our examples have explained two of the six classes of English verbs with gradation which Skeat enumerates, the *fall class* owning its preterit form to contraction of a reduplicated form. These are the *drink class* and the *drive class*, to which *bind* and *bite* respectively belong. The *choose class* is the class with *eu* perf. *ou*, weak form *u*, of which *eleu-somai eilelouth a aor. eluthon* is a mutilated example.

The *bear* and *give* classes are but one, their differences being late developed. They answer to the Greek verb with *e* in pres., *o* in sing. pf., vowel dropt if possible in weak form, as *trépo, tétropha*, pass. *té-trammai—ra* for sonant *r*. And, without delaying you with details, we may compare the *shake class*, pr. *scace*, pret. *scóc*, pl. *scócon*, pp. *scacen*, with *errágen, erroga*, if the presence of *a* indicates an aoristic present. But what of the corresponding cognate nouns? We find in Greek such forms as *dérma, phlégos, peús-tes*, with the strong root form as the present; others like *tomé, loipós, klop-ó-s, phón-os*, with the deflected root form found in the sing. pf., and others have the weak root form, as *pis-t-ós, ti-si-s, psud-ró-s, makrós* (as contrasted with *mékistos*, with root accent and strong root form.) We find traces of the same thing, though overcome by analogy, in Latin—*precor, procus*. But in the Teutonic language it is again very important.

Thus with the vocalism of the pret. sing. we have *bairn, barm, qualm, share, trade, bond, song, wander, wrangle, wrong, abode, wroth, wrath*, etc., answering to Greek words like *lógos* : *légo*, and with weak root forms; *score, spokesman, bundle, drunkard, drift, sod*, etc. And examples may be cited from Sanskrit, as *bhedá, bhitti*, but they do not show the difference between the two diphthong forms. Latin differences in quantity like *duco* (for **deuco*, O.L. *douco*) and *duc-em* are often examples of grada-

tion. These examples, which might be multiplied indefinitely, show how important is gradation in derivation as in conjugation, and that not in one or two branches of the Indo-European family, but throughout its whole range.

A question naturally arises, are these nouns and adjectives which show root forms similar to those of certain tenses, *derived* therefrom? This would involve great difficulties, as the laying aside of verbal and the addition of nominal suffixes. Rather we should say that the vocalization of the noun is called out by the same accentual conditions as is the vocalization of the similar verb-form. This is plain in the case of those which, like *drunkard*, *pis-tós*, *bhit-tí*, *ducem*, have weak forms. And even in such words as *klopós*, *tomé*, the requisite condition may have been furnished by certain collocations of words For, as Sweet says, "At first all sound-changes are carried out consistently throughout each breath-group without regard to word division" (whence he adds the initial mutations of Celtic and the Sandhi of Sanskrit, comparing even our English *the man*, *the-erth*.) And the words which have acute accent on the *o* or the weak vowel-form may not possess their original accentuation, but may have for some reason changed it. Thus there is an important rule that with the suffix *o* (Skr. *a*) adjectives andnomina agentis are mostly oxytone, as *torós*, *ta-rā*, nomina actionis barytone as *gón-o-s*, Skr. *jan-a*, birth.

As these remarks have swelled to a tedious extent, it would be well to pass to declension. Here we see that Sanskrit and Greek monosyllables have a similar rule being oxytone in the oblique cases other than the acc. (in Skr. also the Locative, but not acc. pl.) thus:

podós, *podí*, *pódes*, *poús*, *póda*, *pódas*, *podôn*,
pat, pád-am, padás, padé, pádas, padás, padam.

But in Sanskrit we find that while the nom. and acc. sing. and nom. pl. have stem *pad* with *à* long the other cases have *pad* with *a* short. Here the principle is plain. The forms that accent the stem have the strong, those that accent the suffix have the weak form of the stem. This is a fundamental rule in Sanskrit declension, every noun of certain wide spread classes having its strong and its weak stem. Thus *pita*, *patér* has strong stem *pitar (pater)* and its weak stem *pitr* (like *patr*) or before a consonant *pitr*, (like *patra* for *patr* in *patrási*.) Here it may

be remarked that the apparent irregularities in Greek are merely the maintenance of the primitive type which in Latin has been wiped out by the influence of analogy. We may add that all appearances go to make it probable that originally the oblique cases, except the acc. and in some degree the Locative, accented their suffixes in all words and not merely in monosyllables.

In the light of this explanation some irregularites so-called appear in their true light as preserving a preethnic relation lost in the bulk of words through the working of analogy. Thus the difference between *zeu* of *zeus* and *dĭr* of *diŏs*, are simply like that between *dyau* of *dyaús* and *dĭv* of *dĭv-ăs*, etc., the weak form being caused by its immediately preceding the accented suffix. Even the accent of *zeû* is explained by the fact that vocatives when accented always accented the first syllable. A similar recessive accent, by the way, in the *neut. comp.* *-ion* is a retention of preethnic accentuation. Compare *svad-syaus* with *hedion* and *hédion* and it will be seen that the latter preserves the primitive accent.

We see, therefore, that the principle of gradation or ablaut, resting as it does upon the shifting accent of preethnic times, far from being confined to Teutonic conjugation, is a guiding principle in Greek and Sanskrit conjugation and declension, and in the word formation of all these tongues. Had time permitted we might have shown its traces in Latin (e.g. as in *fido* (*feido*), *foedus*, *fides*), in Irish (as *ben* gen *mna* cf *Dor. bana*, and *mna-omai*), and in Avestan; but enough has been adduced to show its wide-reaching importance in moulding the primitive "speech-material," and how its recognition throws light upon many obscurities and combines apparently unconnected phenomena into one harmonious whole.

REPORT OF THE GEOLOGICAL SECTION.

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

The Section, in submitting their report for the year ending May 11th, 1894, desires to intimate that, although the usual interest in the work has been maintained by the members, there has been a slight falling off in the attendance of visitors. This apparent lack of interest by the general members of the Association can in some measure be accounted for when we consider the reason given, that is, "that the papers read are too technical to be interesting to one who is not fully acquainted with the science; but this objection can be fully met when we consider the object of the different sections of the Association, which is to inculcate correct ideas and information in regard to the various branches of science taken up by the different sections. The earnest student of nature should hail with delight the opportunity offered to him of the privilege of being benefitted by the experience and riper knowledge of those who have devoted much of their time, energy and talents upon a subject which they untiringly pursue with so much pleasure and satisfaction. They have learned to read the great pages of the book of nature, and in the study of those papers they rise to a higher contemplation and a fuller appreciation of the irsurroundings, whether it be in the loneliness of the desert, the vast rolling prairies, or the rich wilds of the forest. They will always meet with one or more of the scientific studies to engage their attention. So that technical phraseology should not stand in the way of acquiring useful knowledge and interesting information.

The Section, fully aware of this objection, has endeavoured to meet it, and our worthy Chairman has referred to it in one of his papers, when he claims to have adopted the popular phraseology so far as can consistently accord with the dignity of the subject under discussion. In October last the Chairman received a request from Prof. Charles D. Watcott, of Washington, D. C., for all the varieties of graptolites found near Hamilton, so that as complete a list as it

was possible to obtain would be represented in the new work under preparation, entitled "The Graptolite of North America." These our Chairman supplied. Fossil specimens have been sent to Britain, different parts of the United States, and to Ottawa, Kingston and Montreal. The Section has also had fitted up a set of drawers in which to stowe the duplicated specimens.

The papers read at the meeting of the Section have been very interesting. Some of them are devoted to the tracing of palaeozoic shells up through the successive formation to their present living representatives; some recording and describing important discoveries in the chain of palaeozoic life. Some deal with the question what was once considered problematical whether the Liceophycus was animal or vegetable, but by the aid of some very excellent fossil specimens and convincing arguments of our Chairman, this question has been settled to be the latter. The thanks of the Section is due to the Chairman, who has contributed all the papers read before the Section, and to his untiring exertion in the collection of fossils, thereby adding a large number to the collection now in the museum of the Hamilton Association.

The Section has held seven meetings, at five of which papers were read. Following are the subjects treated in these papers, and the dates on which they were read:

Oct. 28th, 1893.—"Notes on the Field Day of the Hamilton Association," by Col. C. C. Grant.

Nov. 24th, 1893.—"Notes on Fossils in the Glaciated Chert of the Niagara Beds," by C. C. Grant.

Dec 22nd, 1893.—"Are Pot Holes in Rocks Always Records of Running Streams?" by C. C. Grant.

Feb 23rd, 1894.—"Notes (part 2) on Fossils in the Glaciated Chert of the Niagara Beds," by C. C. Grant.

March 30th, 1894.—"Notes from and on Our Exchangees, Geological and Antiquarian," by C. C. Grant.

All of which is respectfully submitted,

A. T. NEILL,
Secretary.

REMARKS ON OUR ANNUAL EXCURSION.

Read before the Geological Section, October 27th, 1893.

BY COL. C. C. GRANT.

As this is the first meeting of the Section since we adjourned during the heated term, a few remarks may not be considered out of place in explanation of what has been done in the meantime. Our annual outing at the Albion Mill Ravine was unfortunately marred by a sudden and unlooked for thunder shower that completely drenched ladies and gentlemen, rendering it possible to add but little to our collection. I ascertained, however, that on the day previous the new proprietor of the Waterlime-Barton beds was busily engaged in working the Marshall Quarry, which he had recently purchased. These are the shale beds.

I concluded it might be as well to have a look at the exposure before the members and their friends arrived at the mill. The prospect of inducing the gentlemen to leave the ladies behind seemed improbable, and the latter, however enthusiastic, could scarcely be expected to travel a considerable distance over stake fences and other obstacles above the mill pond before reaching the quarry. I thought, taking all things into account, it was better to examine it personally than risk the chance of a later visit, and so I started before the others. On my way down to join our party, I raised and split some of the large, thin shale slabs, containing many specimens of that singular organism named by Dr. Spencer, F. G. S., "Phyllograptus dubius." Now, no one, I think, has ever questioned the organic nature of the specimen. On one point, however, the majority of palæontologists are agreed, that the classification is exceedingly doubtful. This was Spencer's own opinion, hence the name—implying doubt.

It is colored black like graptolites, presents no apparent point of attachment, very flexible, of about a dozen separate individuals on the face of a split flag. No two were precisely shaped alike. If free graptolites, it is difficult to account for their crowding together

in this unusual manner. They are probably confined to two layers in the Barton shales, at least they have not yet been found in any others. As in Inocaulis plumulosa (Hall) the rain-like process, frequently noticed, may represent the cellules of a graptolite. A few rather doubtfully appeared to look on it as representing a Marine Annelid. They vary in length, viz., from one to three inches, being flattened in the indurated Niagara shale. The body, or axis, now seems broader than in the natural state before it became fossilized, and indeed it does occasionally assume a worm-like appearance. I was of this opinion for some time, but such forms offer little for preservation in a fossil state. We know the chitonous teeth may be, and have been, preserved in Silurian beds (I think in Cambro-Sil. rocks also), but even comparatively recent ones display no instance where the softer part of an Annelid has been recognized in a fossil state. There are no burrows or trails.

While I am satisfied Dr. Spencer has correctly assigned it to the Hydrozoa, it may be questioned as to what particular group it comes under. I feel inclined to imagine it to be the representative of an entirely new genera. It appears to differ almost as much from the Quebec Phyllograptus as from the Niagara Inocaulis.

Another minute graptolite puts in an appearance in Barton shale, a little below near the Lime Kiln. It seems to be very rare. We may not, as yet, have hit off its headquarters, or specific centre. A few fine slabs of shale, with the two characteristic Barton Fucoids, were also obtained. They usually display rounded branches on the surface of the flags; they are never found in the same layer, always separately; one is much slighter than the other; both belong to the same family group. Perhaps the most interesting find was in the banks of the stream lower down. The fossil bears a marked resemblance to the curved fin-spine of a species of shark. Such phosphatic spines are not uncommon in the chert and limestone beds of the Niagaras near the city; some, probably, were tail spines of a Crustacean, viz., Ceratiocaris or Colpocaris. Others are so large and heavy, apparently, that it is difficult to see how an ordinary member of the Crustacea could move freely about with such a weight attached. Hugh Miller, in one of his works, stated that the defensive spine of an Onchus had been detached in limestone of the lower Silurian, or Cambrian Age. But the one he referred to was

subsequently found to belong to the Articulata, and not to the fishes (Pisces) at all. Indeed it is generally supposed the latter appeared for the first time in an upper Silurian Sea. A few, however, may possibly have put in an appearance at an earlier date. I cannot remember having ever seen figured a carved tail-spine to a Crustacean, and one can scarcely realize such an appendage.

THE MUSEUM CASES.

In looking over the two cases at the upper end of the room contain our local specimens, you may notice a few additions have recently been made. Hitherto we had no specimens of the rare Conularia of the Niagaras, figured and described by Dr. Spencer under the head C. Niagarifica. The one we now possess is incomplete and probably did not attain its usual size (about nine inches in length.) Another Conularia, also figured by Spencer as a Hamilton Pteropod (Niagara), I did not succeed in getting. It appears to be very rare indeed. I have seen only the one Mr. Turnbull found and one I found many years ago. A third specimen, undescribed, and a single one alone seen, resembles a modern Theca in appearance. It is narrow, sharply pointed at the end, nearly six inches long, and does not present any well-marked ornamental striæ.

The more characteristic Pteropod of the Niagara beds, Conularia Niagarensis, has two representatives in the case. When better preserved ones turn up we can transfer them to the less conspicuous side cases for exchange.

The insufficiency of space for the display of local organic remains has been considerably lessened by the Council of the Association furnishing the Section with the trays we applied for. If I recollect aright, it was proposed originally to have a single complete Brachiopod, or Lamellibranch, duly named and labelled in each small paper box. But internal casts of each valve, showing teeth and muscular impressions, as well as outward marking of shells, are also required by students, independent of varieties in each family, which often widely differ from the original stock.

I would suggest, subject to your approval, to substitute smaller paper boxes for some of the larger ones, and to transfer the accessaries, viz, single valves, to the trays, which appear more suitable for careful examination. We have a considerable number of fossils

in or about this city yet undescribed, like the graptolites. Many of the Polyzoa have frequently been figured from mere fragments. "Their study is thus attended," remarks the late Professor H. A. Nicholson in "Palæontology of Ontario," "with special difficulty," Since there is no class of organisms requiring greater skill and patience in their interpretation, the learned Doctor made the Bryozoans a particular study. He was specially selected by the Director-General of the Ohio Geological Survey to report on the Corals and Polyzoans of the State, and his work proved that no better selection could have been made by Dr. Newberry. He and his friend, Dr. G. J. Hind, discovered in the Devonian rocks of the Province quite a number of Bryozoans new to science. They are so accurately drawn that I cannot see how any mistake can possibly arise regarding them. But, unfortunately, we did not hear of the Professors' arrival until they had left Hamilton, and no person pointed out to them the places where the most interesting fossils were to be obtained. Few collectors would ever imagine that ploughed fields on the Niagara Escarpment were likely hunting grounds for sponges and various other organisms of the Silurian Age. Nevertheless, it so happened here that when the upper chert beds were removed, ground into muddy sediment in fact (which any one may notice on the lower clay resting on the glaciated layers) some of the harder and more flinty nodules successfully resisted the grinding process, and are now found resting on the surface of the glaciated layers. It is quite true that in some instances the plough has turned up the upper beds, near the brow of the Escarpment where the surface soil is shallow; but such was a rare occurrence.

The flint (or chert flake fossils), except occasionally an odd one, are confined to two fields close to the corporation drains, reclaimed swamps, and to a low-lying part of a field in rear of the reservoir. The frost in winter generally exposes the interior, if it holds any organic remains, splitting it into thinner slabs.

I am inclined to think, instead of being washed down from higher ground into the hollows, the chert flakes were deposited by a local retreating glacier. The higher ground, near the Corporation drain, is the base of the new Barton, Niagara beds, hard shales, etc., not like the new chert ones.

Barraude asserted, many years ago, that the graptolites in Europe attained their chief development at the time when the upper

Silurian rocks were deposited there. While the statement was questioned and disproved by leading palæontologists of this continent, I think we are fairly entitled to request a re-examination of the graptolites, for, I think, in our Silurian rocks we can show as many genera and species as ever the Cambrians or even the Cambro-Sils. united have. We laid bare in Canada the same as Barraude discovered in Europe, which is unquestionably of interest to science.

I have to direct your attention to some interesting specimens recently presented to the Museum by Mr. A. Walker. The two beautiful polished slabs of Dalomrtic limestone are a great acquisition to the cases. They clearly demonstrate how such rock material has been built up on the ancient Silurian Sea bottom by fragments of shells, corals, Bryozoans and muddy sediment intermingled before it underwent the subsequent chemical changes. One of the slabs contains an exquisite form of a miniature fern. It was probably a Bryozoan, but I have never seen one resembling it. We are also indebted to Mr. Walker for a fossil of the Guelph (a Megalamus Canadenses), which retains a portion of the original shell (hitherto we had only internal casts of it.) The characteristic *Rhizopod of the Coal Measures (Fusilina Cylindrica), exclusively confined to the Carboniferous Age, and, as such, useful in determining the true position of these Palæozoic rocks. This, kindly presented to us by Mr. Walker, has been temporarily placed in the Devonian case until the council furnishes another badly required for its proper formation

In conclusion, I have to submit, for the consideration of the Section, a communication from the Chief Palæontologist of the United States Geological Survey, Professor C. D. Walcott, enquiring if specimens of our local graptolites could be obtained for the Museum at Washington; and from Dr. Gunney, who intends publishing a work on the Niagara Graptolites. In forwarding a few from my own collection, I mentioned I thought the Hamilton Association could spare some from the side cases in exchange for other specimens from more recent rocks which we do not possess at present. I presume the Professor is now away from the office, as I have not heard from him since.

*This Rhizopod, I am informed, has not, strange to say, as yet been detected in the English Coal Measures.

NOTES ON LOCAL FOSSILS IN THE GLACIATED CHERT NIAGARA BEDS.

Read before the Geological Section of the Hamilton Association, November 24th, 1893.

BY COL. C. C. GRANT.

The small attendance at our Sectional Meetings is exceedingly depressing to all who take an interest in the advancement of scientific research here. The reason of this non attendance is unquestionably a matter for enquiry. I understand it is attributed by some to our using technicalities, Latin names which are incomprehensible to some without having the equivalents in English. Of course you all know this is unavoidable, as our fossils in general have no English names. On the other hand our papers may be severely criticized by scientific exchanges, when we attempt to meet the public requirement, for not entering more fully into details and descriptions, more especially when such is absolutely necessary to enable our readers to form an idea of any new or rare specimens. Dry details of the kind indicated may be welcome to a few, but certainly not to many.

We must endeavour to interest the rising generation in our pursuits. This I look upon as a matter of supreme importance, and I am glad to see many of the youth of the city are already beginning to acquire small collections of fossils and to express a wish to have them named, and are desirous to learn all about them. One of the boys recently explained to me they found it hard work to pass the examinations; that they had little time for recreation, and Saturday, when the museum is opened, is the only day in which they can enjoy a good game of baseball or cricket. This explanation may probably be considered sufficient to account for the absence, in some instances, of by no means an inconsiderable portion of the community. Well, despite all that, the fact is, several intelligent lads in the city and neighbourhood are really interested in things which have little attraction for the same class in European countries—Natural

History, "Neglected in Irish schools do you say!" was the indignant remark of the Principal of a diocesan establishment. "Is not Goldsmith's Animated Nature sufficient for all our requirements in that direction?" The writer refrained from reminding the worthy domine of the sarcastic comment of Dr. S. Johnson; "Goldy's work on this subject! Why, I doubt if he knows the difference between a horse and a cow, and, if he does, 'tis the extent of his knowledge."

I have obtained for the side trays during the past few months a large number of fossils from the glaciated chert beds (the richest of all our local rocks in organic remains). From a single field, close to the Corporation drain, came nearly all the flint-flake specimens we see in our side trays, together with duplicates transmitted to Europe and elsewhere. One would imagine after so many years researches (over a fourth of a century) by your Chairman and Mr. A. E. Walker that not a vestige of a fossil remained in that limited space to repay the collector. But the swampy portion this year has been planted with Indian corn, and when that was removed the surface presented an unusual number of flint-flakes—more than ever previously noticed. The time for collecting was very limited; shortly after the crop was stacked it was removed and the field ploughed over. There is now no chance of obtaining specimens from it until next spring, when the frost, snow and rain have brought the buried flakes again to the surface.

These glaciated Niagara beds (eight feet in thickness) are well displayed at the rock cutting on the railway east of the Reservoir. It was from this locality I obtained the sponges and sponge sections *in situ*. I noticed they were chiefly confined to the upper layers, that the surface soil overlying was exceedingly thin in places, and I concluded it was probable before the soil was deposited, as the limestone was a softer and less durable material than the chert, I might find withered out specimens in the ploughed fields on the escarpment. The opinion I arrived at was subsequently confirmed. I filled my pockets with well preserved sections and sponges in the first one I examined. I was informed by the proprietor that several years before the ground there had been cleared of the second growth of forest timber. Within the last few years the clearing has been extended a few hundred yards east of it and the ground recently ploughed, but the sponges evidently require a certain time for ex-

posure in order to weather out. The lumps of half decayed chert are there, but the outer edge of the sponge within does not yet make an appearance, and the sections are rarely perceptable.

The upper glaciated chert beds hold great numbers of fossils, which doubtlessly come under the head "Cladopora" (Hall). Prof. Foorde (British Museum) expresses his opinion that it belongs to the Monticuliporidæ. If difference in form is deemed sufficient to constitute new species, there are here several as yet undescribed.

The fibrous structure of Monticuliporidæ or Chetætes is very clearly displayed, but one in my possession presents an undoubted straited Epitheca, which leads me to suppose its true classification may be with the Polyzoa. The Fenestellidæ are also well represented in these upper chert beds. The majority I have seen figured are mere fragments Now, here the radix or base presents itself, and they widely differ in many instances; some like certain forms of the Graptolites are cup-shaped, others display a fan-like appearance, the stem proceeding from spreading rootlets. They are also often beautifully preserved.

It is much to be regretted that the swampy places near the Corporation drain, where Bryozoans are chiefly found, were unknown to Drs. Nicholson and Hinde when they visited Hamilton. It is about the last spot in which the geologist would ever dream of hunting for organic remains. The Professors made the Fenestellidæ a special study, and discovered several forms previously unknown in the Devonian rocks of Ontario. On this account, I regret no opportunity was afforded me to point out to them where Niagara Polyzoa were obtainable, and in far better preservation than any known to me extracted from the true limestones of the Niagaras used for building purposes.

But the Niagara sponges (mainly confined to these glaciated layers which disappeared on the brow of the Hamilton escarpment in The Great Ice Age), the Cladoporæ, the Bryozoans (so characteristic) by no means represent the entire organic remains of that portion of the layers deposited. Graptolites, differing from any figured or described by Dr. Spencer, have been noted in the deeply grooved and polished upper beds of the city quarries, and others adjacent. The Corporation drain swamp recently afforded me several interesting specimens of rare flint-flake fossils, viz.:

Cornulites Flexuosa, Cornolites Bella Striata and another (probably new) which unfortunately is imperfect. It bears a near resemblance to the Teutaculite, figured by Dr. Hall from the Waverly beds, Caleolus Herzire. In addition to Crania Anna, already figured and described in the Niagara fossils of Dr. Spencer, I succeeded in securing the limpet-like dorsal valves of two other species, one of which may be Crania Siluriana, as it comes very near the description given ; the other differs from any known to me.

The Ariculedæ, or Wing Shells, are also represented in the upper portion as well as the base of the chert beds. I forwarded to a well-known English Palæontologist some years ago a flint-flake containing an Aricula, naming it A. Emacerata. He appeared to doubt its precise agreement with the European specimen known by the name. Indeed, I inferred from his subsequent letter that he was rather inclined to look on ours as an American variety.

Three species of Acidaspis put in an appearance in the chert beds, only one of which, I think, has been described "A. Halli" (Spencer).

I do not recollect ever seeing in any geological work a notice of the terminal Moraines along the Burton and Glanford stone road. One between the turnpike and school house could scarcely have escaped observation. It looks like an artificial mound such as we read of as occuring in the States. A few years ago a farmer opened a drain along the base, and exposed quite sufficient to satisfy me the great mass of boulders, sand and clay had been deposited by a retreating glacier. What! Fresh water ice drop such a load as you see there?

In the President's annual address, published in one of our exchanges (Bulletin Natural History Society of New Brunswick, No. XI), Prof G F. Matthews, alluding to modern faunas of oceanic tracts, points out : "We see in contrast two groups of animals—those that inhabit the warm shallow seas and those that may be found in the deeper and colder parts of the ocean. As there are now tracts occupied by waters of different temperatures, so there were in the earliest Palæozoic times, and this is shown by the remains of marine animals entombed in the rocks. In certain regions

are found remains of Coral building forms and Molluses, which correspond to those of the warm and shallow seas of the present day; and in other regions, as in the confines of this city and at various points in the Maritime Provinces, are entombed the remains of animals corresponding to the *Sertularians* (Graptolites), *Pteropods*, *Glass Sponges* and other forms of the open ocean."

I infer from the foregoing extract that Professor Matthews entertains a view, held by many Palæontologists even now, that the Graptolites (Ancient Sertularians) were confined to shale beds and indicated deep sea bottom. He may not be aware that this class of organic remains has numerous representatives in the Niagara limestones of Ontario associated with Pteropods (Conularias, four or five species), Glass Sponges (many undescribed as yet), Bryozoans, Brachiopods, Fucoids and Corals. Certainly the two latter were not likely to live in water of any very considerable depth, and if we assume that the Archaeans of this continent acted as a barrier and protected the Mediterranean Sea from cold Arctic currents, it seems difficult to explain where such could find an entrance at all, save, as the Atlantic does now through the gut of Gibraltar, in an undertow. It must be admitted that several Graptolites occur in the Niagara shales, but they are found in the limestones below as well as in the blue building beds above this material. Indeed, several of the layers bear a striking resemblance to some modern Coral Reefs, especially the ones called by quarrymen "The Sand Beds." Why so called I am unable to say; it may be because they are not unlike certain of the Medina freestones in color. It is an exceedingly difficult manner to determine the depth of the Palæozoic Seas from the Brachiopods embedded in the rocks. These constitute a considerable majority of the shells found fossilized in these rocks, and the species still existing appear to feel as much at home in deep as in shallow warm water.

Again, taking the Trilobites for instance, we all know how very numerous the head and tail shields of the Crustacean are in our local limestones. They may have drifted shoreward from deep water after decay. Single valves of *Lingulella* occur in great abundance, but we rarely find the complete shell, and only occasionally can we ascertain if it has been fossilized in its burrow. Fucoid sea plants afford us more reliable indications regarding the laws of distribution,

and we may reasonably infer that the Laminarian Zone of olden times did not materially differ from the one of the present day. Bryozoan (Polyozoa) so abundant in the chert band of the Niagara Escarpment here, cannot be looked upon as safe guides in deducing geological conclusions regarding the depth of primeval seas. The modern Sea Mats, Mooses and "Mermaids Lace Work" are world-wide, inhabiting alike Arctic and tropical waters, attached to the floating Gulf weed (*Sargassum*) and to the dense sea forests that annually spring up about Norfolk Bay and the shores of the North Pacific. Indeed, fossil plants, Algæ or Fucoids, are not certain indicators on this point either unless undoubted evidence can be obtained that sea currents had not transported the broken sea weeds from a distant place. The Laminarian Zone is supposed to extend from low water to about fifteen or sixteen fathoms, but banks, etc., may occur a considerable distance from land and there the plants would flourish, no doubt, yet they are liable to be torn away from their anchorage in heavy gales and carried seaward, not shoreward.

THE CHITON (MODERN COAT OF MAIL SHELL).

I was recently asked when the above named shell first put in an appearance in a fossilized state. The late Professor Billings claimed he discovered a specimen in the Black River Series Cambro, Sil. He named it "*Chiton Canadensis*."

Another was described by the late Dr. Salter, Palæontologist of the Geological Survey of Great Britain and Ireland. It came from the Coal Measures, Europe, and was named *Chiton Carbonarius*. The former I have not seen figured or described, but little doubt can be entertained regarding the correct classification of the latter. We may see how very imperfect the geological Record must be when no specimens have been found in the intervening beds. The Devonian formation alone is nearly three miles in thickness. *Dentatium*, commonly called the Tusk Shell, is another Mollusc, which apparently survived from Palæozoic times.

ANADONTA—UNIONIDÆ.

In "Characteristic British Fossils," of the late Professor W. H. Baily of Dublin, you will find figured the oldest fresh water bivalve I think yet discovered. It occurs in the upper part of the old red

sandstone—that portion of the Devonian formation supposed to be chiefly of laenstrine origin. Externally it bears a remarkable resemblance to to the Unionidæ of our lakes and rivers, known better here as *Clams*. I do not know whether it presented the usual nacreous lustre of the family or whether it had been submitted to microscopical examination by the late Dr. Carpenter. Perhaps not; for Woodward in a note, "Manual of the Mollusca," page 213, remarks: "The fossil shells of the older rocks are so generally pseudomorphous or partake of the metamorphic character of the rock itself, that it is difficult to obtain specimens in a state for microscopic examination."

Here a strange coincidence occurred. On putting aside my notes, I received a package directed from Ottawa. On removing the outer cover, I found "Notes on the discovery of large Unio-like shells in the Coal Measures, South Joggins, N. S.," by J. F. Whiteaves. Doubts may be entertained regarding the true affinity of the Irish specimens, but taking into account that the Nova Scotia shell was associated with true land plants, (fragments of Sigillaria, Cordaites) and that a portion of the test of a bivalve (Nacreous throughout) was found in the same bed, few can doubt but Professor Whiteaves' conclusions are pretty accurate (despite absence of the hinge dentition) viz., that it represents an aberrant and extinct type of the *Unionidæ*.

THE ARK SHELL.

Another modern Lamellibranch, named above, had a representative in the Palæozoic age, the *Ctenodonta*, of Salter. The hinge line displayed a double row of teeth, bent, connected by smaller ones below the beak. This peculiarly was unknown to Dr. Jas. Hall, and, from its external appearance solely, he had previously named the fossil *Tellinomya*, as its shape suggested a certain relationship to the *Tellins* and *Myas*. Hall's name apparently holds its original place in the States. Dana figures *T. Nasuta* H., Trenton, at page 200 in his manual (revised edition), and also gives the teeth, which clearly shows that it belongs to the family *Arcacidæ*. The *Isoarca*, of Count Munstus, 1842, antedates both names, and Woodward, in the manual of the Mallusca, includes Salter's Ctenodonta under the head.

"The ark shells of the Palæozoic strata," he remarks, "have their anterior teeth more or less oblique like Arca, their posterior

ones parallel with the hinge as in Cucullæa." Leda, of the Leda clay, belongs to this family group. Nucula, another member of the family group, was also represented in Palæozoic times.

TRIGONIA.

In Australia the sole survivor of its race, *Trigonia Pectinata*, a beautiful nacreous shell (interior purple or gold) may be obtained in Sydney Harbour. Woodward figures Trigonia Costata from the British Oolites, giving the general range of the Genera from the trias to the chalk, remarking, 'not known in Tertiarus.' Silicified casts of Trigonia are found at Tisbury, preserving even the animal itself with the gills complete. It is said there are three species, but they are probably varieties only. In a paper I received from the late J. Beete Jukes, I find the following: "When acting as Naturalist in H. M. S. Fly, 1845, I came upon nests of Brachiopods under rocks (Waldheimia Australia). They varied so much in size, shape, etc, that McLeay proposed to make three species out of my first find. As they occured in family groups—parents and children, uncles, aunts and cousins—I doubted the specific distinction. After collecting some hundreds, it was plainly perceptable that variation in size and in external marking from smooth to deep ribbing graduated into each other, and there was no definite distinction."

I think there must be some mistake regarding the first appearance of the fossil *Trigonia*. *Lirodes ma post striata* is mentioned by Dr. Spencer as accuring at Burlington Heights in Cambro-Silurian pebbles. I gave him one of three specimens obtained there, and unless we exclude external appearance altogether, it surely mus be considered a member of the Trigonidæ.

THE CYPRINIDÆ.

Representing a genera of shells formerly numerous—are also on the wane. The modern Heart Cockle, *Esocardia Cor.*, Pitish Seas and *Astarte Sulcata* are examples. Megaladons "Megomus Canadensis, Hale," are said to belong to this group.

ARICULIDÆ.

The Ariculidæ or Wing-Shells, to which the famas pearl oysters of Ceylon belong, and perhaps the Prima also (ahough I may add Tryon and other Conchologists consider thi latter is

entitled to a distinct family classification,) were undoubtedly represented in Palæozoic times by Molluscs bearing at least externally, I cannot say a close, but certainly a resemblance to the shells of tropical or sub tropical seas of our own days. *Pterinea Demissa* and *Ambonychia Radiata*, so frequently found in Cambro-Silurian drift pebbles and shingles, here are supposed to come under this head, as as also *Fosidonomya*, *Posidonia* and two or more specimens from the Barton Niagaras. *Solemya*, a shell yet living in the Mediterranean, also dates from Palæozoic times.

PECTEN, SCALLOP OR COMB-SHELL.

Nearly related to the foregoing, although included among the Ostracidae by Woodward in "The Manual of the Mollusca," are the Scallops. Three species occur in the lower Carboniferous of Ireland now known by the name of Aricula pecten, McCoy. One, *A. Sowerbii*, still retains its wavy zig-zag bands of amber color in the mountain limestone beds. I had not the good fortune to collect a single example of this beautiful and very rare fossil, although I succeeded in securing many of the characteristic ones figured in the late Professor W. H. Baily's work. A quarry near Templemore, Tipperary, afforded me some of the best preserved organic remains such as limestones seldom yield. I never possessed, I believe, even average skill in extracting such things from the matrix. But then, owing to the soft nature of some of the layers, I found little difficulty in obtaining almost perfect casts of well known Palæozoic shells, with one exception, Orthoceras. The modern *Naticas* and *Pyramydellidæ* were also represented by species in the mountain limestone of Cork and Limerick, the latter by a *Loxonema*. *Pleurotomaria* occurs in the carboniferous rocks and *Nautilus Dorsalis*, Phillips. The last, however, I did not get. No doubt I may have omitted other families that can be traced to Plæozoic times.

Independent of a few shells, whose position is yet unsettled, the Echinus or Sea Urchin was represented by *Palæchinus Elegans*, McCoy. I did not obtain even a spine in the quarries I examined.

BRACHIOPODS.

While I feel I am reversing the order of their appearance, this necessarily follows in the course we take in any attempt to link the

present with past ages, and however imperfect the record may be, and however difficult to comprehend the changes which have taken place underlying all, one may perceive that the accepted beliefs of former generations have lost, or are losing, their hold, not only on leading scripture men, but on the public as well. From the strange relationship this class of the Mollusc bears, not only to the higher Lamellibranchs, but to Annelids, Tunicates and Polyzoa, it naturally attracted considerable attention of late years. The researches may not have led to all that was expected, but they have yielded much important information already, and will pave the way for future investigation. So far back as 1834, Von Buch asserted that the classification of the Brachiopods ought to be determined by the nature of the pedicle opening. The general external features, however, continued the essential basis up to 1848, but about that time King pointed out the interior of the shell afforded more reliable data. This view, with additions of his own, was adopted by Davidson, and modifications were subsequently proposed by others. It is now claimed that the results of the studies of fossil forms combined with that of living species have led to the recognition and establishment of certain primary characters resulting in the discovery of an original structure now applied to a more correct classification. According to Professor Sheuchert, whose words I quote, Drs. Beecher and Clarke, Hyatt, Morse, Sheply and Brooks deserve great credit for their respective discoveries. Thus the views of Von Buch are now accepted. Better late than never.

It has been ascertained that Lingula passes through two stages *Paterina* and *Obolella*, consequently it is no longer considered the prototype of its class, Paterina being the most primitive genius known, being found in lower Cambrian. Indeed it appears to be considered the ancester of all Bracheopods. Forty-seven families or sub-families are recognized. Six still living are represented as Plæozoic survivors, including *Thecidium*, a Mediterranean *Terebratula* recently traced back from the Trias fossils. But the specimen I have never seen, and do not altogether understand the grounds of separation. Professor Whiteaves, the Palæontologist of our Dominion Survey, is exceedingly cautious in reminding us not to forget Dr. Woodward's remarks which he incorporates in his own description, viz., "That the Molluscan Genera of the older of the newly discovered shell

rocks are believed to be nearly all extinct; and though the names of many recent forms appear in catalogues of Palæozoic fossils, it must be understood they are only employed in default of more exact information." The unio-like Devonian Irish shell, unlike King's Anthracosia, is invariably associated with land plants.

DISCOVERY OF COLORED LINGULÆ IN CAMBRO-SILURIAN ROCKS, HAMILTON, ONT.

The oldest colored shells yet discovered are three distinct species of Lingulæ, *Lingula oblonga*, *L. oblata*, *L. perorata*, from the Clinton Silurian beds of Hamilton; colors, blue, pink and brown The Chairman submitted for inspection a still older specimen from Burlington Heights, obtained from a drift boulder containing also two characteristic Trenton fossils, *Rhinchonella Plena*, and another which is also found in the Hudson River series. A Nacreous Gasteropod was some years ago discovered by the Rev. A. Carmichael at this locality in Cambro-Silurian shingles.

NOTE.—I confess I am unable to see why the Limpets (*Patelledæ*, *Calyptræidæ*) should not be included among the Mollusca which appeared in Palæozoic times. The *Metoptoma Estella* (Billings) from English Head, Anticosti, seems to be a true *Bonnet Limpet*. The brittle stars, that possess the property of dissolving their Corporations at will, were represented at the time in question by *Protaster*.

NOTES FROM OUR EXCHANGES—GEOLOGICAL AND ANTIQUARIAN.

BY COL. C. C. GRANT.

Read before the Hamilton Association, March 30th, 1894.

In the middle division of the Upper Laurentian, below the St. John's group (base Cambrian rocks), a very important discovery has been recently made by Professor G. Matthews, M. A., New Brunswick. He claims to have extracted low organisms, sponges, spicules, and stomatoporid forms in this series at St. John's. The latter is a calcareous column encircled by siliceous matter in which the wavy lines are considerably arched. He thinks it more closely allied to *Cryptozoon Proliferum Hall* (calciferous) than to *Eozoon Canadense*. You may recollect I submitted for your inspection a few years ago a Cryptozoon I obtained near the Corporation Drain, which was derived originally from "Lime Ridge." My specimen bore such a marked resemblance to the one figured in "The New York State Survey" that I forwarded the fossil, and Dr. Jas. Hall's figure of the calciferous one to Sir W. Dawson, as I was unable to perceive any marked difference between them.

The Rosette-like concentric form I fail to recognize in Professor Matthews' problematical fossil, *Archæozoon Acadiense*. Yet I believe it represents a low organism—a jelly-like mass of Protoplasm, not widely differing from the Amabæ, still existing. The sponge spicules the Professor claims to have discovered in "the Plumbago bed" and "Graphite" itself may be questioned, and it certainly is difficult to understand how on earth sponges came there if the late Sterry Hunt's views regarding the origin of Plumbago are accepted.

But this cannot be said of the fossil named and figured in "the Bulletin, No. IX., Natural History Society of New Brunswick," *Cyathospongia Eozoica*. The Quartzite specimen from the Laurentians bears so close a resemblance to the Cambrian sponge—*Protospongia fenestrata Salter*—that its nature can hardly be doubted; it merely differs in the *size* of the spicules. One of the principal

objections regarding the animal nature of *Eozoon* was that no other well defined fossils have ever been found in Archæan rocks, and Sir W. Dawson must be highly pleased at this recent discovery. How can his opponents, with any show of reason, explain away the additional evidence now forthcoming? They can hardly accept Salter's sponge and reject Matthews'. Hitherto no unquestioned or well defined organic remains have been found so low down in the earth's crust; yet indications of such have been remarked by several. I forwarded to an English friend, some years ago, fragments of Drift Laurentian and Huronian boulders from Hamilton. He mentioned that prepared sections of some of the specimens under the microscope revealed, as he considered, organic matter. The chief Palaeontologist of the United States, C. D. Walcott, found in the Laurentians fragments of what he supposed to be a *Trilobite* and a phosphatic shell. We can hardly expect to find many organic remains in rocks which have been crystallized *Quartzites* or *Granites*, although research or accident may yet reveal such in *the limestones* of the formation.

"In truth," remarks the Director of the Geological Survey of Great Britain and Ireland, "we are profoundly ignorant as to the conditions under which these Archæan rocks arose. Is their apparent bedding original or the result of after disturbance? The question cannot be answered." One thing seems clear. If, as the late Sterry Hunt contends, the Archæan rocks are probably altered sedimentary deposits, they must have been derived from still older ones than any known to us, which disappeared completely in some far off revolutionary change the world has undergone.

We are indebted already to Professor G. Matthews for the discovery of the Arcadian or St. John's Group (2,000 feet Lower Cambrian). When the Potsdam sandstone was found resting on Archæan rocks, it was natural to suppose it was the base of the system, but it represented merely the rim of the depression or basin (the New Brunswick beds underlying).

A certain unwillingness may be noticed, both on this continent and in Europe, among a few of the older Geologists to recognize the Cambrians of Sedgwick as separable from the Lower Silurians. Now, C. D. Walcott, chief Palaeontologist of the United States Survey, who has closely studied the Cambrians all over the conti-

nent, emphatically asserts that it is as well defined a formation as the Devonian or any other.

MOUND-BUILDERS AND INDIAN RELICS.

The systematic exploration of the Mound-builders' remains, by the United States Survey, has led to the conclusion that they were erected by the ancestors of the Red Man. This decision is undoubtedly satisfactory to Professor Lapham and a few of us who shared his views. It is amusing to reflect how slowly light dawned on this long debated matter. Dr. S. Peet, the editor of *The American Antiquarian*, Chicago, in an early paper, considers it absurd to suppose that the Indians—for instance, Dakotas, Cherokees, etc.,—were the Mound-builders, or that they were descended from them. Then later on follows the true conclusion, obtained apparently from more reliable data, that the Mound-builders were changed to the Indian merely by contact with the white man. Here we have no attempt to minimize the original mistake.

The Burial Mounds in the Northwest Territory, near Rainy River, appear to be more ancient than many opened in the United States. Mr. D. Young made a cutting into the one in which Dr. Bryce had previously obtained an earthenware vase. He found, it is said, the form of a man in a sitting position, with face towards the east, pieces of pottery beside him, as well as a large granite spear-head. The Winnipeg *Free Press* adds that Mr. Crowe also opened a trench in this Mound, in which was found a body in a like position, encased in birch bark. Unfortunately it was not stated whether the incision was made through the summit or not, and the United States explorers inform us that it is quite a common custom still for tribes of the Aborigines to inter their dead in such places.

A smaller Mound contained a skull and bones, with two vases, all of which fell in pieces when touched. Professor A. Lawson, an officer of the Canadian Geological Survey, found some copper beads and vessels, with three vases like the first one found by Mr. Bryce. Unfortunately the writer does not state whether the former was of native or "white men's" manufacture. I have seen a vase from an ossuary at the Beach which had been roughly hammered out of a sheet of Lake Superior copper. The same cemetery also contained

glass beads and other ornaments, undoubtedly obtained from Europeans.

Some Indian relics from Ontario were submitted for examination to an Irish Antiquarian several years ago. To my friend's surprise he stated that nearly all the so-called "Indian Wampum" was made by the whites, as also the more highly finished stone implements. The early adventurers and traders noticed the great value attached to these articles by "the Red Men," due perhaps to the difficulty of procuring a suitable sea shell and the tedious processes pursued in finishing. The Aborigines formed the shell money by breaking up the material into fragments and rounding these on heated stone But "the whites" turned out such immense quantities by machinery that the Red Men ultimately purchased it by strings six feet long.

The Ossuaries opened in this portion of Ontario cannot be very ancient. As far as I can learn they all, like the ones at Lake Medad and the Beach, contained ornaments and utensils made by white people. We can produce no proof that man has existed for any long period at least in this part of the continent. However, wandering hunters, living chiefly by the chase, were not likely to leave behind them many permanent records of their existence. Had undoubted implements of human make been found *in* the undisturbed gravel, etc., of Burlington Heights (the old Lake Ontario Beach), it would merely take us back to a time subsequent to the withdrawal of the great glacial ice sheet, for you may remark the Tile underlies it.

The United States Geological Survey and its able chief, Mayor Powell, are deserving of the highest praise for the thorough investigation of the Mounds all over the United States, and their contents. They certainly are entitled to very great credit for clearing up the mystery regarding the copper marks and ornaments so frequently discovered in burial places in the South. "They are ceremonial ornaments of various designs," remarks the Director of the States Survey. "I had several of them mounted on glass, and on studying them with a powerful magnifier I ascertained that they were made by *machinery* and struck with *dies*." Here we have what we may consider a truly original discovery. It is also satisfactory to find additional confirmation that the Mound-builders of Florida and the

South interred their dead in precisely the same way as in the North-west Territory. Mayor Powell's Report is undoubtedly a valuable contribution to American Anthropology, but the Washington authorities simply produce additional proof in support of views which a few of us in Canada and the United States expressed many years ago.

The sea shells—*Mactra Solidissima* or *Callista Gigantea*—contributed to form "shell money" as well as *Fulgar Carica* and *Venus Mercenaria.* Wampum made from the river mussell—*Unio*, —as I have remarked, has been found in New Brunswick. Dr. Bryce, of Manitoba, is one of the few Professors in this Dominion who take much interest in Antiquarian matters. He, I believe, expresses the erroneous opinion that the Mound-builders were a distinct race which had been wiped out of existence by the Indians. Perhaps, if he should ever pay us a visit, I may suggest that he ought to examine the very interesting collections of Mound implements and other relics in possession of Mrs. Carey and Mills, of Hamilton, and compare them with the valuable one at Toronto belonging to the Canadian Institute. If, after a careful comparison of these, his views are not considerably changed, I shall feel greatly surprised. No doubt, in some instances, the implements obtained from the Mounds are superior to the ordinary ones we picked up in ploughed fields, but all are similar as regards design, and, indeed, the superiority is frequently in the other direction.

REPORT OF THE CURATOR.

Donations to the Hamilton Association during the year 1893-4.

A specimen from Nanaimo of the Sea Worm Teredo Navalis, with a piece of A. Douglas' pine pile destroyed by the same.—Donated by E. M. Land.

Three petrified fish, of the Eosene period —By Mrs. C. Lock

A fine skin of the Horned Owl, and five other birds.—By Mrs. H. McLaren.

A Boomerang, from Australia—By Mr. G. Taylor.

Stone Chisel, from New Zealand.—By Mr. W. Flitcraft.

The jaw of an Elephant Fish, from Bay of Bengal.—By J. S. Grieves.

Small coin (medal) made of pure aluminum.—By ————

Beetles and Butterflies, from British Guiana.—By Mr. McIlwraith.

A Sword, picked up from the battle field of Preston Pans, fought on the 19th September, 1745.—Donated by Mr. Reid, of Hamilton, whose grandfather found the same.

One of the Silver Medals granted to the Six Nation Indians who served in the wars of 1812.—Loaned by Mr. C. Sewall.

Copy of "The Times" (newspaper) dated London, 1792, containing an account of Nelson's victory of the Nile.—Donated by Mr. B. E. Charlton.

A Venus' Basket and Shells.—By Col. C. Grant.

A six pound Cannon-ball, from Navy Island.—By Mr. Haskins.

A stuffed English Cuckoo.—By Mrs. Littlehales.

A valuable collection of Geological specimens.—D. E. Roberts.

The Association has also received a very valuable collection of the ferns of Arizona and New Mexico, and the sea-weeds of the Pacific, from the late Pro. Wright. These have arrived too late for the publication of a classified list, which will appear in the next Journal of Proceedings.

A number of Fossil Sponges have been cut and polished (and placed in the case) under the direction of Col. C. Grant and Mr. Walker, of Hamilton.

The Museum has been kept open every Saturday afternoon during the winter, and very much appreciated judging from the number of visitors. A large number of Fossils have been added to the collection by Col. C. Grant and other friends.

ALEX. GAVILLER,
Curator.

May, 1894.

REPORT OF THE PHOTOGRAPHIC SECTION.

Read at the Annual Meeting, May 10th, 1894.

In presenting this Report we feel pleased to think of the advancement that has been made by this section over last year.

During the summer very little was done at the regular meetings outside of the general business.

In the month of August Mr. John Eastwood announced that he would give two prizes for the best set of three slides made from the work of 1893. The prizes have since been won by Mr. Baker and Mr. Lees in the order named. At that same meeting Mr. A. M. Cunningham kindly donated an album to contain the work of 1892 and 1893, as a record of the Club's advancement. At the same meeting it was arranged that Mr. Cunningham should give a lesson in Development. When the general business was finished the meeting adjourned to the dark room to witness the demonstration in development. Your Secretary regrets that so few of the members were present, as a lesson was gained that not one member should have missed. The thanks of the Section are due Mr. Cunningham for the great interest he has taken in this work, and I am sure we all appreciate his efforts and are grateful to him for his kindness in imparting information to the members.

During the month of November several of our members sent in a number of views to the *Canadian Photographic Journal* competition. The result was very gratifying, Mr. Baker and Mr. Lees being successful in having their names placed on the honor roll.

On November 17th, 1893, a special meeting of the Section was held to arrange for an exhibition of World's Fair slides, loaned by the Toronto Camera Club, to be held on Thanksgiving Day, Nov. 23rd, 1893. The success of this exhibition you are all aware of.

At the meeting held January 9th, 1894, it was, on motion of Mr. Grant, decided that a special meeting be held on the second Tuesday of February, March and April, when any business of a special nature could be taken up and general discussions on Photo-

graphy held. These meetings have been of great benefit to a large number of members.

In the month of February this Club sent a number of prints and slides for competition to the exhibition of the Toronto Camera Club. The pictures were highly spoken of by the *Photographic Journal*, and our esteemed Chairman captured the bronze medal for his view of Mr. Copp's house, in the Architectural class.

On the 13th and 14th of March a very interesting exhibit of photographs was held in the museum of our Association by this Section, and it was agreed by all who availed themselves of the opportunity of viewing the collection that it was, without exception, the finest collection of amateur phothgraphs ever gotten together. In a letter I received from Clarence B. Moore, he informs me that one of his pictures had been hung in the Salon at Paris and another in the Salon at London, England. This is proof that photography is rapidly coming to the front among the fine arts. Apart from our own entertainments, the Club has provided two evenings for the Association. The first evening was the display of pictures made at the opening meeting of the Association; the other one the lantern night, which was held on the evening of March 8th. Both of the evenings were very successful and were highly appreciated by the officers, members and friends of the Associaton.

I cannot close this Report without thanking all who have in any way aided in making our entertainments and general meetings so successful, and especially to our esteemed chairman, Mr. Briggs, who has been so constant in his attendance at our meetings. And I hope that although he retires to-night from the chair, he will not lose any of his enthusiasm and interest in the Section.

All of which is respectfully submitted.

WILLIAM WHITE,
Secretary.

HAMILTON ASSOCIATION.

Statement of Receipts and Disbursements for the Year ending May 11th, 1894.

INCOME.

Cash balance from 1893	$160 57
Government grant	400 00
Sale 1, Birds of Ontario	1 00
Interest on deposit	20 00
Members' subscriptions	122 00
	$703 57

EXPENDITURE.

Rent	$206 50
Subscription to publication	9 50
Printing notices, stationery and postage	68 70
Caretaker	42 00
Insurance, repairs, gas, and sundry expenses	54 73
Times Printing Co., for Annual Report	189 71
Balance on hand	132 43
	$703 57

THOMAS MORRIS, JR.,
Treasurer.

I have examined the vouchers and found them correct.

H. P. BONNEY,
Auditor.

May 10th, 1894.

THE

JOURNAL AND PROCEEDINGS

OF

THE HAMILTON ASSOCIATION

IS SENT TO THE FOLLOWING:

I.—AMERICA.

(1) CANADA.

Astronomical and Physical Society	Toronto.
Canadian Institute	"
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	"
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 Canadien de Quebec	"
Natural History Society of New Brunswick	St. John.
Manitoba Historical and Scientific Society	Winnipeg.
Guelph Scientific Association	Guelph.

(2) UNITED STATES.

Kansas Academy of Science	Topeka, Kan.
Kansas University Quarterly	Lawrence, Kan.
Psyche	Cambridge, Mass.
American Academy of Arts and Sciences	Boston, Mass.
Library of Oberlin College	Oberlin, Ohio.
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.
Minnesota Academy of Natural Sciences	Minneapolis, Minn.
Academy of Natural Sciences	Philadelphia, Pa.
Academy of Sciences	St. Louis, Mo.
Missouri Botanical Gardens	" "
American Chemical Society	New York City.
New York Microscopical Society	" "
The Linnean Society	" "
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	Kansay 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.
Rochester Academy of Sciences ..... Rochester, N. Y.

(3) WEST INDIES.

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

(4) SOUTH AMERICA.

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

II.—EUROPE.

(1) GREAT BRITAIN AND IRELAND.

England.

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.
Mining Association and Institute of Cornwall.

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.....Léige.

(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 Societies of Bombay and Ceylon.
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.....Hobartown.

Obituary.

THE LATE DR. JOHN RAE, LL.D., F. R. S., F. R. G. S.

Dr. Rae was First Vice-President of our Association when it was established in 1837, and in the following year he was President. His name has been in the list of our honorary members for several years, and we have always considered it a great honor to have had such a famous man connected with our Association in the foregoing capacities.

Born in the year 1813, in the Orkney Islands, in the north of Scotland, he was therefore in his 80th year at his death, which took place on the 13th of July, 1894, in London, England.

He studied medicine at Edinburgh, taking his degree in 1833, and entered the service of the Hudson Bay Company in the same year. In 1846 he set out on his first voyage on behalf of the same Company, and so successfully was this accomplished that he was offered and accepted the place of second in command of the expedition under Sir John Richardson, to search for Franklin. This expedition was unsuccessful, but in 1849 Dr. Rae was appointed to command another search party to the Arctic coast. In order to utilize the time before navigation opened, he, accompanied by two men, made a journey along the shores of Wollaston Land, traversing over 1100 miles, he himself dragging the sledge. The average day's journey was about 25 miles, and the whole shore was minutely examined, including Victoria Strait, in which, as it afterwards appeared, Franklin's ships had been abandoned. Continuing the exploration, he and his party, with the aid of snow-shoes, marched continuously at the rate of 27 miles a day to Fort Garry, now the city of Winnipeg. In eight months they had travelled 5380 miles, 700 miles of which was newly discovered territory. For this he got the Gold Medal of the Royal Geographical Society. Again, in 1853, he took command of an expedition organized by

the Hudson Bay Company to trace the west cost of Boothia, and, from information obtained from the Esquimaux, he succeeded then in placing beyond all doubt the fact that Franklin and his men had perished from exposure and hunger. On this occasion he purchased from the natives a number of the relics of the ill-fated party. Returning to London in the early part of 1855, he found that he was entitled to £10,000, which the Government had offered for the first news of Franklin, a fact unknown to him while conducting the Expedition. It should be stated here that he shared this sum with his men, and again resumed his position in the Hudson's Bay service. This, however, he left as soon as his pension could be secured, and for some years he resided here and in Toronto. It was during this period that he was a member of this Association. In 1860 he married a daughter of Captain Thompson, of Toronto, who survives him. In the same year Dr. Rae took the land part of a survey of a contemplated telegraph line to America from Britain *via* the Faroe Islands and Iceland. Greenland was next visited, and in 1864 he took a leading part in a telegraph survey from Winnipeg across the prairies and through the Rocky Mountains. Subsequently some hundreds of miles of the dangerous parts of Fraser River were run down in small dug-out canoes without a guide, a most perilous undertaking, but successfully accomplished. He saw much in his time of unknown parts, covering some 1800 miles of previously unexplored ground. He settled permanently in London about 1866. His reports to the Royal Geographical Society are very valuable. He was a frequent and welcome attendant at the meetings of that Society, where his record of travel, his genial manner and graphic powers of description were often in request.

Our late honorary member, Dr. Rae, who has gone to his rest, was a grand old man. His name recalls the age of romance in Arctic exploration, when attempting to reach the North Pole or searching for the northern passage was a far more hazardous operation than it is to-day. For nearly half a century Rae's name had been connected with the moving tale of the long search for Sir John Franklin. It was to Rae that the English public were indebted for what they came to know of the fate of Franklin and his party.

Dr. Rae was a man of fine, resolute courage, of tender sympathy, of manly and heroic persistence. The modern world knew lit-

tle of him, but scientists honored him. He was a man of remarkable personality. As a man, he was simple, courageous, honest and true; he was of great stature and immense physical powers, as his age of four score, after many years of peril and privation in Arctic regions, testifies. He was buried in the church yard of Kirkwall Cathedral, in the Orkneys. So that all that was mortal of the Arctic hero rests among the people whom he loved, where the northern sea and the wild bird notes make the music that he loved.

Dr. Rae was also a Fellow of the Royal Society, and was greatly honored by many foreign scientific bodies.

REV. W. P. WRIGHT, M. A.

To many of the older members of the Association, the subject of this notice was well and favorably known. No member connected with this Association from 1870 to 1882 was more constant in his attendance, and more earnest in his endeavors for its best interests, than the late Professor Wright. His genial disposition and kindness of heart made him much beloved by his fellow members.

During his connection with this Association he did much for it. He was for many years a member of the Council, and in 1881 was First Vice-president. He contributed many very interesting and valuable papers to the Association, all indicating an intense love of the beautiful in nature, and a habit of close observation of his modes of operation. Geology and Botany were his favorite pursuits—the latter especially so.

He was an industrious collector of specimens. His collection of Ferns and Algæ, now the property of the Association, donated through the kindness of Mrs. Griffith, of this city, will have a place in our Museum, and will be a beautiful reminder of his beautiful life and character, and bring to mind his cheery, happy face, as some of us remember it.

Mr. Wright was born at Pompey, Onondaga County, New York, in 1828. He came to Canada when 11 years of age, and graduated from Victoria University, Cobourg, in 1846, being only 18 years of age. He afterwards completed a Theological course of study in New England, and was called to Cobourg as Professor in 1850. In 1855, with Dr. Dempster and Professor Goodfellow, he laid the foundation of what is now the North Western University of Evans

ton, near Chicago. He taught for some time there, and then was for six years minister in the Rock River Conference. Returning in 1861 to Canada, he was called to the Chair of Natural Science in the Ladies' College in this city, filling it with great acceptability for 20 years, when he and his family moved to California. He died at Los Angeles on July 3rd, 1893, aged 65 years.

As a boy he was very bright and studious. He had a splendid memory; at 13 years of age his name was on the college register with names of young men almost twice as old, and his teacher at that time declared that he had already passed a course of long, hard classical study, with others so many years older than himself. As a minister he was instructive. He was a successful teacher, and made his class-room a very pleasant place.

He was witty, intelligent and very kind, and as has already been hinted, his face was the exponent of a spirit, whose life-purpose being cheerfulness, had indelibly written upon it a radiant hopefulness.

Previous to his death he had a long period of weary suffering; yet even up to the last he did not complain, and retained his characteristic courage.

LIST OF MEMBERS

OF THE

HAMILTON ASSOCIATION.

HONORARY.

1881 Grant, Lt.-Col. C. C., Hamilton.
1882 Macoun, John, H. A., Ottawa.
1885 Dawson, Sir Wm., F. R. S., F. G. S., F. R. C. S., Montreal.
1885 Fleming, Sanford, C. E , C. M. G., Ottawa.
1885 Farmer, William, C. E., New York.
1885 Ormiston, Rev. William, D. D., Gladstone, Los Angeles, Cal.
1865 Rae, John, M. D., F. R. G. S., LL. D., London, England.
1886 Small, H. B., Ottawa.
1886 Charlton, Mrs. B. E., Hamilton.
1887 Dee, Robert, M. D., New York.
1887 Keefer, Thomas C., C. E., Ottawa.
1890 Burgess, T. J. W., M. D., F. R. S. C., Montreal.
1891 Moffat, J. Alston, London.

CORRESPONDING.

1871 Seath, John, M. A., Toronto.
1881 Clark, Chas. K., M. D., Kingston.
1881 VanWagner, Lieut.-Col. P. S., Stony Creek.
1881 Spencer, J. W., B. Sc., Ph. D., F. G. S., Savannah, Ga.
1882 Lawson, A. C., M. A., California.
1884 Bull, Rev. Geo. A , M. A , Niagara Falls South.
1885 Frood, T., Sudbury.
1889 Yates, Wm., Hatchley.
1889 Kennedy, Wm., Austin, Tex
1891 Hanham, A. W., Quebec.
1892 Woolverton, L., M. A., Grimsby.

LIFE.

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

ORDINARY.

1892 Adam, Alex. E.
1882 Adam, Jas. R.
1881 Aldous, J. E. P., B. A.
1872 Alexander, A., F. S. Sc.
1892 Alexander, Ernest.
1891 Arthur, C. C., M. A.
1892 Baker, C. O.
1892 Baker, Alfred H.
1885 Baker, Hugh C.
1880 Ballard, W. H , M. A.
1880 Black, Geo.
1890 Bonney, H. P.
1881 Boustead, Wm.
1892 Bowman, J. W.
1881 Bowman, Wm.
1880 Briggs, Samuel.
1857 Brown, Adam
1891 Brown, O. J., M. A.
1885 Buchanan, W. W.
1892 Buckley, Miss M. A.
1792 Burkholder, J. G. Y.
1880 Burns, Rev. A., D. D., LL. D.
1894 Burns, Miss B.
1891 Burns, J. M.
1889 Campbell, D. J.
1894 Campbell, Robt.
1892 Cameron, Chas. E.
1890 Cape, John
1891 Carpenter, H., B. A.
1891 Chapman, J. R.
1891 Chapman, W.
1880 Charlton, B. E.
1891 Cheyne, John P., Commander R. N.
1884 Childs, W. A., M. A
1890 Clark, D., D. D. S.
1890 Cloke, J. G.
1887 Colquhoun, E. A.
1894 Crawford, G.
1891 Crawford, J. T., B. A.
1892 Crisp, Alf. C.
1880 Cummings, James
1892 Cuttriss, Geo. H.
1892 Davidson, Mrs. M.
1872 Dickson, George, M. A.
1880 Dillabough, E. H., M. D.
1892 Devine, A L.
1892 Dow, R. C.
1891 Eastwood, John M.
1892 Edgar, Robt. L.
1890 Elliott, W. H., Ph. B.
1881 Evans, J. DeV.
1891 Evans, W. Sanford
1891 Fearman, F. W.
1882 Ferres, James
1890 Finch, C. S.
1880 Findlay, W. F.
1880 Fletcher, Rev. D. H., DD.
1880 Forbes, A. F.
1891 Foster, F. G.
1880 Foster, W. C.
1892 Garrett, A. D.
1880 Gaviller, Alex.
1882 Gaviller, E. A., M. D.
1883 Gibson, Hon. J. M., M.A., LL. B.
1888 Grant, A. R.
1892 Grant, W. J.
1887 Greene, Joseph
1883 Grossman, Julius
1888 Galbraith, W. S.

1894 Hansel, F., D. D. S.
1882 Harris, W. J.
1892 Heming, A. H. H., O.S.A.
1887 Hobson, Thos.
1890 Holden, Mrs. J. Rose
1892 Holliday, John, M. A.
1891 Hore, J. C.
1887 Ireland, S. J.
1892 King, A., M. A.
1882 Laidlaw, Rev. R. J., D. D.
1890 Lancefield, R. T.
1884 Lee, Lyman, B. A.
1892 Lees, George
1890 Lees, Thomas
1857 Leggat, Matthew
1890 Leslie, Geo. M.
1880 Leslie, James, M. D.
1880 Littlehales, Thomas
1891 Lochead, L. T., M. A.
1887 Logie, W. A., B.A., LL. B.
1880 Lyle, Samuel, Rev., B. D.
1891 McClemont, Wm. M.
1894 McConnell, Miss L.
1891 McCullough, C. R.
1857 McIlwraith, Thos.
1890 McInnes, Hon. Donald
1884 McLaren, Henry Major
1890 McLaughlin, J. F., B. A.
1880 Macdonald, J. D., M. D.
1857 Malloch, A. E., M. D.
1891 Manning, A. E.
1890 Marshall, William
1886 Martin, Edward, Q. C.
1892 Mathesius, R. A.
1892 Mills, Edwin
1887 Mills, Geo. H.
1886 Milne, Alex.
1884 Mitchell, Wm.
1887 Mole, Wm., M. R. C. V. S.
1892 Moodie, Jas. R.
1887 Moore, A. H., Lieut.-Col.
1890 Moore, Charles
1890 Moore, Henry E.
1892 Morgan, Arthur
1891 Morgan, S. A., B. A.
1886 Morgan, W. S.
1887 Morris, Thomas Jr.
1883 Murton, J. W.
1870 Mullin, John A., M. D.
1891 Myles, Wm. H.
1880 Neill, A. T.
1887 Nelligan, J. B.
Noyes, Mrs. Ed. F.
1892 Overell, M. J.
1885 Plant, John
1892 Pottenger, John
1892 Powis, A.
1891 Rastrick, E. L.
1891 Rastrick, F. J.
1881 Reynolds, T. W., M. D.
1990 Roach, George
1892 Robertson, R. A.
1882 Robinson, W. A.
1892 Ross, Lucien, G.
1892 Rutherford, Geo.
1887 Sanford, Hon. W. E.
1892 Sanford, E. Jackson
1890 Schofield, W. H., B. A.
1880 Scriven, P. L.
1891 Sinclair, S. B., M. A.
1885 Smart, Wm. L.
1892 Southam, Richard
1890 Staunton, F. H. Lynch-
1890 Staunton, George Lynch-
1890 Stratton, A. W., B. A.
1892 Swanzie, Miss Kate G.

1892 Sweet, David
1892 Sweet, Harry
1892 Smith, J. H.
1892 Sykes, W. J., B. A.
1892 Thompson, R. A., B. A.
1881 Tuckett, Geo. E.
1891 Turnbull, A. C.
1892 Turnbull, J. D.
1892 Turnbull, W. R.
1880 Turnbull, William
1891 Turner, J. B., B. A.
1892 Turner, W. J.
1891 Tyrrell, J. W., C. E.
1881 Vernon, Elias, M. D.
1887 Walker, A. E.
1892 White, Wm.
1888 Williams, C. J.
1881 Williams, J. M.
1892 Wilson, Wm.
1857 Witton, H. B.
1885 Witton, H. B., Jr., B. A.
1891 Witton, J. G., B. A.

E.
D.

B. A.
A.

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2nd Vice-President.
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