PROCEEDINGS

OF THE

Nova Scotian Institute of Science.

SESSION OF 1909-1910.

ANNUAL BUSINESS MEETING.

House of Assembly, Province Building, Halifax;
8th November, 1909.

THE PRESIDENT, DR. EBENEZER MACKAY, in the chair.

Other members present: DR. A. H. MACKAY, DR. A. STANLEY MACKENZIE, MAYNARD BOWMAN, ALEXANDER MCKAY, WATSON L. BISHOP, F. W. W. DOANE, PARKER R. COLPITT, WILLIAM MCKERRON, THOMAS C. MCKAY, and HARRY PIERS.

PRESIDENTIAL ADDRESS: (1) Deceased members; (2) Work of the Institute; (3) The atomic theory.—By PROFESSOR EBENEZER MACKAY, PH. D., Dalhousie College, Halifax.

Deceased Members.

In reviewing the history of our last year preparatory to beginning, as we do this evening, the work of a new session, it is fitting that reference should first be made to the losses which our membership has sustained through death. It is with profound regret I have to record the death of four members: one associate member, Mr. R. R. McLeod, and three corresponding members, Mr. Charles Pickford, Dr. James Fletcher and Mr. Hugh Fletcher. Of these the last named was, by virtue of his geological work in the Province and his contributions to the Transactions of the Society, associated in an especial way with the work of the Institute.

MR. ROBERT RANDALL MCLEOD, of Brookfield, Queens County, died at Winthrop, Massachusetts, in February of the present year. Mr. McLeod was a man of high intelligence and wide reading. He was master of an excellent English style, and perhaps no contemporary Nova Scotian author was so well-known to the reading public of the Province. He was besides a true lover of nature and was the author of "In the Acadian Land," a charming series of nature sketches. He was also the author of a work on the resources of Nova Scotia, entitled "Markland."

MR. CHARLES PICKFORD, of Halifax, was never identified with the scientific work of the Institute. But he will be remembered by older members as having done our society the service of attendiing to its financial affairs during the treasurership of the late W. C. Silver.

DR. JAMES FLETCHER, of Ottawa, who died in November, 1908, was one of the foremost Canadian naturalists and was the author of numerous papers on the insect life of Canada. Since 1887 he was entomologist and botanist at the Central Experimental Farm, Ottawa. He was also sometime Honorary Secretary and Treasurer of the Royal Society of Canada, of which he was a Fellow. A man of pleasing personality as well as an accomplished scientist his loss will be felt by a much wider circle than that of his personal friends.

When in last September the death of MR. HUGH FLETCHER was announced through the press, many members of this Society and many others in all sections of the Province felt a sense of personal loss. His death occurred at Lower Cove, Cumberland County, on the 23rd of September. Mr. Fletcher entered the service of the Geological Survey of Canada about thirty years ago, after a brilliant undergraduate course in the University of Toronto. Much of his professional work was done in Nova Scotia and no one else possessed so intimate a knowledge of the geology of this Province as he. His was the ideal scientific temperament —painstaking, accurate and conscientious as an observer, cautious in reaching his conclusions, tolerant of the opinions of others, but firm in his adherence to what he himself believed to be the truth. To the mining interests of the province he rendered notable and widely acknowledged services, and to pure science his work is of no less value. Mr. Fletcher was much more, however, than a mere geological specialist; he was an accomplished linguist, and a man of wide culture and broad interests. But no sketch of him would be adequate which did not above all recall characteristics of the heart as well as of the head, the lovable personality, the nobility of character, which will make his name long cherished in the wide circle of his friends in Nova Scotia. In Mr. Fletcher's death Canada loses one of its most eminent scientific men and most devoted public servants.

Work of the Institute.

The work of the Institute for the past year has not been characterized by any unusual features. Eleven papers were communicated. Of these four were geological, two botanical, and two chemical, and of the remainder one dealt with celestial mechanics, one with mineralogy, and one with the examination of cement.

Having now submitted some report upon our doings for the past year, I hope I shall be pardoned if, following the practice in many scientific societies, I devote the remainder of the time given me this evening to a brief discussion of a scientific topic.

The Atomic Theory.

The last two decades have been as rich in epoch-making work, at least in the departments of physics and chemistry, as the corresponding decades a century ago which saw the formulation of the laws of definite and multiple proportions and the birth of the atomic theory And some of the most notable discoveries of these two decades have been of such a character as to raise doubt in some minds as to whether Dalton's theory is any longer tenable. On the one hand the investigation of the nature of radiant matter seems to show the existence of bodies a thousand times more minute than the smallest of Dalton's atoms, while on the other hand among many new kinds of matter discovered some have revealed properties of so revolutionary and anarchistic a character as seemingly to threaten the stability of the whole chemical edifice, hitherto thought to be securely founded on its century-old atomic foundations. The statement is frequently heard that these discoveries must revolutionize chemical theories and conceptions. It is my purpose this evening to attempt to show very briefly what the position of the great central theory of modern chemistry is in the light of the most recent investigation.

It is just a year more than a century ago that Dalton published to the world the first full account of his atomic theory, in order to explain the laws of chemical combination which he had himself helped to formulate. The idea that matter has a grained structure, or is composed of minute particles more or less distant from one another, was advanced by one of the early Greek philosophers more than twenty-four centuries ago, and thereafter similar speculations had been from time to time entertained by various poets, philosophers and scientists. But to Dalton is due the credit of first applying these ideas to the explanation of chemical laws, and thereby converting an idle metaphysical speculation into a fruitful scientific theory. The fundamental fact which the atomic theory has to explain is that the combination of elements with one another not only takes place in certain invariable proportions but also that these proportions can all be expressed as integral multiples of certain numbers, one for each element. Thus, the only proportions in which oxygen is known to combine with other elements can be expressed by 16 multiplied by 1, or 2, or 3, or some other whole number. The proportions in which carbon is found in any of its hundred thousand compounds can always be expressed by 12 or some integral multiple of 12. These are the facts. Now it is plain that these facts receive a simple explanation if we suppose that each element is composed of minute particles, all of constant weight for the same element, and that chemical combination takes place between these particles. This was Dalton's atomic hypothesis. According to it, then, elementary matter resembles those articles of commerce that we can only buy in cakes or parcels of a definite weight, like soap. Different elements correspond to different brands of soap, each brand being made up into cakes of a uniform weight, but of different weight from the cakes of any other brand. The association of one or more cakes of one brand with one or more cakes of any other constitutes chemical combination. Now let us suppose our cakes so minute that they are far beyond the powers of the most delicate balance to weigh or of the most powerful microscope to reveal and we have a fair conception of Dalton's atom and of the atomic hypothesis.

A scientific hypothesis to be of value must serve two purposes: it must satisfactorily explain the facts already known and it must point the way to fresh discoveries. Judged by this criterion, the atomic hypothesis is among the most valuable in the history of science. Its effect in stimulating research was immediate and permanent. Under its influence, in the second decade of the last century, the great Berzelius carried out the gigantic work necessary to establish the laws of chemical proportions, which henceforth became the foundation of all chemical research. And from that time until the present the atomic theory has dominated chemical thought.

Dalton assumed the atom to be indivisible and of constant mass or weight, but made no assumption regarding its other properties, for example, its size or shape or colour or any of its physical characteristics. But as investigation proceeded this conception was modified in two directions. On the one hand the idea was advanced that the atom might itself be composite; on the other hand it was endowed with certain new properties. The first of these modifications was proposed within a decade of Dalton's publication of his theory. Prout, an English physician, observing that atomic weights as then determined were all either whole numbers or very nearly whole numbers if the weight for hydrogen were made unity, put forward the hypothesis that hydrogen was the one primordial substance of which all other elements were composed, their atoms being simply groups of hydrogen atoms. This hypothesis has proved itself one of the most seductive in the history of science. It appealed to the imagination of the chemical philosopher since it revived the ancient idea of the oneness of matter and provided a soul-satisfying unity underlying the infinite multiplicity of chemical changes. It was soon found, however, that several atomic weights could not be expressed by whole numbers. That of chlorine, for example, was certainly nearer 35.5 than 35. To meet these facts it was assumed that the primordial matter was not hydrogen but something having half that weight; so that the hydrogen atom itself was composite. Afterwards, as methods of determining atomic weights became more refined and the existence of various fractional values in atomic weights could be maintained with certainty, this primordial matter had to be still further subdivided, until its subdivisions became too minute to be capable of verification by chemical analysis. The truth or falsity of the hypothesis could then no longer be tested by experimental methods and the hypothesis itself retreated from the territory of science into that of speculative philosophy. Meantime under the stimulating influence of the atomic theory the investigation of atomic weights and the properties of elements contnued until, a little more than fifty years after the publication of Prout's hypothesis, these investigations blossomed into a generalization which recalled to chemists once more, this time with convincing force, the conception that the atoms must after all be composite substances. This was the Periodic Law of Mendeléeff and Lothar Meyer. If we arrange the elements in a long line in the order of their atomic weights and then observe successively their properties, we find the same set of properties recurring again and again at regular intervals. It is as if we were dealing with a succession of generations, the individuals of each generation reproducing more or less faithfully the characteristics of their respective ancestors. Now we are free to adopt either of two attitudes towards this law. The facts are undeniable: and we may either refuse to speculate about the cause, or we may allow ourselves to indulge in that luxury. If we choose the latter course, it is difficult to avoid the conclusion that our elements are not the ultimate forms of matter; and if we assume the atomic theory, it follows that our atoms are composite.

We now see that the idea of the composite character of atoms is nearly as old as the atomic theory itself and in one form or other, like the poor, has been with us always. But the validity of the atomic theory has not thereby been undermined or in any way affected. For the conception of an atom involved in it is not that it is the smallest particle of matter capable of existence, but is that minute mass of matter which maintains its individuality throughout all chemical reactions. No difference how composite it may be, if it maintains its unity throughout all chemical operations to which it can be subjected in the laboratory, then it is, so far as the chemist is concerned, indivisible, and constitutes a chemical atom. This is the conception of an atom that has long prevailed in chemical circles.

About ten years ago Sir Joseph Thomson's researches on the nature of radiant matter revealed the existence of corpuscles a thousand times smaller than the hypothetical hydrogen atom of the atomic theory. This great discovery seems to have disturbed the faith of weaker brethren, who imagined they saw in it the approach of a cataclysm which would sweep away old landmarks and leave few or none of our familiar chemical conceptions any longer recognisable. But from what has now been said it will be clear that while the discovery was one of extreme interest to chemistry, it had no tendency to invalidate the atomic theory. The tendency was rather in the opposite direction, since the discovery furnished additional evidence of the existence of extremely minute particles of matter.

Just half a century after the publication of the atomic theory, the progress of chemical knowledge and the corresponding evolution of chemical thought resulted in endowing the atom with a new property, namely, a strictly limited capacity for combining with other atoms, as measured by the number of atoms with which it can combine. This is the property called valency. The facts known were best explained by the assumption that a given atom cannot become directly associated with or, figuratively speaking, linked to, an indefinitely large number of other atoms. On the contrary, the number is at most small, the atoms of each element having a certain maximum capacity of combining. The capacity of the atoms of some elements, hydrogen for example, is exhausted when it has combined with one other atom. An atom of oxygen, on the other hand, can combine with two but with no more than two such atoms as hydrogen. Or again, the limit of combination for an atom of carbon is four atoms of hydrogen or two atoms of oxygen. Hydrogen atoms accordingly are said to have a valence of one, oxygen atoms of two, carbon atoms of four. The highest valence which any atom exhibits is eight. The effect of this extension of the atomic theory was to vastly increase its usefulness. It now became possible to formulate relationships between the atoms in the molecules of even complex organic compounds. In other words, chemists were now able to form a mental picture of the internal mechanism of molecules of compounds, which, whether it corresponded closely to fact or not, at least justified itself, for it greatly facilitated chemical investigation. A single example will serve to illustrate this. An analysis of acetic acid shows that it is composed of 40.11 per cent. carbon, 6.80 per cent. hydrogen, and 53.09 per cent. oxygen. Expressed in the language of the atomic theory, this composition would be given by the formula CH_2O. Physical as well as chemical considerations lead to a molecular formula just double this, or $C_2H_4O_2$, expressing, of course, the same composition. Now experiment shows that one-quarter and no more than one-quarter of the hydrogen in acetic acid can be replaced by an equivalent weight of a metal, as sodium, yielding sodium acetate. The remaining three-quarters cannot be so replaced. This fact is expressed in terms of the atomic theory by the statement that one hydrogen atom in the molecule of acetic acid bears a relation to it different from that of the other three. Again, experiment shows that in a wide variety of reactions where one-quarter of the hydrogen of the acid is abstracted from it, one-half of the oxygen also disappears at the same time, and these quantities of hydrogen and oxygen reappear again together in one of the products of the reaction. The inference is that part of the oxygen and hydrogen in acetic acid are closely associated, or, in terms of the atomic theory, one of the hydrogen atoms in the molecule is closely combined with, or linked to, one of the oxygen atoms; and as the valence of hydrogen is unity and that of oxygen two, the hydrogen must be attached to the rest of the molecule by means of the oxygen; and hence if the oxygen is split off the hydrogen must go off with it. Proceeding in this way, interpreting experimental results by the atomic theory and its extension in the theory of valency, we finally arrive at a mental picture of the molecular structure of a compound. Now the important feature is that this mental picture may suggest new methods of making the compound and may point to new and unexpected properties, which in turn can be verified by further experimentation; and thus knowledge grows from more to more.

A striking illustration of this process is furnished by the benzene theory. This is simply a mental picture of the relation of the atoms in a molecule of the hydrocarbon benzene. Its publication in 1865 led to an unexampled advance in the knowledge of that great class of organic compounds known as benzene derivatives, which include, among many other substances, the aniline dyes; and it was this advance which made possible the great German colour industry of to-day with its millions of capital, its army of workmen and, last but not least, its alluring dividends. No more practical proof than this of the utility of a theory can reasonably be demanded.

But this very utility has had a train of evil consequences. So universally useful has the atomic theory been in explaining the properties of matter that in some quarters the existence of atoms is tacitly assumed as a fact. Careless writers of elementary text-books are especial sinners in this respect, and in consequence many beginners in chemistry acquire as firm a belief in the reality of atoms as in the existence of footballs or chocolates, to the complete subversion of all clear thinking in chemical subjects. I have in mind a text-book of elementary chemistry which I keep by me as a constant reminder of how the subject should not be presented. On one of the first pages of this book, the author, having defined "mass" and "molecule" in the same breath, directs the attention of the student to a piece of sugar and inquiries:

"Cannot the smallest particle of sugar, the molecule, be separated into still smaller particles of something else? May it not be a *compound* body, and will not some force *separate* it into two or more substances? The next experiment will answer this question."

The pupil is then instructed to pour some sulphuric acid on sugar. The sugar is charred, and the author, after pointing out that this action is an example of chemical change continues as follows:

"From this we see that molecules are not the ultimate divisions of matter. The smallest sugar particles are made up of still smaller particles of other things which do not resemble sugar, as a word is composed of letters which alone do not resemble the word."

A few sentences later we have the statement: "An atom is the smallest particle of an element that can enter into combination."

Now, if after faithfully working in the laboratory, book in hand, the high school pupil comes away with the idea that he has proved the existence of atoms, and that there is much the same sort of evidence for their reality as there is for that of sugar, whose fault is it? And if after a course of laboratory training of this sort, he seems to have lost forever the power of drawing from simple experiments the deductions which they warrant and those only, whose fault is it?

While at the present day the atomic theory is at the basis of the explanations of all properties of matter both in chemistry and physics, it has had to be confessed hitherto not only that it has not been proved but that it is perhaps incapable of direct experimental proof.

To understand the difficulty one has only to realize the extreme minuteness of the magnitudes to be dealt with. The calculations of Lord Kelvin and others have shown that, assuming the existence of atoms and molecules, the atom is probably not more than one-millionth of a millimeter in diameter, that is, ten million atoms placed side by side so as to touch one another would just stretch across the nail of one's little finger. Similar calculations show that a cubic centimeter of air, that is, a little cube each edge of which measures about the width of one's little finger nail, would contain under normal conditions twenty million million million molecules, each of them being a group of two atoms. Professor Fleming, of London, gives the following illustration:

"We can in a good Whitworth measuring instrument detect a variation in length of a metal bar equal to one-millionth of an inch. This short length would be occupied by 25 molecules placed in a row together. We can in a good microscope see a small object whose diameter is one hundred-thousandth of an inch. In a small box of this size we could pack 16 million molecules close together. The smallest weight which can be weighed on a very good chemical balance is one-hundredth of a milligram. The united weight of one million million million molecules of hydrogen would therefore just be detectable on such a balance."

It is not surprising that direct confirmation of the existence of bodies having such infinitesimal magnitudes has seemed hopeless; and in consideration of this there arose a school of chemists in Germany in the last decade of the last century who, with Ostwald at their head, have attempted to dispense with the atomic theory and rebuild the fabric of chemical theory on a surer foundation than an hypothesis at once unproved and seemingly incapable of proof. If this attempt were ultimately approved by the world of physicists and chemists, whatever the philosophic gain might be, the practical loss would undoubtedly be great and the progress of physical science retarded. On this account the recent announcement of Professor Rutherford that he has obtained a direct experimental proof of the existence of atoms is one of unusual interest and importance.

This evidence has come from a quarter from which at one time some timid souls thought present chemical conceptions had much to fear, namely, from the investigation of radio-active matter. The contrary has proved to be the case. Light has already been thrown on atomic structure, of which previously nothing could be asserted, since its problems could not be attacked by ordinary chemical methods. The new knowledge is thus making conceptions more definite which formerly had to be left vague through ignorance. It has not come to destroy but to fulfil.

The brilliant researches of Rutherford and his co-workers on radium and other radio-active matter have led to the conclusion that the astonishing properties of these substances are only to be explained on the assumption that atoms are to be thought of as complex systems and that the atoms of radio-active substances are unstable, some of them constantly undergoing spontaneous decomposition. In decomposing the atom usually projects particles into the surrounding space while at the same time new forms of matter make their appearance.

In the case of radium two kinds of particles are projected with great velocity, α particles of atomic dimensions, and β particles of the same order of size as the corpuscles detected by Sir Joseph Thomson, or a thousand times smaller than an atom of hydrogen. The question at once arises, how is the detection of such minute masses of matter possible? The answer is that these particles are electrically charged and that the possibility of following their movements is thereby almost infinitely increased. Sir Joseph Thomson in his recent presidential address to the British Association at Winnipeg gave a very striking illustration of this fact. The smallest quantity of unelectrified matter ever detected is, probably, a trace of neon amounting to half a millionth of a cubic centimeter. This small quantity would contain about ten million million molecules. "Now", to quote the words of the address, "the population of the earth is estimated at about fifteen hundred millions, so that the smallest number of molecules of neon we can identify is about 7000 times the population of the earth. In other words, if we had no better test for the existence of a man than we have for that of an unelectrified molecule we should come to the conclusion that the earth is uninhabited." On the other hand when molecules are electrified the presence of only three or four of them in a cubic centimeter can be detected.

It was by taking advantage of this fact that Rutherford and his co-workers have recently been able to detect by a special electric method the entrance of a single α particle into a vessel prepared for its reception. The detection was effected by the impulse given to an electrometer needle on the entrance of the particle. The experiment was so arranged that each α particle emitted could be counted by continuing the impulses of the needle. The next step was to allow these α particles to be projected in vast numbers into a suitable receiver previously exhausted. It was found that helium gas accumulated in the receiver. Now it may be shown that, if there are such things as molecules at all, the molecule and atom of helium must be identical, that is, it is what is called a monatomic gas. It follows that the α particles expelled from radium are helium atoms or molecules and hence we have what seems direct experimental proof of the existence of the atom.

This result was confirmed by a second method. Everyone is probably acquainted with the little instrument devised by Sir William Crookes in which a speck of radium set up in front of a screen of phosporescent zinc sulphite under a microscope slide is seen with a lens to produce upon the screen innumerable flashes of light. These scintillations can only be due to the *a* particles emitted by the radium. Rutherford modified this arrangement until the scintillations produced were no more numerous than could be counted, and thus not only had a second demonstration of the existence of atoms but obtained data based on actual counting from which could readily be calculated the number of molecules in a cubic centimeter of gas. Henceforth, therefore, we may feel that the atomic theory, unlike the systems that have their day and cease to be, is to abide with us as a permanent utliity.

The Treasurer, M. BOWMAN, presented his annual report, showing that the receipts for the year ending November, 1909, were $881.92, the expenditures $626.73, and the balance in current account $255.19; while the permanent endowment fund is $834.79, and the reserve fund $18.87. The report, having been audited, was received and adopted.

The Librarian's report was presented by H. PIERS, showing that 1,697 books and pamphlets had been received by the Institute through its exchange-list during the year 1908; and 1189 had been received during the first nine months of the present year (1909), viz., January to September inclusive. The total number of books and pamphlets received by the Provincial Science Library (with which those of the Institute are incorporated) during the year 1908, was 3,761. The number of books borrowed was 381, besides the many that were consulted in the library. No binding has been done for some years owing to lack of funds. Arrangements have been made to move the Provincial Science Library from No. 201 Hollis street to the new Technical College, on Spring Garden road, where it will be placed in a stack-room, 48 by 41 feet, with a small adjoining reading-room, on the second floor of the building.—The report was received and adopted.

The subject of binding volumes in the Institute's library was referred to the incoming council.

On motion of DR. A. H. MACKAY and H. PIERS the following resolution was unanimously adopted:

"Whereas, the Nova Scotian Institute of Science has learned with deep regret of the death of its corresponding-member, MR. HUGH FLETCHER, B. A., geologist of the Canadian Geological Survey, which sad event occurred at Lower Cove, Cumberland county, Nova Scotia, on the 23rd of September, 1909;

"Therefore resolved, that the Institute of Science at its annual meeting held on the 8th of November, 1909, place on record an expression of appreciation of his high scientific and scholarly attainments, of his untiring, enthusiastic, extensive and accurate work in the field of Nova Scotian geology, of his sterling modesty of character, and of his kind disposition and helpfulness towards all with whom he came into touch."

It was resolved that the thanks of the society be conveyed to His Honor, the SPEAKER OF THE HOUSE OF ASSEMBLY, and the Hon. the COMMISSIONER OF PUBLIC WORKS AND MINES for their courtesy in permitting the use of the assembly room as a place of meeting.

The following were elected officers for the ensuing year (1909-10):

President,—PROFESSOR EBENEZER MACKAY, PH. D., *ex officio* F. R. M. S.

1st Vice-President,—WATSON L. BISHOP.

2nd Vice-President,—PROFESSOR A. STANLEY MACKENZIE, PH. D.

Treasurer,—MAYNARD BOWMAN, M. A.

Corresponding Secretary,—A. H. MACKAY, LL. D., F. R. S. C.

Recording Secretary and Librarian,—HARRY PIERS.

Councillors without office,—ALEXANDER MCKAY; PROFESSOR FREDERIC H. SEXTON, B. SC.; PHILIP A. FREEMAN; FRANCIS W. W. DOANE, C. E.; A. L. MCCALLUM, B. SC.; DONALD M. FERGUSSON; and PARKER R. COLPITT.

Auditors,—WILLIAM MCKERRON and H. W. JOHNSTON, C. E.

FIRST ORDINARY MEETING.

Mining Engineering Lecture Room, N. S. Technical College, Halifax; 13th December, 1909.

THE PRESIDENT, DR. E. MACKAY, in the chair.

The PRESIDENT referred to the meeting of the society being held for the first time in the Technical College, at which place future meetings will take place.

It was announced that at the April meeting of the council, W. S. BRODIE, B. A., of Lunenburg, N. S., had been duly elected an associate member.

DR. A. H. MACKAY delivered an address on "A new Nova Scotian insect: the Birch-leaf Saw-fiy (*Phlebatrophia mathesoni,* Alex. MacGillivray)." The subject was discussed by MESSRS. DOANE, PIERS, BISHOP and BROWN.

HAROLD S. DAVIS, of Dalhousie University, read a paper prepared by himself and H. W. MATHESON, "On a New Method of estimating Iodides." The paper was discussed by the PRESIDENT, C. B. NICKERSON, D. M. FERGUSSON, and DR. A. H. MACKAY.

SECOND ORDINARY MEETING.

Mining Lecture Room, Technical College, Halifax;
14th February, 1910.

THE PRESIDENT, DR. E. MACKAY, in the chair.

It was announced that at the last meeting of the council, the REVEREND M. C. KELLY, of St. Mary's College, Halifax, had been duly elected an ordinary member.

D. S. MCINTOSH, B. A., B. SC. lecturer on geology, Dalhousie University, read a paper entitled "A Note on the Recent Earthquake in Cape Breton." (See transactions, p. 311). The subject was discussed by PROFESSOR A. S. MACKENZIE; and DR. T. C. MCKAY gave a description of his experience during the late great Californian earthquake, which he illustrated by stereopticon views made from photographs.

T. C. MCKAY, M. A., D. SC., instructor in physics, Dalhousie University, presented a paper on "The Variation of the Hill Effect with the Temperature and Previous Heat Treatment in the case of Magnetic Metals."

PROFESSOR A. S. MACKENZIE followed with a discussion of the phenomena produced by any physical strains causing molecular change in metals.

THIRD ORDINARY MEETING.

Assembly Room, Technical College, Halifax;
11th April, 1910.

THE PRESIDENT, DR. E. MACKAY, in the chair.

PROFESSOR ERNEST HAYCOCK, of Acadia University, Wolfville, read a paper entitled "The History of Erosion in the Cornwallis

Valley, N. S." The paper was discussed by PROFESSOR SEXTON, H. PIERS and D. S. MACINTOSH.

THOMAS J. MCKAVANAGH, electrician of the cable steamship "Minia," gave an address on "Recent Results in Wireless Telegraphy," illustrated by experimental apparatus in operation.

FOURTH ORDINARY MEETING.

Mining Lecture Room, Technical College, Halifax;
9th May, 1910.

THE PRESIDENT, DR. E. MACKAY, in the chair.

On motion of MESSRS. PIERS and MCKERRON, it was resolved that, as a mark of respect to the memory of His late Gracious Majesty, KING EDWARD, the meeting adjourn to this day fortnight.

ADJOURNED FOURTH ORDINARY MEETING.

Mining Lecture Room, Technical College, Halifax;
23rd May, 1910.

THE PRESIDENT, DR. E. MACKAY, in the chair.

The following papers were presented:

(1) "The Rusts of Nova Scotia."—By WILLIAM P. FRASER M. A., Pictou Academy, Pictou, N. S, Read by title. (See Transactions, p. 313).

(2) "The Action of Organo-metallic Halides on Quinone."—By C. C. WALLACE, B. A., Dalhousie University. Read by title. (See Transactions, p. 301).

(3) "A Possible Change in the Concentration of Solutions due to Gravity."—By HAROLD S. DAVIS, B. A., Dalhousie University. (See Transactions, p. 291).

(4) "The Occurrence of Opal near New Ross, Lunenburg County, N. S."—By HARRY PIERS, curator of the Provincial Museum. (See Transactions, p. 446).

The papers read were discussed by those present, and a vote of thanks presented to the non-member, MR. DAVIS.

HARRY PIERS,
Recording Secretary.