PROCEEDINGS

OF THE

Nova Scotian Institute of Science,

SESSION OF 1913-1914.

Annual Business Meeting.

Civil Engineering Lecture Room, Technical College, Halifax; 8th October, 1913.

The President, Donald M. Fergusson, in the chair.

Others members present: Dr. A. H. MacKay, Dr. H. L. Bronson, Maynard Bowman, Dr. E. Mackay, Alexander McKay, Dr. D. Fraser Harris, Donald S. McIntosh, Carleton B. Nickerson, W. McKerron, J. H. L. Johnstone, and Harry Piers.

Presidential Address: (1) Deceased Members; (2) Problems in Biochemistry.–By Donald M. Fergusson, F.C.S., Halifax.

I take this opportunity of thanking the members of this Society for the honor conferred in electing me as President, an honor the more appreciated as during this term we have reached our jubilee as a society.

Deceased Members.

During the past year we suffered the loss of two members who have passed from this life.

GEORGE UPHAM HAY, Ph. B., M. A., D. Sc., F. R. S. C., corresponding member of this society, was born at Norton, N. B., June 18th, 1843. Starting as a journalist he became an educationist and was a power for advancement in our sister province. With Dr. A. H. MacKay, he established the *Educational Review*, which he managed and edited; and latterly he published several historical works. It was as a botanist that we knew him. He was a president of the Natural History Society, St. John, president of the Botanical Club of Canada, and member of the New England Botanical Club. In 1904 he was president of Section IV of the Royal Society of Canada. In 1902 he was elected a corresponding member of this Institute. His contributions to botany were many and varied and are found in the Transactions of the Royal Society of Canada, Bulletin of the Natural History Society, N. B., and Educational Review. He also contributed papers on education and natural science to the Proceedings of the Dominion Education Association, Educational Institute of N. B., and Educational Review.

JAMES GORDON MACGREGOR, M. A., D. Sc., LL. D., F. R. S., F. R. S. C., F. R. S. E., was a native of Halifax, N. S., being born March 31st, 1852. Educated here he obtained his B. A. at Dalhousie University in 1871 and M. A. in 1874. From hence he proceeded to Edinburgh University and to Leipzic and obtained the D. Sc. degree from London University in 1876. In the same year he became lecturer on physics at Dalhousie, changing to a like position at Clifton College, England, a year later. Coming back to Dalhousie University to take the Munro professorship of physics in 1879, he remained there until 1901 when he left to become professor of natural philosophy in Edinburgh University, succeeding his

old teacher Prof. P. G. Tait, and occupying that post until his death.

As a student at Dalhousie University he had a career unsurpassed in the history of that institution, the calendar of 1871 showing his name opposite every prize open to him, and his subsequent life was but a continuance of that appetite and capactiy for work which distinguished his early days.

While holding the position of Munro Professor of Physics at Dalhousie, he for several summers during his vacations, returned to Edinburgh to work in the larger laboratories there, and thus when Edinburgh University called him, he was no stranger, but one whose worth and value were known.

At Dalhousie University he acted as Secretary of the Faculty of Arts, and later as Secretary to the Senate, and there as in his laboratory and class rooms he was a source of inspiration to those with whom he came in contact. The same may be said of him in relation to our society which he joined in January, 1887. He was our President 1888-91, and for the work he did in this connection I must refer you to the paper on Past Presidents given at the beginning of this last session by our able Secretary, Mr. Piers.

At Edinburgh, he, during the twelve years there, developed and extended the Department of Natural Philosophy, changing the old Infirmary in Drummond Street into a well equipped physical laboratory, and his energies in that direction were only limited by lack of funds.

A foundation F. R. S. C., he was President of the mathematical and physical section of that body in 1892, was a Fellow and Councillor of the Royal Society of Edinburgh, and in 1900 was elected a F. R. S.

He contributed papers to our Society, to the Trans. Roy. Soc'y, Canada, Philosophical Magazine and the Physical Review, and was author of "Kinematics and Dynamics" (1887-1902) and "Physical Laws and Observations."

Taken suddenly ill on the morning of May 21st, 1913, he had time to call his son and died almost immediately afterwards. We deeply feel his loss, for to many of us he was a true friend. A man of unselfsh character and lovable, he devoted himself entirely to those around him, to his students, his fellow scientists and his family. Cognizant of our own loss, we can extend our sympathies to those bound by family ties, whose loss is not only that of the man but of husband and father.

Biological Chemistry.

The chief event, this session, in our society, has been the passing of the fiftieth milestone, and although a review would naturally suggest itself, yet any fair summary of our work would exceed the usual limit of the annual address. I have chosen rather to speak of a branch of chemistry that is now beginning, or rather has well begun, and that bids fair to be foremost in the field during the next half century.

Fifty years ago in 1863 Duvaine first established a connection between bacteria and disease, identifying a bacillus as the cause of anthrax. Down through the years intervening has research continued; bacteriology has grown to be one of the most important of the biological sciences, and one whose applications have immensely benefited humanity. One by one the bacteria, pathogenic and nonpathogenic, were isolated, and there followed methods of growing, staining and identification. From inoculations of filtrates from culture growths of pathogenic bacteria, physiological disturbances identical with those in the disease were observed. Immunity in varying degree had been known as a result of disease, and it was found that immunity could be obtained by inoculation of the artificial growth filtrate. Thus arrived the ideas of toxins and antitoxins which form the basis of the modern immunity theory.

Other bodies formed by bacterial infection were noted, such as lysins and agglutinins, the formation of the latter

being taken advantage of in the Widal test for typhoid infection. A vast amount of work was done on the effect of introducing into the blood stream foreign elements such as blood corpuscles of other species, albuminous bodies, e.g., serums, extract of muscle, etc. These developed antibodies, and we have now the biological blood test, precipitin test for flesh, and many others. Here we have evidence of a large number of reactions — chemical reactions—between bodies of whose composition and properties little is known. To investigate such is the work of a new individual, the biological chemist. There lies open to him a new and immense field in the chemistry and physics of life, in the science of the cell, with its protoplasmic contents and their activities.

The biochemist is a new specialist who must have a long and varied training, for so co-related are the sciences that he who would interpret aright the phenomena he observes must have the broadest foundation on which to build.

With some point of kinship to the toxins we have as cell products the Enzymes. The enzmyes of digestion and fermentation have long been known and investigated, and a host of enzymes are classed as catalysers, and much work has been done on the dynamics of reaction and the effect of activating and inhibiting agents.

Being catalysers, accelerators of reaction, they need only be, and are, present in small quantities, but they have a most important part in synthesis and degradation of organic matter in the life cycle. Up to the present it cannot be said that any enzyme has been obtained in a state of purity. Methods of purification employed destroy activity for some reason or other, so that little is known of their constitution beyond a general analysis.

Work is being done on the physics of the cell, on surface tension, osmotic pressure, etc. About two years ago Prof. MacCallum by means of a microchemical stain was able under the microscope to show the distribution of Potassium in cells,

and connecting the distribution of electrolyte with surface tension gave an explanation of muscle contraction and the associated nerve impulse. He also showed that a concentration of electrolyte, or ions, at one point in the living cell would explain why is was that cellular membranes acted differently in the organism from the way in which they act as dead membranes in the laboratory during osmotic experiments.

Last year Czapek published results on higher plant cells, which have a bearing on secretion and excretion. He found that these cells did not part with their soluble constituents in osmosis until the surrounding media had its tension lowered to .65 (water air surface-1). Red blood corpuscles and yeast cells did not give up haemoglobins and invertase respectively until the surface tension was reduced to .5.

One line of biological research that is going on at the present time, one on which much time and money has been spent, and the research which appeals most to the world at large, is the endeavor to find the cause and cure of cancer. The cell of abnormal growth presents a difficult biological problem. Here is a cell which breaks away from the mechanism controlling growth, and starts on a career of its own, like a semi-independent organism. Proliferating with increased rapidity it departs from its type also in division, showing varying abnormality in karyokinesis. After the physical chemistry of the normal cell is known, the abnormal cell will still present itself. Two new and important methods of technique have recently been announced which may aid in the solution of the problem. One is Dr Carrel's method of tissue growing *in vitro*, and the other is the method of *intra vitam* staining as shown by Prof. Goldmann before the Royal Society last year.

Let us hope the cure will be discovered long before the biochemist arrives at the scientific explanation of the cell of abnormal growth.

The rediscovery of Mendel's work in 1900 gave an impetus to scientific breeding experiments with animals and with plants Results of economic importance and scientific value have followed. Cambridge has given the English farmer cereals increased in strength and yield and immune to rust, hereditary qualities capable of being transmitted in accordance with Mendel's law of segregation. As the chemist now looks to the physicist for the constitution of his unit, the atom; so the biologist appeals for the exploration of his unit, the cell, to the biochemist. With the union of gametes we have the cell in which the problem of heredity is wrapped up; and as Dr. Schäfer has said, we must not be blind to the possibility that these transmitted qualities may be connected with specific chemical characters of the transmitted elements: in other words, that heredity is one of the questions the eventual solution of which we must look to the chemist to provide.

Miss Wheldale has recently done work on the coloring of flowers, finding chromogens supposedly derived from glucosides by hydrolysis, in which the color is developed by enzyme oxidases and peroxidases. White flowers may be of two kinds, one in which chromogens are absent and the other in which they are present, but unacted on by the enzymes. Prof. Keeble and Dr. Armstrong have investigated this subject and developed chemical tests to distinguish the two kinds of white flowers, to do which previously, breeding experiments would have been required. The significance of this is, that here we have the beginning of the chemists' work on heredity, color being a Mendelian unit-character.

Examination of the bacterial content of soils has shown their intimate connection with plant growth, and the parts played by some of these organisms have been worked out. Recent work on partial sterilisation of soils, after which the bacterial growth is much enlarged with consequent increase in crops suggests the destruction of protozoan enemies of the bacteria as the cause of increased bacterial content.

The term catalytic fertilizers has been applied to compounds of manganese, boron, zinc, etc., which when added to the soil in small doses have in cerain cases caused remarkable yields of crops.

The U. S. Dept. of Agriculture has given us a soil poisoning theory, finding di-hydroxystearic acid present in impoverished soils. Experiments at Rothampstead, England, have failed to confirm this. All these problems are still under investigation as are those of soil solutions, capillarity of soils, water level, etc., in relation to plant growth.

I have mentioned only a few of the subjects which the biological chemist is investigating, for the field of research is large indeed.

To show the growth of this new science, I may mention that Chemical Abstracts (published by American Chem. Society) for August 1908 contained 52 references to articles on biological chemistry whilst the August numbers for this year contained over 600 abstracts.

In the future the biochemist must simplify the language of immunity, replacing the present word-pictures by definite molecular formulae and equations. We look to him to isolate, find the composition of and eventually synthesize the enzymes, secretins, hormones, antitoxins and a host of other bodies. He must find out nature's secret when she manufactures in her laboratory by means of enzyme and chlorophyll the countless substances found in plant life, and must give us the enzyme or other catalyst to work at ordinary temperatures and utilise the sun's radiations going to waste around us. In short, he must solve the problem of photosynthesis. Ciamician, in his address before the International Congress of Applied Science last year, has given us a picture of the future, thus: "On the arid lands there will spring up industrial colonies without smoke and without smoke-stacks; forests of glass tubes will extend over the plains and glass buildings will rise every-where; inside of these will take place

the photo-chemical processes that hitherto have been the guarded secrets of the plants, but that will have been mastered by human industry which will know how to make them bear even more abundant fruit than nature, for nature is not in a hurry and mankind is."

After the physics and chemistry of the life processes are laid bare, after metabolism and its derangements are understood, then may come some idea of life and its origin. Present ideas of origin may be summed: (1) that life is originating even now around us, but beyond our powers of observation,(2) that life had its origin in finite time, and (3), the view of Arrhenius, that life had no origin in finite time but was coeval with matter and energy at infinite time. If the physicist destroy our notion of matter there will remain but life and energy; and it may be that that dualism is more apparent than real, for we only know life by energy change.

The Present Trend and Suggestions.

The solution of these problems necessitates long and continued research and that means time and money. I should like to see our provincial colleges so endowed as to give much more opportunity for research than at present. Sir J. J. Thompson, regarding students, has said: "I have always been struck by the quite remarkable improvement in judgment, independence of thought and maturity produced by a year's research. Research develops qualities that are apt to atrophy when the student is preparing for examination and quite apart from the addition of new knowledge to our store it is of the greatest importance as a means of education."

Not only could we have more research for our students but our professors should be so situated as to be able to engage in research, and not be tied down attending to all the small details of college work.

A feature of our day has been the appointment of national commissions on Conservation of National Resources. The

powers of these bodies could be vastly extended to providing endowment for research and founding establishments like the Kaiser Whilhelm Institut in Germany. If civilised nations could see the absurdity of settling ethical issues by destruction of cellular tissues, large sums of money would be available for research into conserving the national resources which we use at present, and tapping those going to waste around us. We might then feel less ashamed of what future generations will think of the manner in which we squander their birthright of mine, field and forest. We have passed our fiftieth year and some of our younger members may see the centenary of our society. Then many present researches will have been finished but we can assure ourselves that the field ahead will be more expanded than we dream of.

Tonight we have reports from Museum and Science Library. Fifty years after this, I hope that commensurate with the large increase of population we see looming ahead the reports will show that each of these institutions will occupy as much space as the whole of the buildings in part of which they are now housed. The growth of such institutions but reflects the vitality of that phase of intellectual development which it is our pleasure and duty as a society, to advance, and which must be carefully fostered if we in this Province would keep pace with other peoples in deriving pleasure and profit from the search into Nature's secrets.

The Treasurer, M. BOWMAN, presented his annual report, showing that the receipts for the year ending 31st September, 1913, were $1,042.43; the expenditures, $914.17; and the balance in current account, $128.26; while the reserve fund was $300.00, and the permanent endowment fund, $939.49. The report was received and adopted. Attention was drawn to the desirability of raising the permanent endowment fund to one thousand dollars, and then investing it in suitable bonds. This was referred to the Council for consideration.

The Librarian's report was presented by H. PIERS, showing that 1,763 books and pamphlets had been received by the Institute through its exchange list during the year 1912; and 1,298 have been received during the first eight months of the present year (1913). The total number of books and pamphlets received by the Provincial Science Library (with which those of the Institute are incorporated) during the year 1912, was 3,385. The total number in the Science Library on 31st December, 1912, was 48,882. Of these, 35,848 (about 73 per cent.) belong to the Institute, and 13,034 to the Science Library proper. The number of books borrowed was 440, besides those consulted in the library. No binding or purchasing was done by the library, directly, during the year, there being no regular grant for the library's support. The report was received and adopted.

D. S. MCINTOSH, M. Sc., instructor in geology, Dalhousie University, delegate appointed to represent the Institute, read a report on the work of the Twelfth Session of the International Geological Congress, which was held at Toronto, Canada, from 7th to 14th August, 1913, there being 950 members enrolled and 433 in attendance. The Nova Scotian excursion, 20th to 29th July, was one of the most interesting of those held. The report was received and adopted.

It was reported that HORACE GREELEY PERRY, M. A., professor of biology, Acadia University, Wolfville, N. S., had been elected an associate member on 12th May last.

The following were elected officers for the ensuing year (1913-14):

President,—DONALD MACEACHERN FERGUSSON, F. C. S., *ex officio* F. R. M. S.

First Vice-President,—PRESIDENT ARTHUR STANLEY MACKENZIE, Ph. D., F. R. S. C.

Second Vice-President,—ALEXANDER HOWARD MACKAY, LL. D., F. R. S. C.

Treasurer,—MAYNARD BOWMAN, B. A.

Corresponding Secretary,—PROFESSOR EBENEZER MACKAY, Ph. D.

Recording Secretary and Librarian,—HARRY PIERS.

Councillors without office,—PROFESSOR CLARENCE LEANDER MOORE, M. A., F. R. S. C.; ALEXANDER MCKAY, M. A.; PROFESSOR DAVID FRASER HARRIS, M. D., C. M., D. Sc., F. R. S. E.; DONALD SUTHERLAND MCINTOSH, B. A., M. Sc.; CARLETON BELL NICKERSON, M. A.; PROFESSOR HOWARD LOGAN BRONSON, Ph. D.; and WILLIAM HARROP HATTIE, M. D.

Auditors,—WATSON LENLEY BISHOP and WILLIAM MCKERRON.

FIRST ORDINARY MEETING.

Civil Engineering Lecture Room, Technical College, Halifax; 10th November, 1913.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

DAVID FRASER HARRIS, M. B., C. M., M. D., D. Sc., F. R. S. E., professor of physiology and histology, Dalhousie University, Halifax, read a paper "On the Existence of a Reducing Endo-Enzyme in Animal Tissues". (See Transactions, p. 259). The subject was discussed by the PRESIDENT, Dr. A. H. MACKAY, PROF. MOORE, C. B. NICKERSON, and PROF. E. MACKAY.

A paper by HENRY S. POOLE, D. Sc., F. R. S. C., Guildford, Surrey, Eng., on "*Senecio jacobæa* and its parasite, *Callimorpha jacobæa:* the Ragwort and the Cinnabar Moth," with additional remarks thereon by the reader, was read by DR. A. H. MACKAY. (See Transactions, p. 279). The subject was discussed by DR. E. MACKAY, C. B. NICKERSON, W. MACKERRON, and others; and it was agreed that some steps should be taken to suppress such a noxious weed as the Ragwort. The matter was referred to the Council.

SECOND ORDINARY MEETING.

Civil Engineering Lecture Room, Technical College, Halifax; 19th January, 1914.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

It was reported that on 28th November, STANLEY NEWLANDS GRAHAM, B. Sc., professor of mining, N. S. Technical College, Halifax, had been elected an ordinary member, and E. CHESLEY ALLEN, Yarmouth, N. S., an associate member.

HERBERT BRADFORD VICKERY, Dalhousie University, read a paper entitled "Notes on the Analysis of 'Ironstone' from the King's Quarry, North West Arm, Halifax". (See Transactions, p. 209). The subject was discussed by the PRESIDENT, DR. E. MACKAY, C. B. NICKERSON, DR. BRONSON, DR. A. H. MACKAY, and H. PIERS; and a vote of thanks was presented to Mr. Vickery.

THIRD ORDINARY MEETING.

Civil Engineering Lecture Room, Technical College, Halifax; 16th February, 1914.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

A paper by SIDNEY POWERS, Geological Museum, Harvard University, Cambridge, Mass., on "The Geology of a Portion of Shelburne County, Southwestern Nova Scotia," was read by PROF. MCINTOSH. (See Transactions, p. 289). The subject was discussed by PROF. MCINTOSH, the PRESIDENT, H. PIERS, and others.

A paper by FRANK W. DODD, C. E., of the Whitehead Torpedo Works, Weymouth, Eng., entitled, "Additional Notes on 'Integral Atomic Weights,'" was read by PROF. E. MACKAY, (See Transactions, p. 223). The discussion which

followed, was taken part in by the PRESIDENT, DR. A. H. MACKAY, PROF. E. MACKAY, and C. B. NICKERSON.

Votes of thanks were passed to the authors of these two papers, MESSRS. POWERS and DODD.

FOURTH ORDINARY MEETING.

Civil Engineering Lecture Room, Technical College, Halifax; 9th March, 1914.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

JOHN H. L. JOHNSTONE, B. Sc., demonstrator of physics, Dalhousie University, Halifax, read a paper, "On the Electrical Properties of Acetic Acid in the Solid and Liquid Phases". (See Transactions, p. 191). The subject was discussed by DR. BRONSON and PRESIDENT A. S. MACKENZIE.

PROFESSOR DAVID FRASER HARRIS, M. D., D. Sc., F. R. S. E., Dalhousie University, read a paper on "Coloured Thinking". (See Transactions, p. 308). The subject was discussed by the PRESIDENT, DR. E. MACKAY, PRESIDENT MACKENZIE, H. PIERS, DR. A. H. MACKAY, and others.

FIFTH ORDINARY MEETING.

Civil Engineering Lecture Room, Technical College, Halifax; 20th April, 1914.

THE VICE-PRESIDENT, DR. A. H. MACKAY, in the chair.

PROFESSOR L. C. HARLOW, B. Sc., Provincial Normal College, Truro, read a paper on "Analyses of Nova Scotian Soils". (See Transactions, p. 322). The subject was discussed by the CHAIRMAN, G. F. MURPHY, PROF. D. S. MCINTOSH, W. MCKERRON, and H. PIERS.

Sixth Ordinary Meeting.

Provincial Museum, Technical College, Halifax; 18th May, 1914.

The President, D. M. Fergusson, in the chair.

A paper by A. H. MacKay, LL. D., F. R. S. C., on "Phenological Observations in Nova Scotia, 1913", was read by title. (See Transactions, page 347).

Harry Piers,
Recording Secretary.