PROCEEDINGS

OF THE

Nova Scotian Institute of Science

SESSION OF 1915-16.

(Vol. XIV Part 2)

54TH ANNUAL BUSINESS MEETING.

Mechanical Engineering Lecture Room, Technical College, Halifax, 13 October, 1915.

THE PRESIDENT, DONALD M. FERGUSSON, F. C. S., in the chair.

Other members present: DR. D. FRASER HARRIS, DR. A. S. MACKENZIE, DR. E. MACKAY, DR. A. H. MACKAY, CARLETON B. NICKERSON, and PROF. D. S. MCINTOSH.

PRESIDENTIAL ADDRESS: (1) Obituary Notices, (2) Review of Year's Work, (3) Some Results of the War.—By DONALD M. FERGUSSON, F. C. S., Halifax.

Obituary Notices.

Since our last annual meeting we have lost by death two of our old and valued members: William McKerron and John Forbes.

WILLIAM MCKERRON, born in Elgin, Scotland, came to Halifax about 48 years ago. He was essentially a business man, but he took a keen interest in science, especially in those branches relating to agriculture and horticulture. For some years he acted as secretary of the Halifax exhibitions, and this position gave him opportunity to foster scientific methods amongst our farmers. He was particularly active in improving the breeds of cattle in the Province. He was a faithful attendant at our Institute meetings and could be depended on to be present whether the subject of the evening was of interest to him personally or not. He was the third treasurer of the society, serving from March, 1903 to Nov., 1906. Then he was appointed as one of our auditors, which position he filled satisfactorily until his death, which took place on March 23rd, 1915.

JOHN FORBES, son of William Forbes, a government official, was born at Birmingham, England, January 26th, 1834. He came from England when he was between nine and ten years of age. The voyage in the barque "Manchester" took 58 days, a contrast to the time required to cross the ocean in our present day. He lived in the United States for some time, and in 1860 returned to Halifax. John Forbes was a mechanical genius, and his ideas found expression in several patents which he took out. He was manager of the Starr Manufacturing Co., and the skates made by them under his patents were known all over the world. Later on he branched out into structural work, and after leaving the Starr Mfg. Co., he entered the government railway employ. For some time he was in business for himself as president of the Forbes Manufacturing Co. On his retirement to private life he continued to exercise his inventive faculties and had a little workshop fitted up at his home. Shortly before his death he was working on a patent, and one hour's more work would have completed his model. He died June 18th, 1915, in his eighty second year. The older

members know of the interest he took in the Institute's work. Whenever I had opportunity to talk to him I found him to be a mine of information on mechanics and on the properties of metals. He was a man of sterling character and was loved and admired by all with whom he came in contact.

Review of Year's Work.

The papers presented to us this last year have been rather under the average—in number, not in quality; for as usual some of them give the results of research extending over months and years. We were all struck by the ingenuity displayed by Mr. Henderson in the construction of his apparatus from the material at his disposal, apparatus which gave him results enabling him to take issue with the theories of some of our leading experimentalists who have access to all the fine instruments which money can buy.

Dr. Harris, in order to complete his research on neuro-muscular rhythms and the tremor of tonus, requires something that cannot be built in the college laboratory. Let us hope that the doctor may soon meet some wealthy individual who will give him a vibration-free building or one at least as free as possible from vibration as human ingenuity can devise Dr. Harris, I see from current literature, has been continuing, in collaboration with Dr. Creighton, the research into the properties of the enzyme reductase, concerning which they have in previous sessions given papers to this Institute. One fact they note, viz., that reductase is not affected by exposure to the discharges from radium bromide, and this has an important bearing on the attempts being made to use these discharges in the treatment of certain diseases. For those taking a layman's interest in this subject, I would refer to an address delivered this year before the Dublin Clinical Club by Prof. Joli. After stating the theory of the action of beta and gamma rays, he drew a parallel between the cell and the photographic

film, and detailed the action on the latter of sensitizers and developers. Among such are alkaloids, the substances in tobacco smoke, and tannin bodies. Prof. Joli, unable to find any custom of the populace to account for increase of cancer, inquired as to change of food in the last decades, and he finds an increased use of tea and coffee, both tannin containing bodies. Relative to the action of nicotine and tobacco smoke, he stated that in cases of cancer of the mouth with us, males are in a majority, whilst in the East where both sexes chew the alkaloid-containing betel nut the cases are more evenly distributed between the sexes. His suggestion is that these bodies mentioned sensitize the cells so that they are responsive to the stimulus which starts the cell into abnormal growth. Thus we have an addition to the list of food stuffs which have been blamed as causes of cancer.

Two years ago I referred to the cancer problem and it is still as pressing a subject for research as ever it was. The cell of abnormal growth is still a puzzle to medical science and biology. May we in a flight of imagination conceive the cancer cell with its abnormal mitosis as a type of the pre-evolved cell existing before Nature by trial and elimination had found the normal cell with its even and orderly division of chromosomes—the cell that survived. The ancients in their evolutionary ideas spoke of the beginings of life as shapeless masses without form, a description that fits a cancerous mass, and the active proliferation of the abnormal cell reminds one of an organism injured and doomed to die putting forth every effort to propagate its species.

The discovery of the X-rays and their then known properties by which they became a valuable adjunct to surgery made a powerful appeal to the mind of the general public. Their use to medical science has greatly increased since the early days by improvement in technique which has been progressive down to the present time, and we read of advances

made in the application of the X-rays at the battle front today. As the result of Prof. Bronson's research we have been given a method of measuring X-rays, one of certainty, and greatly in advance of previous methods which fell short of what was desired by the physicist and physician.

A year ago I referred to the remarkable results being achieved in physical chemistry by the use of X-rays in exploring the structure of crystals, etc. These researches have been continued and many papers have been published. The host of workers, Rutherford, Barkla, Moseley, the Braggs, and others have given us not only theories of atomic constitution but have shewn the distribution of the atoms in elements and compounds; and the Messrs. Bragg by X-ray methods hope shortly not only to shew the distribution of the atoms but also to give us data concerning their electronic rings. This will be of value in view of the interest being taken at the present time in the size or sphere of influence of the atoms and their compressibilities—in general, of the factors in the Van der Waals' equation.

I shall mention only one more paper. We have, as usual, had submitted to us by Dr. A. H. MacKay, the Phenological Observations in Nova Scotia for the previous year. The compilation of these data presented year after year entails a large expenditure of time and labor, gladly given on the part of our Superintendent of Education. Not only do we benefit, but the information collected now will be of greater service to those coming after us, and I trust the pioneer work of Dr. MacKay will be continued through the future generations. The collection of the data, affecting as it does almost every pupil and school teacher, must be looked on as an important part of education in our Province in that it not only opens the eye to the wonders of surrounding Nature but develops the faculty of observation and trains the child to "see".

At this point I would mention a branch of our educational system that deserves the warmest support of our Institute, viz.: the teaching of rural science, with which work some of those in front of me are connected. Many of our school teachers have been trained, and an ever increasing number are taking the necessary courses, in rural science at the college in Truro. Lately, on a visit to the country, I had the pleasure of seeing some results of the rural science work and nature study at an exhibition held in the eastern part of Halifax county. Here were shewn by the children from many schools, collections of wild flowers and plants, moths, butterflies, crop-destroying parasites, weeds, weed seeds, and specimens of rocks and minerals in the various districts. If there be in the Province any child born to be a great botanist, zoologist, or geologist it has every chance not to miss its calling and that itself is worth something to the world. The training of the faculty of observation, a fundamental to the pupil who would advance in experimental science, is a valuable asset in any walk of life; and the rising generation of agriculturalists will moreover be able to understand and appreciate, and also to cooperate in the work being done on their behalf by the various Dominion and Provincial Experimental Farms.

Some Results of the War.

A year ago, in the early days of the war, we wondered what would be the effect of shutting off the export trade of our enemies, particularly in the chemical lines. The greatest sufferers in the public eye at least, seemed likely to be the agricultural and textile industries; the former from inadequate potash supply and the latter from lack of synthetic dyes. The governments of the United States and Canada have issued pamphlets to their farmers giving advice relative to potash and urging them to conserve potash resources on the farm and prevent waste that too often takes place. The deficiency of potash has led to enhanced prices of all

potash salts used in pharmacy and the industrial arts and has spurred chemists in research toward the manufacture of potash salts from many sources. Germany, as a supplier of potash, depended, of course, on possession of great natural deposits; but her pre-eminence amounting almost to monopoly in the glass industry, in dye manufacture and in the production of the finer synthetic organic chemicals so necessary to medicine and the arts, was due to other factors. There arose in Britain and on this continent a popular outcry against the possibility of being without dyes. It is noteworthy how war brings out the elemental in humanity. In the battle front today men display primitive instinct when killing is no murder, and this popular outcry was expressive, all unconsciously, of course, of instinct and of color as a factor in sex selection.

Compared with the days of our forefathers, the improved material conditions surrounding us everywhere are primarily due to Science, and one would think that governments whose chief function is to ameliorate the condition of their peoples' lives would foster science and encourage and aid in every possible way scientific endeavor and research work. In this, to a large extent, the British Government had failed, notwithstanding appeals made year after year by her leading scientists. When the war broke out and Britain found itself dependent on foreign nations for the production of certain goods necessary to individual and national existence (dependent even on the enemy for glass for periscopes), there was at last a national awakening in which process some decidedly plain and outspoken language was used. The scientific societies under the leadership of the Royal Society offered their aid to the nation; the Government threw open enemy patents to use by British manufacturers and although such patents often hide more than they disclose, the result has been highly satisfactory. At the outset, the Board of Trade had published lists of industrial products and chemi-

cals the export of which from Britain was prohibited. The restrictions are gradually being removed, first in favor of British Colonies and protectorates and of our allies, and later in favor of other countries excepting, of course, our enemies; and Britain is now exporting many of these goods and chemicals necessary to science and the industrial arts which hitherto she had never manufactured. To cope with the dye situation the British Government has endeavored to start a national dye industry.

A committee of the Institute of Chemistry has published formulæ for glasses, from resistance-glass necessary for chemical apparatus, and hard glass, to the soft glass used for X-ray tubes; and the production of optical glass is being actively pushed. We are now able to obtain from England filter paper of high-grade quality equal to the best foreign make.

In the United States the Senate called for a report on the dye situation, and another investigation has been called for. Many concerns are taking up manufacture of dyes, chemicals, and glassware. That country can obtain the crude materials necessary for aniline dyes as bye products from the coke ovens, of a prospective annual value of $100,000,000 wasted hitherto.

Not only have British scientists aided the industries but by committees and boards of invention and research they are giving valuable assistance to the various branches of the Army and Navy in the conduct of the war.

It was brought home to the British Government (as expressed by various pleaders) that the factors in industrial progress were "organization and research", and that "scientific research work carried out in the laboratory is the soul of industrial prosperity." In our own country of Canada there has been some appreciation of science by our Provincial and Federal Governments as witness our Experimental Farms, the Geological Survey, etc.; but as an index of where

we stand let me state that it is at present impossible to start any chemical manufacture in which alcohol is used. Our legislation regarding industrial alcohol is behind that of Britain as Britain lags behind the continental nations.

In May last there was a debate in the British Parliament on the appointment of "an Advisory Council on Industrial and Scientific Research," and never before has science received such notice in that chamber. One speaker stated that in the chemical works of Germany there was one highly trained specialist for every fifteen employees, and so important was that industry that there was one highly trained specialist in chemistry for every forty-five employees taking in all the industries of that country; and he drew a contrast with England where there were three hundred and fifty research students. He also stated, and his words will bear repetition: "I go so far as to say that eventually the whole civilization of this world and not merely that of England itself must turn on the axis of science, and as we advance we must give proportionately greater and greater importance to this great developement of scientific life."

As a result of Britain's awakening to realize the value of science and scientific research the Advisory Council and Committee were appointed, and this, we will feel assured, augurs well for the future of the mother country. Let us hope the awakening may be complete and permanent and that the lesson will be taken to heart by the Governments of her children, the Over-seas Dominions.

The presentation of the Treasurer's and Librarian's reports were deferred to a future meeting, their reports not being at hand. (See meeting of 22 February, 1916).

Dr. A. H. MacKay presented a report from the committee appointed to ask the Government, on account of

the accidental lapse of the annual grant to the Institute for the last two years, to pay, at least, the expenses of printing the Proceedings and Transactions up to date. The report stated that the balance owed to our printer on 27 July, 1915, was $776.23; and this amount, on being presented to the Government, was paid by the latter before the end of September. The society is therefore indebted to the printer, at the present time, only for vol. xiv, part 1, of the Transactions, the bill for which has not been presented.

The following were elected officers for the ensuing year (1915-16):

President,—Professor David Fraser Harris, M. B., C. M., M. D., B. Sc. (Lond.), D. Sc., F. R. S. E., F. R. S. C., *ex officio* F. R. M. S.

First Vice-President,—President Stanley Arthur Mackenzie, Ph. D., F. R. S. C.

Second Vice-President,—Professsor Clarence Leander Moore, M. A., 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,—Alexander Howard MacKay, LL. D., F. R. S. C.; Professor Donald Sutherland McIntosh, M. Sc.; Carleton Bell Nickerson, M. A.; Professor Howard Logan Bronson, Ph. D.; F. R. S. C.; William Harrop Hattie, M. D.; Professor Frederic H. Sexton, B. Sc.; and Donald MacEachern Fergusson, F. C. S.

Auditors,—George W. T. Irving and Alexander MacKay, M. A.

First Ordinary Meeting.

Provincial Museum, Technical College, Halifax; 8th November, 1915.

The President, Dr. D. Fraser Harris, in the chair.

It was reported that at the meeting of Council held on 2nd November, the following gentlemen, who had been proposed on the 13th October, were elected members:

Melville Cumming, B. A., B. S. A., principal of the N. S. College of Agriculture, Truro, N. S., (associate); William H. Brittain, B. S. A., professor of zoology and entomology, Truro, (associate); Percy J. Shaw, B. A., professor of horticulture, N. S. College of Agriculture, Truro, (associate); James E. Barteaux, M. A., inspector of Manual Training and Technical Schools, Truro, (associate); Loran A. DeWolfe, M. Sc., director of Rural Science Schools, Truro, (associate); J. M. Scott, M. A., M. Sc., professor of chemistry, Provincial Normal College, Truro, (associate); John Cameron, M. D., D. Sc., F. R. S. E., professor of anatomy, Dalhousie University, Halifax, (ordinary); Albert G. Nicholls, M. A., M. D., D. Sc., F. R. S. C., professor of pathology, Dalhousie University, Halifax, (ordinary); John G. McDougall, M. D., C. M., lecturer in clinical surgery, Dalhousie University, and assistant surgeon, Victoria General Hospital, Halifax, (ordinary); George Hugh Henderson, M. A., B. Sc., instructor in physics, Dalhousie University, Halifax, (ordinary); Hubert Bradford Vickery, B. Sc., sicence master, Bloomfield High School, Halifax, (ordinary); and Donald J. Matheson, B. Sc., senior master, Halifax County Academy, Halifax, (ordinary).

A paper by E. Chesley Allen, of Yarmouth, N. S., entitled, "An Annotated List of the Birds of Yarmouth and vicinity, southwestern Nova Scotia," was read by title. (See Transactions, page 67.)

On motion it was resolved that at the forthcoming state funeral of Sir Charles Tupper, Bart., the Institute be represented by its Council.

Second Ordinary Meeting.

Civil Engineering Lecture Room, N. S. Technical College, Halifax; 22nd February, 1916.

(The President, Dr. D. Fraser Harris, in the chair.)

The Recording Secretary reported what steps he had taken, under the resolution of the last meeting, to secure a place for the Institute in the state funeral of Sir Charles Tupper; but no such place had been assigned the society, and no definite reply had been received to his communication. The Institute, therefore, had been unable to attend in a body as had been intended.

The annual report of the Treasurer (Mr. Bowman), dated 6th Oct., 1915, was presented, showing that the receipts for the year ending 30th Sept., 1915, were $269.00; the expenditures, $34.30; and the balance on hand $234.70; while the reserve fund balance was $321.23. The report was received and adopted.

The Librarian's report, dated 9th Oct., 1915, was presented by Mr. Piers, showing that 1,803 books and pamphlets had been received by the Institute through its exchange list during the year 1914; and 913 had been received during the first nine months of the year 1915, namely January to September inclusive. The total number of books and pamphlets received by the Provincial Science Library (with which that of the Institute is incorporated) during the year 1914, was 2,848. The total number in the Science Library on 31st Dec., 1914, was 54,658. Of these, 39,417 (almost 72 per cent.) belong to the Institute, and 15,241 to the Science Library proper. Two hundred and forty-four

books were borrowed, besides those consulted in the Library. No binding or purchasing had been done. Since the outbreak of the present war in August, 1914, no publications have been received from societies or other institutions in the enemy's countries, or in the zone of military operations; and some societies with headquarters in districts affected, have announced that for the present they have had to cease publication. In sending out our Transactions, all societies in hostile countries have been omitted as recipients, as well as those within the zone occupied by the enemy. The report was received and adopted.

It was announced that the Transactions, vol. xiii, parts 3 and 4, and vol. xiv, part 1, had been distributed to members and others on the exchange-list.

The chair was taken by DR. A. H. MACKAY, and a paper was read on "The Beneficial Action of Certa'n 'Poisons'; and the Influence of Poisons on Protoplasm and on Enzymes respectively," by the president, PROF. DAVID FRASER HARRIS, M. B., C. M., M. D., D. Sc., F. R. S. E., of Dalhousie University, Halifax. (See Transactions, page 96.) The subject was discussed by H. B. VICKERY, C. B. NICKERSON, PROF. CAMERON, DR. A. H. MACKAY, and D. M. FERGUSSON,

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THIRD ORDINARY MEETING.

Civil Engineering Lecture Room, N. S. Technical College, Halifax; 10th April, 1916.

THE FIRST VICE-PRESIDENT, DR. A. S. MACKENZIE, in the chair.

JOHN CAMERON, M. D., D. Sc., F. R. S. E., professor of anatomy, Dalhousie University, Halifax, read a paper on "Some Recent Researches on the Anatomy and Psychology of the Ancient Egyptian of the Twelfth Dynasty."

The Anatomy and Psychology of the Ancient Egyptian.

—By John Cameron, M.D., D.Sc., F.R.S.E., Professor of Anatomy, Dalhousie University, Halifax, N. S.

(Read 10 April 1916)

The wonderful civilization of Ancient Egypt has for long fascinated the writer. It is, however, only during the last eight years that a serious study of the language, manners and customs of this remarkable race has been undertaken, the stimulus to which was a request, in 1908, by Miss M. A. Murray of the Department of Egyptology, University College, London, to examine and make a report on the anatomy of two mummies belonging to a royal burial of the twelfth dynasty. One gets some idea of the immensity of time when one recollects that these personages had lived more than two thousand five hundred years before Christ, and had been buried before the advent of the biblical flood They were, therefore, antediluvian. These presented so many remarkable features (some of which will be referred to in the course of this paper) that they stimulated the writer to undertake some further researches on the anatomy and mentality of the ancient Egyptian. The results of these are incorporated in the present communication.

Previous to the evolution of the civilization of Ancient Egypt the river Nile ran through a barren rockbound country on which authorities have estimated that nothing but primitive man could have subsisted. With reference to the exact period of time when civilization commenced and paleolithic man became annihilated in Egypt, remarkable data are provided by the rate at which the fertilizing Nile mud has been deposited in the Delta region. Geologists have demonstrated that in the Archaic Ages this mud was all poured directly into the Mediterranean. Borings in that area have disclosed the fact that the maximum thickness of this material is thirty-three feet, and as careful calculations have shown that the mud is deposited at the average rate of about four

inches for each century; by a simple calculation one can ascertain that the maximum period during which Egypt could really have existed as a habitable country is about ten thousand years, that is to say, from about 8000 B. C. As the written records of the country only begin with the commencement of the Dynastic Period—about 5000 B. C., very little is known about the Predynastic or Prehistoric Period, though one is furnished with proofs of its remarkable handcraft in the shape of beautiful alabaster jars of elegant design and workmanship. The burials of this period were also very characteristic, the body of the deceased being usually placed in its tomb in the attitude adopted by the unborn child in the womb, a fact which suggests that this early race believed in the existence of an after life; for the body was probably placed in this characteristic position so as to be ready for the rebirth,or in other words, the Resurrection.(1)

The culture, the art, and the learning of Ancient Egypt undoubtedly constituted the foundation of our modern civilization, and this fact alone affords sufficient justification for the study of this wonderful people. Indeed it was, in its way, of a higher order than the culture (spelt with a K) which a certain outlawed nation is in this year of Grace, 1916, trying to thrust upon the world by brute force. During the earlier dynastic periods, extending over 3800 years, from B. C. 5000 to B. C. 1200, the Israelites were slaves in Egypt. During the building of the great pyramids in the fourth Dynasty they were utilized, under the lash of their oppressors, to drag the vast blocks of stone up the long inclined planes which were erected, as the simplest means then known to the Egyptian engineers, to facilitate the placing of the blocks in position. There is some disagreement amongst authorities as to the exact date of the Exodus of the Israelites from Egypt. Some regard Merenptah, a pow-

1 This fact has been referred to by the writer in a recent paper. See the Canadian Medical Journal for May, 1916.

erful king of the nineteenth Dynasty, as the Pharoah of the Exodus; whilst others localize that historic epoch two or three Dynasties later. In any case, the Israelites had two or three thousand years in which to be influenced by the Egyptian civilization which they applied to good purpose in Palestine, and built up the stable fabric of the Jewish civilization. Another race which was strongly influenced by the Egyptian culture of the later Dynasties (from the 20th to the 30th) was the Ancient Greeks, and this interchange of art and learning between the two races was greatly facilitated during the Ptolemaic Period. After the death of Cleopatra, who was the last of the Ptolemies, in B. C. 30, the occupation of Egypt by the Roman conquerors enabled them also to obtain much benefit and inspiration from the Egyptian civilization.

The purpose of this lengthy introduction is to show that the Jewish, Græcian and Roman civilizations, which formed the foundation of European learning and culture, owed a great proportion of what was "brightest and best" to the wonderful inspiring influence of Ancient Egypt. It is declared by some that this wide-spread influence even reached far away Scotland, which is said to be named after Scota the daughter of one of the Pharoahs.

In regard to the physical anthropology of the ancient Egyptian, one of the most striking features I have been able to ascertain is their small stature. This seems remarkable when considered in conjunction with the warlike propensities of the race. All the mummies I have seen or examined have been those of short people. Indeed, the thing that strikes one on first examining a mummy is its remarkable shortness. As a result of my investigations, I have come to the conclusion that the average height of the Egyptian male adult could not have been more than 5 feet 3 or 4 inches, whereas, as you know, the average height of a man nowadays is about 5 feet 7 or 8. This, you will note, is a

considerable difference. There can, therefore, be no reasonable doubt about the fact that the human race is gradually getting taller. As a result, one can prophecy that in a few more thousands of years, if the present rate of progress is maintained, we shall find the world inhabited by a race of giants. I was so much struck with this idea that I made an examination of the wonderful collection of armour at the Tower of London, and was enabled to ascertain that many of the men of today would experience the greatest difficulty in donning one of these suits. It would thus appear as if the knights of old were not the splendid specimens of manhood one sees, for example, in the 85th Battalion, C.E.F., of which Nova Scotia is so justly proud. I do not know if environment has anything to do with stature, but I feel that emigration to a new land exerts some influence, for it was a pleasure to me to witness the magnificent physique of the members of the Australian Expeditionary Force, who, as you know, were the wonder and the admiration of everybody at the Dardanelles. In the official account of the military operations there, special reference was made over and over again to the amazing stature of the Australians, and I was much interested to note that Sir James Crichton Browne has recently suggested as an explanation that the children in Australia are brought up on a liberal amount of protein diet in the shape of beef and mutton, of which, of course, they possess an abundant supply. Physiologists are unanimous in their opinion that this is the most efficient form of diet for inducing a rapid and vigorous growth of young animal tissue.

Now the Ancient Egyptians appear to have indulged mainly in a cereal diet, as most of their animals were held sacred and were, on that account, not utilized for food to any great extent. This statement is borne out by the fact that the teeth in all the mummies I have examined were worn

absolutely flat, due, as all authorities declare, to the action of the millstone grit which got mixed with the flour during the process of grinding the corn. Thus a study even of the skeleton can provide us with a hint as to the nature of the diet of the individual. I should mention here that the teeth of Egyptian skulls, though often worn to an excessive degree, do not often exhibit decay or caries.

The capacity of the cranium of the ancient Egyptian, which is, of course, an excellent criterion as to the extent of the intellectual development of the individual, was found to be very high, as was to be expected in such a highly civilized race. The capacity of all the skulls measured by me was over 1450 c. cm. They were thus to be regarded as mega-cephalic, according to the classification of Flower, and indeed all compared favourably with the average cranial capacity of modern white races.

The cephalic index, though it is no criterion of mental capacity, proved of some interest. All the ancient Egyptian skulls I examined approached the index of 80, and therefore tended to be of the brachycephalic or broad-headed type. This is in striking contrast to the skull of British races, the average cephalic index of which is about 76 and thus approximates to the dolicocephalic or long-headed type. It may be of interest to you to note that the German skull tends towards the brachycephalic type, so that the present war might be regarded from the point of view of anthropology as a fight for supremacy and world domination between the long-headed and the broad-headed races.

The investigation of the important gnathic or alveolar index yielded interesting results. As you know, the human skull is specially distinguished from that of lower mammals by the vast expansion of the cranial portion, and a relatively feeble degree of development of the jaws. Therefore, in the lower races of mankind the jaws are strongly developed and project forward, as one would expect, such skulls being

described as prognathous. In the white races, on the other hand, the jaws are feebly developed while the frontal region is prominent—these skulls being termed orthognathous. The average alveolar index for the British race is in the neighbourhood of 96. Some of the ancient Egyptian skulls I examined were remarkably orthognathous, and, therefore, represented a very fine type, the index in one case being 93.8. This latter skull, which was that of the son of a prince, presented a high degree of evolution, the frontal region being particularly well modelled and intellectual in appearance. I was able, however, to find traces of negro admixture in many instances, one skull that I examined being strongly prognathous, with an alveolar index of 104.34, which actually exceeded in degree the average of the aboriginal Australian of today, which is 104, and is supposed to represent one of the lowest types of mankind.

Many other customs or habits of the Ancient Egyptians are shown by the condition of their skeletons. One of the most interesting of these is the effect produced by squatting on the bones of the lower limbs. Chairs or seats of any sort were a luxury in those days, so that the majority of people were compelled to use Mother Earth to sit upon. The result, as you will at once recognize, was to produce an extreme degree of flexion of the hip, knee, and ankle joints. You can study this posture for yourselves in the Egypt of today by walking along the streets of Cairo, where you will see the various vendors seated in a squatting position on the ground by the side of their wares. The result of this characteristic attitude is to cause the neck of the femur or thigh bone to press hard against the margin of its socket and the capsule of the hip joint, thus producing a smooth polished surface or facet on the front of the neck of the bone. The effect on the knee joint is to cause the upper end of the tibia or shin bone to become tilted backwards (retroversion) in order to adapt itself to the altered position of the limbs. In the erect

attitude of the body the upper end of the tibia ought, of course, to look directly upwards, in order to receive the weight of the body in the position of mechanical advantage. Again, the lower end of the tibia normally distributes the weight of the body to the foot by bearing vertically upon the upper surface of the astragalus. The effect of the squatting posture, however, is to thrust the front edge of the lower end of the tibia hard against the neck of the astragalus, thus producing a squatting facet on that part of the bone. The posture assumed by the individual during life can thus literally leave its indelible mark on the skeleton, and therefore even a close study of such apparently uninteresting things as bones can provide us with some instructive facts regarding the habits and mode of living adopted by their owner. These squatting facets were so excessively pronounced in some of the skeletons that I am inclined to think that these individuals had freely indulged in luxury and indolent habits.

One can learn much about the psychology of the Ancient Egyptians by studying the method of disposal of their dead. No subject has been discussed more freely than the reason why such very special means were taken to preserve the body from decay. The whole question is still of a very controversial nature, but the opinion which apparently possesses most weight nowadays is that each person possessed a spiritual double or *Ka*, the hieroglyph symbol for which is a very curious one. It is represented by a figure showing the arms raised above the head in the attitude of prayer or appeal, possibly for the future welfare of the deceased. The *Ka* was at liberty to leave the body of the deceased at death and might therefore possibly become reincarnated in another human being or even in an animal. In order to obviate the latter risk, which would have been manifestly serious, the body was preserved so that its *Ka* could return to it at any time of its own free will. For this purpose various inducements or attractions were provided for the *Ka* in the

shape of elaborate sepulchral furniture. For example, model boats with crews were provided so that the *Ka* could relieve the tedium of waiting by having a sail on the Nile which was quite near at hand, seeing that all the tombs were situated along its western bank, placed there, no doubt, in order to face the rising sun on the morning of the resurrection. Very frequently two boats were provided, the one for going down stream being simply supplied with oars whilst the one for travelling up the Nile against the current was a boat with the sail set. The transit of the *Ka* to or from the mummy was likewise encouraged and facilitated by painting false doors at intervals around the sides and ends of the coffin. In some cases these were actually made to open. In order, however, to ward off evil spirits from the deceased, the eyes of the hawk-headed god Horus, known as the Sacred Eyes, were painted on the coffin over the spot where the eyes of the mummy faced outwards. In the twelfth dynasty the mummy was usually laid on its left side and therefore the Sacred Eyes were placed on the side of the coffin opposite this point. Jars containing food, or models of slaves carrying food baskets were likewise provided for the use of the *Ka*, as was clearly explained on the body case of Khnumu-Nekht, a mummy of the twelfth dynasty which was unwrapped by Miss Murray and myself. Part of the inscription was in the form of a prayer that the god Osiris, would give "funeral offerings of bread, beer, oxen, fowls, clothing, incense, ointment, all things good and pure on which the god lives, for the *Ka* of the great uab-priest Khnumu-Nekht." There can thus be no reasonable doubt regarding the fact that the Ancient Egyptian believed not only in the existence of the after life, but also in the theory of reincarnation.

The process of mummification varied greatly throughout the dynasties, so that one was thereby enabled to locate the period to which the burial belonged by noting the means which were taken to preserve the body. For example the

mummies of the Ptolemaic Period were characterized by being embedded in bitumen or resin. The mummies of the twelfth dynasty investigated by Miss Murray and myself, were earlier in date than any that had been previously examined, so that we were eager to discover the mode of preservation and the chemicals used. From an analysis of the remains it was found that the chief materials employed were the chlorides, carbonates, sulphates, phosphates and silicates of potassium, sodium, calcium, and aluminium; in one case the chief substance employed being common salt, and in the other lime salts. The operation of embalming was apparently carried out as follows. The body was first eviscerated and then allowed to pickle in a solution of the above compounds for some time, at the end of which period the bandages were applied. It is astonishing to note the efforts that were made to preserve every particle of tissue. Each finger and each toe was carefully bandaged separately, and special means were taken to preserve even the nails which were held in position by being bound up with linen thread. Forty or fifty bandages for each mummy was a common average, some of these strips of cloth being ten yards or more in length, and their average width about four inches. This gives one some idea of the tedious work involved in the process of unwrapping. I well remember one mummy which gave two of us eight hours hard work. The bandages were all made of linen cloth beautifully hand-woven. This is rather remarkable in view of the fact that one of the greatest assets of modern Egypt is cotton, which, however, was apparently not introduced into Egypt until the Roman occupation.

The internal organs were separately embalmed and in many cases placed in four earthenware jars closed by a large wooden plug in the shape of a human head. I may mention here that the ancient Egyptians were great experts in the manufacture of pottery. These jars were termed Canopic

by the earlier Egyptologists, because they were supposed to resemble the god Canopus who was worshipped in Egypt in the form of a jar with a human head. The gods of the four cardinal points—north, south, east, and west—were delegated to safeguard the preservations of the internal organs, which were therefore placed in four jars—one for the lungs and heart, a second for the stomach and large intestines, a third for the small intestines, and a fourth for the liver and gall bladder. These jars were then placed in compartments in a beautifully decorated box called the Canopic Chest, on each side of which was a false door for the passage of the *Ka*. The contents of the chest were, as in the case of the coffin, rendered secure from all evil influence by painting the Sacred Eyes on each of the four sides of the box.

To many minds the idea of disturbing the dead may create a feeling of disapproval or even of repulsion, but I would like to say in justification of the act that the unravelling of the mysteries of long past ages can in most cases only be effected by studying the way in which primitive peoples disposed of their dead, as these are usually the only memorials of ancient civilization left to us to study in the absence of any written records. In this way one is provided with information not only regarding the mode of living, the manners and customs of these peoples, but also their mental outlook both on this life and on the life to come. No one, I think, will deny the fact that the information thus acquired is not only of the highest educative value, but also possesses the inestimable advantage of broadening our own mental horizon, and ought to stimulate us, fully armed as we are with all the advantages of a modern civilization, to higher and nobler achievements.

This paper was discussed by DR. A. S. MACKENZIE, H PIERS, W. H. PREST, G. W. T. IRVING, DR. F. WOODBURY, and DR. E. MACKAY.

DONALD S. MCINTOSH, M. Sc., professor of geology, Dalhousie University, Halifax, read a paper entitled, "A Study of the Cow Bay Beaches, Halifax County, N. S." (See Transactions, page 109.) The subject was discussed by DR. MACKENZIE, H. PIERS, and W. H. PREST.

FOURTH ORDINARY MEETING.

Civil Engineering Lecture Room, N. S. Technical College, Halifax; 10th May, 1916.

THE PRESIDENT, DR. D. FRASER HARRIS, in the chair.

In the absence of the writer, Carleton B. Nickerson, M. A., read a paper by HENRY JERMAIN MAUDE CREIGHTON, DR. Sc., assistant professor of chemistry, Swarthmore College, Swarthmore, Penn., U. S. A., on "The Use of Soaps for the Absorption of Bromine Vapor." (See Transactions, page 120.) The subject was discussed by C. B. NICKERSON, PROF. E. MACKAY, PROF. BRONSON, H. B. VICKERY, D. M. FERGUSSON, and THE PRESIDENT.

LIEUTENANT GEORGE HUGH HENDERSON, R. C. E., M. A., instructor in physics, Dalhousie University, Halifax, read a paper on "The Distribution of the Active Deposit of Radium in an Electric Field." (See Transactions, page 123.) The subject was discussed by PROF. BRONSON, PROF. E. MACKAY, and THE PRESIDENT.

A paper by ALEXANDER H. MACKAY, LL. D., F. R. S. C., superintendent of education, Halifax, on "Phenological Observations in Nova Scotia, for 1915," was read by title. (See Transactions, page 133).

HARRY PIERS,
Recording Secretary.