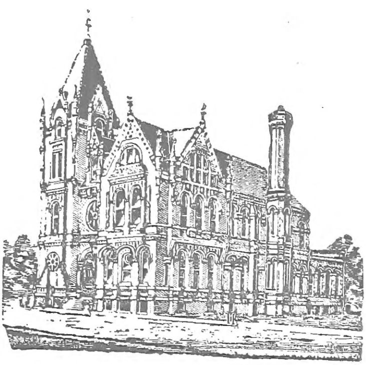
JOURNAL AND PROCEEDINGS

OF THE

Hamilton Scientific Association

SESSION 1905-1906

NUMBER XXII.



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1905—Wm. Acheson, James Gadsby, J. M. Williams, Robt. Campbell, J. G. Cloke.

Friday, May 18th, 1906.

Annual meeting, at which the affairs of the Association in their various bearings were fully discussed.

Twenty new members were elected to the Association.

The following reports were read and adopted:

Report of the Council, by the Secretary.

Report of the Curator, by Col. C. C. Grant.

Report of the Treasurer, by P. L. Scriven.

Report of the Geological Section, by A. T. Neill.

Report of the Photographic Section, by Sinclair G. Richardson.

Report of the Astronomical Section, by E. H. Darling.

Report of the corresponding Secretary, by R. J. Hill.

The following officers were elected for the ensuing year;

President—R. J. Hill.

First Vice President—Rev. D. B. Marsh, Ph.D., F.R.A.S.

Second Vice-President—James Gadsby.

Corresponding Secretary—G. Parry Jenkins, F.R.A.S.

Recording Secretary—J. F. Ballard.

Treasurer—P. L. Scriven.

Curator—Col. C. C. Grant.

Assistant Curator—J. M. Williams.

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Council—Wm. Acheson, Robert Campbell, Walter E. Hill, A. H. Baker, Rev. Canon Henderson.

Report of the Council

. . OF THE . .

Hamilton Scientific Association

SESSION 1905-06.

Your Council take pleasure in submitting the following report for the Session 1905-06:

During the past Session there have been seven meetings of the Council.

Of the general Association we record ten meetings, as follows:

Nov. 9, 1905—Opening meeting. Inaugural address—George L. Johnston, B.A., President.

Dec. 14, 1905—Rivers of Canada—Prof. Coleman.

Jan. 12, 1906—Churches of France—Prof. Squair.

Feb. 8, 1906—Immunity—J. Edgar Davey, M.D.

Feb. 22, 1906—Labrador Eclipse Expedition—Rev. D. B. Marsh, F.R.A.S., and G. Parry Jenkins, F.R.A.S.

March 8, 1906—Archæology and The Origin of the Hebrew People—Rev. Logie Macdonnell, M.A.

March 22, 1906—Progress of Photography—James Gadsby, P. C. S.

April 19, 1906—From Prince Albert to Port Churchill—J. W. Tyrrell, C.E., D.L.S.

May 10, 1906—Vacation Rambles in the Old Land—P. L. Scriven, T.H.S.A.

May 18, 1906—Annual Meeting, Receiving Reports, Reports of Sections, Election of Officers.

During the Session twenty new members have been added. There have also been added five honorary members, including E. W. Maunder, F.R.A.S., Greenwich Observatory; Mrs. Maunder; W. L. Grenfell, M.R.C.S., Labrador; W. F. King, B.A., LL.D., Ottawa, and Prof. Brazier, of Allegheny University.

Dr. Fletcher, of Ottawa, was chosen to represent the Association at the meeting of the Royal Society there.

The Museum has been re-arranged and the seating room much enlarged.

All of which is respectfully submitted.

G. L. JOHNSTON,
President.

J. F. BALLARD,
Secretary.

Inaugural Address

By G. L. Johnston, B.A., President.

NOVEMBER, 1906.

After acknowledgments for the honor of re-election to the Presidency, the motive of the paper was given as a trip across the continent—through the sea of rocks in Northern Ontario and the sixty miles of extremely picturesque scenery about Schrieber and Jackfish bay ; on to Fort William with its elevators and its interest as a distributing point for the great West now, as it was a centre for the fur-traders of the past ; on to Keenora (Rat Portage) and the beautiful Lake of the Woods district ; past Keewatin, with its wonderful water-power ; and on into the prairie region of Manitoba and the West.

Winnipeg is a city of abounding interest at the present as in the past. It has everything that an up-to-date city could wish for in streets, public buildings, churches, schools, business houses, and even a Carnegie Library. Its parks are beautiful, its streets are clean and well paved, and its growth most rapid—whole streets of houses springing up, as it were, in a night. Then, its past, centres your interest around the Red River, Old Fort Garry, St. Boniface, Kildonan, and the monument of Seven Oaks, which commemorates the blood shed in settling the strife between the Hudson Bay and North West companies.

The church at Kildonan contains the memorial tablet of "Rev. Jno. Black, D.D., first Presbyterian minister to Rupert's Land, Sep. 18, 1851, and first pastor of this parish, to whose spiritual wants he ministered for more than 30 years. Died Feb. 11, 1882, at age of 64 years. He being dead yet speaketh." Kildonan cemetery contains such inscriptions as these : "Alex. Ross, for many years sheriff in this colony, also elder and leader of the Presbyterian colonists. Died Oct. 23, 1856." "In memoriam.

Hugh Polson, born in Kildonan, Sutherlandshire, Scotland; emigrated to this country in 1815; died 1887, aged 81 years."

The foreigners at Winnipeg provide a most interesting study, as you see them arriving at the C. P. R. station or passing along the streets. The writer was very favorably impressed with the neat appearance of the women, and the willingness to work of the men—about 2,000 are employed by the corporation in Winnipeg. In the British and Foreign Bible Society they have been asked for the Scriptures in 43 languages. There are grounds for hope that these peoples will make peaceable, contented citizens because they will improve their conditions and become prosperous.

In the trip westward over the prairie you are impressed by the vast extent, and wide wheatfields. It is a land of grain-elevators. The country, however, is not a dead level. Portage La Prairie has an altitude of 800 feet; Brandon, 1,150; Broadview, 1,950; Qu'Appelle, 2,050; Regina, 1,875; Moosejaw, 1,725; Swift Current, 2,400; Medicine Hat, 2,150; Calgary, 3,388. At Brandon there is a government Experimental Farm, where they are successfully evolving hardy apples, etc. Small fruits do well. At Broadview there is an encampment of Cree Indians; at Indian Head, another experimental farm; near Regina, headquarters of the North West Mounted Police—a force of 840 men; at Moose Jaw you find stock yards as well as grain elevators. You are now entering the ranching country. On the prairie you can see the buffalo trails and wallows, and the mind wanders back to the time when the prairie was black to the horizon with these furry beasts. Near Swift Current there is a sheep-farm of some 16,000 sheep. There are many alkaline lakes in this neighborhood, and wild geese and ducks abound all through the country.

Medicine Hat is in the centre of ranching country which extends thence on to Calgary. Here the Canadian Pacific Railway is proceeding with irrigation canals to convert this country into farm lands. This has been done successfully in Southern Alberta by the Mormons. The people of Calgary boast to you of their fine climate, favored as they are by the chinook winds. On over the foot-hills to the Rockies, the first view of which was that of bold towering masses, castellated heights, rugged promontories, enormous alcoves, rising out of the grey mist of the morning. These mountains are tremendous uplifts of stratified rocks of the Devonian and Carboniferous ages broken out of the crust of the earth and slowly heaved aloft; some pushed straight up, others tilted more or less on edge, whilst others are bent and crumpled out of their original form.

Ascending the valley of the Bow river, we arrive at Banff, the beauty and grandeur of which my pen cannot describe.

The material for thought suggested by this trip may be divided into three classes: First, the conditions of the present and hopes of the future of this great and rapidly filling country; second, the history of the explorers, Indians, and fur trading companies of the past; and lastly, the more remote history of the geological structure of the country. The appeal of the latter being strongest, the subject of this paper is Geology in general, with special reference to the rocks of Canada.

Numerous maps and charts were used to illustrate the subject, which was treated of under the following heads:

1. Origin of earth—kinds of rocks.

2. Archæan period—rocks mostly crystalline—usually crumpled—indications of life in this period—picture hot seas, heavy atmosphere, land emerging from water—a very long period. The Laurentian and Huronian rocks of Northern Ontario, and around Hudson Bay are of this period. These occupy an area of about 2,000,000 square miles in Canada and are important metalliferous rocks. The latent mineral wealth of Northern Ontario is likely very great.

3. Palæozoic period—stratified rocks contain first remains of life—crinoids, coral, and marine shells in limestone—formed evidently in shallow seas. Laurentian rocks around Hudson Bay are now being worn down to provide material for building up rest of continent. Volcanic action very common, also frequent upheaval and subsidence of earth's crust. Life was more uniform over the world. The same fossils have been found in Britain, Russia, America, China and Australia. Climate also warmer, as fossils

found in high northern latitudes are same as those found in England. Animal life—invertebrate in earlier periods. Earliest vertebrates were fishes. Highest organisms in later Palæozoic time were amphibians corresponding to our frogs and toads.

Divisions of Palæozoic period: Cambrian, to which belong the gold-bearing rocks of Nova Scotia. Found also in Rockies along line of C. P. R.—Mount Stephen, near Field. Trilobites are very numerous here at 11,000 feet altitude. Found also in Yale district of British Columbia. Quartzites and slate of Yukon gold-bearing district, also of this date. Fossils of Cambrian period include both plants and animals. The flora is exceedingly meagre, consisting of seaweed impressions called algæ. There are traces of land vegetation among higher rocks; spores and stems of cryptogams, also lycopods or club-mosses, and ferns. These continue and become very highly developed in Carboniferous period. Fauna is meagre in grits, sandstones and conglomerates, but plentiful in shale and limestone. Simplest forms, foraminifera and sponges. Graptolites and corals abound. Crinoid, or stone-lily, so numerous that its remains made beds of limestone hundreds of feet thick.

Star-fishes are found from the Cambrian period on. Tracks and burrows of sea-worm are abundantly present. Trilobites are amongst the most abundant and oldest crustaceans, sometimes nearly two feet long. They flourished all through the Silurian period, but died out before the close of the Palæozoic period. Mollusca, or shell-fish, are a most important division of the animal kingdom. It is mainly these that have been preserved, and from their abundance and wide diffusion form a basis of comparison. Brachopods, a species of the genera lingulæ, have persisted with little change to the present day from ancient Palæozoic times. Gastropods similarly—upwards of 1,300 species found in Silurian rocks, represented by snail and periwinkle at the present day. Cephalopods flourished exuberantly in the Palæozoic and Mesozoic periods. They are represented at present by nautilus and cuttlefish. Remains of fishes found in the Upper Silurian rocks showed the earliest traces of vertebrate life. These became very abundant in the next period. All fauna above mentioned belonged to the sea.

In 1884 discoveries were made of scorpions in the rocks of Sweden, Scotland and the United States about the same time. Also of an insect allied to the living cockroach in France. It is likely, therefore, that other forms of land life existed.

Picture of the aspect of the globe in Silurian times: No greenness of meadow, no flower, bird or insect; land being worn away and detritus carried out and poured into sea by the rivers. In our own continent, the eastern part was gradually being formed.

Position of these rocks in Canada: Lower Silurian in Laurentian lowlands; Hudson, Utica, Trenton, Black-River formations in Ontario, and chazy and calciferous in Quebec. Several series also in Manitoba. They consist of beds of yellowish or reddish sandstone, conglomerate, shales and limestone of various kinds. In the Cordilleran region, near Banff, along Kicking Horse Pass, rocks of this period are recognized. Upper Silurian rocks: in Nova Scotia, Quebec, and especially in Ontario—Water lime, Onondaga, Guelph, Niagara, Clinton, Medina. The Medina, or lowest one, consists mostly of conglomerate, sandstones, and red marls with *few* fossils; Clinton, of shales with a few bands of magnesian limestone and iron ore bands; Niagara, compact, cherty limestone, abounding in fossils; Guelph, light, cream colored magnesian limestone with many fossils. Natural gas is formed frequently in these strata. Onondaga and water lime, salt, gypsum, and cement stores are derived from these—a light, yellowish, grey magnesian limestone.

Devonian: In general character resembles rocks beneath. Contains both marine and fresh-water deposits. Upper part of this period called Old Red Sandstone. In New Brunswick and Gaspe upwards of one hundred species of plants have been discovered, mainly flowerless plants, ferns, lycopods, horse-tails, reeds, etc. There are traces of coniferous plants. Imagine the greenness of the forests of those times. Insects' wings have been found—ancient forms of the May-fly, one wing measuring five inches across. Traces of land snails have also been detected. The flora and fauna of the land, however, are only sparingly preserved. Fishes of the time, called ganoid, had overlapping bony plates covered with glossy enamel. They are represented at the present day by sturgeon. They are found very abundantly in old red sandstone. Some fishes of the time were large, said to be 18 to 20 feet long. Some found their way to sea like our salmon. They were, however, mostly inhabitants of lakes and rivers. In marine fauna graptolites disappear. Trilobites also diminish and finally die out in next or carboniferous period. Where found in Canada—Devonian rocks found in interior continental plain bordering on the Silurian west of Hudson Bay and extending from the mouth of the Mackenzie River to Manitoba. In Cordilleran region also, near Banff Springs Hotel at Banff. The most important product of American Devonian rocks is petroleum. It is stored by nature in what are called the "oil sands"—beds of porous sandstone. The oil is supposed to be produced by decomposition or slow distillation of organic matter.

The carboniferous period is named from coal measures. Its rocks sometimes reach a thickness of 20,000 feet—in Joggins section, Nova Scotia, 14,000 feet—and chronicle a remarkable series of geological changes. Its rocks include limestone, made of corals, crinoids, brachipods, etc., which swarmed in the clearer parts of the sea. Sandstones are often found full of coaly streaks and remains of terrestrial plants—shales and seams of coal varying from an inch to several feet or yards in thickness, and generally resting on beds of fire-clay. This suggests successive subsidence and elevation of those regions. The limestone attains a thickness of several thousand feet, with hardly any mixture of sediment. The formation of coral limestone speaks of long periods of subsidence. Coal beds also show the same. Coal is composed of mineralized vegetation. Each layer of coal is the remains of a forest. In Nova Scotia there have been traced 76 of these, 15 of which contain good coal beds. What is the solution of the problem? The flora of this period are still ferns, lycopods, etc., growing to great heights, perhaps 50 feet. The fauna of the period is but scantily preserved. Specimens of air-breathing animals, such as scorpions, tree insects, and amphibians are found. The scorpions closely resemble living ones, and possess stings. The carboniferous forests must have

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hummed with insect life, for there have been found ancestral forms of dragon-flies, May-flies, white ants, cockroaches, crickets and locusts. Some of these were of great size, with wings seven or eight inches in length. Thirteen hundred species were found at one place in France. The lagoons in which the coal growth flourished were tenanted by numerous forms of life—mussel-like molluscs and ganoid fishes. During the carboniferous period the highest form of life was amphibian—modern frogs and toads, some small, others measuring perhaps seven or eight feet. The marine life of the carboniferous period preserved in limestone includes corals, crinoids, and shells. Crinoids are most numerous, massing into numerous beds of limestone, hundreds of feet thick. Of crustaceans, trilobites and brachipods disappear before the more highly organized gastropods. The remains of fishes show sharp teeth and spines belonging to sharks. These were necessary to crush the hard bony plates of ganoid fishes on which they would feed. Ganoid fishes are not found in limestone. Sharks' teeth are sometimes found in shale and coal seams. The inference is that the shark would sometimes invade the lagoons to feed upon the fish. Where found in Canada: As already stated these rocks are largely developed in Nova Scotia. There are none in Ontario. Carboniferous limestone is found in the Rockies near Banff and at other points. The coal seams there, however, are of a later age—cretaceous.

Permian.—Following the prolonged subsidence of the carboniferous period came a series of great terrestrial disturbances whereby the lagoons and coal-growing swamps were in great measure effaced. No great change took place in the character of the fossils, however. The name of the period is derived from Perm in Russia, where these rocks are well developed. They consist of red sandstones, marls, conglomerates, and brecchias with limestone and dolomites. The sandstones are usually bright brick red in appearance, owing to the presence of earthy peroxide of iron, which cements the particles of sand together. The shales and marls are colored by the same pigment. This color is so characteristic that a series of these rocks have been called the "New Red Sandstone." Red strata are as a rule quite barren of organic remains, probably because the water containing the peroxide of iron must have been unfitted for support of life. Among the red strata, however, occur dark shales which have yielded numerous remains of fishes. This period is characterized by large deposits of gypsum and rock salt, which were not formed in the open sea, but in more or less land-locked basins, where the water evaporated, and being charged with iron, a precipitation took place, producing the beds of gypsum and rock salt. The flora and fauna of the Permian period are, therefore, little known. Yet the luxuriant vegetation of the carboniferous period must have continued to some extent. Conifers appeared and cycads, or palm-like plants. In fauna a great advance is made by the appearance of the earliest known lizard, which, like the living crocodile, has its teeth planted in distinct sockets. Where found in Canada: Some in Nova Scotia are thought to be Permian. They are absent in other places. The reason for this will be referred to later.

Mesozoic Periods.—Triassic: When we ascend into the Triassic, we meet with a decided contrast in organic remains. A new and more advanced phase of development presents itself in the shape of a richer and more varied assemblage of plant and animal life in Mesozoic times. The rocks of this period are a continuation of the same red sandstones, marls, beds of gypsum, rock salt and limestone of the Permian period, pointing to a similar origin and similar conditions. The flora of the period has been preserved chiefly in the shales and thin coal seams of some of the inland basins, and consists chiefly of ferns, horse-tails, conifers, and cycads. Of ferns, the characteristic forms are tree ferns Cycads increase so in number and variety that this period has been called "the age of cycads." Occasional footprints of amphibians on the sandstones give a glimpse of the higher forms of life that moved about on the margins of the salt lakes.

The crinoid is still a most typical form. A remarkable and long extinct order of reptiles, the deinosaurs, made its first appearance. These creatures had peculiarities of structure that linked them with both reptiles and birds, and in size resembled elephants and rhinoceroses. They seem to have walked mainly on their hind feet, the three-toed or five-toed bird-like imprints of which are numerous in some beds of sandstone. The earliest known crocodiles have been found in the Triassic rocks. But the most important advance was the appearance of mammalian life. The representatives at this time, however, were small creatures.

Jurassic or Oolitic : Sandstone, shales and limestone alternate more frequently and are more local in their extent, indicating greater changes in process of deposition and more frequent alternations of sea and land. Flora is the same as before. Among the conifers are the remote ancestors of our pines and firs. Remains of numerous cycads have been found in Spitzbergen, showing that the climate of the Arctic regions must have been at that time sub-tropical. Animal life much more varied both in land and sea than during previous ages. A characteristic feature was a profusion of corals—no longer the Rugose ones of the Palæozoic seas, but the true reef-building coral.

Crinoids still abundant, but old types disappear, and form becomes like those found in seas at the present day. Sea-urchins swarmed on the sea floor. Trilobites entirely disappear. Abundant ten-footed crustaceans—the ancestors of our lobsters, shrimps cray-fish and crabs—make their appearance. Certain beds contain numerous remains of insects—dragon-fly, May-fly, grasshopper and cockroach. The wing of a butterfly was also found. Fishes abounded—ganoids and various tribes of sharks. Reptiles were so remarkably developed that this has been called "the age of reptiles." Some forms haunted the sea, some frequented the rivers, some lived on land and some flew through the air. The descendants of these are our crocodile, alligator and turtle. But most types are long extinct. Of these sea lizards, the icthyosaurus was 24 feet long and resembled a whale in shape and bulk. Pleisosaurus differed from previous ones by having shorter tail, longer neck, smaller head, larger paddles, and teeth in distinct sockets. It probably haunted lagoons, rivers and shallow seas. Its long swan-like neck enabled it to lie at the bottom of water and raise its head to the surface to breathe, or when at the surface to send down its powerful jaws and catch its prey at the bottom. Pterosaurs, or flying reptiles, were strange bat-like creatures with extremely large heads and the outermost toe of each forefoot greatly prolonged and supported by a membrane by which it could fly. Their bones were hollow and filled with air like those of birds. Deinosaurs—huge ostrich-like reptiles, some 25 feet long—seem to have walked on their massive hind legs along the margin of shallow seas. One form of deinosaurs—ceteosaurus—may have been some fifty feet from snout to tip of tail, stood some ten feet high, and fed on vegetation along rivers and lagoons. Remains of some more gigantic still have been found, the imprints of whose feet measure about a square yard in area. The largest of these monsters—and so far as known, the most colossal animal that ever walked the earth—was the atlantasaurus, believed to have been not much less than 100 feet in length and 30 feet or more in height.

Another marked feature of this period: It contained the earliest known birds, differing much from common birds in having peculiarities of structure that linked them with the reptiles. They had teeth in jaws and some of them long lizard-like tails. Marsupials made their appearance and continued to be the only representative of mammalia during this period. Where found: Few mesozoic rocks are found in Canada. The continent during this period was likely elevated above sea-level and so erosion rather than deposition was going on.

Cretaceous: Received its name from the chalk cliffs of England, and is of marine origin like limestone. Flora passes from ferns, conifers and cycads to ancestors of our common trees and flowering plants. The earliest dicotyledons—species of maple, alder, poplar, oak, walnut, beech and others, also species of pine. This flora extended as far north as Greenland, from which nearly 200 species have been obtained. The climate must have been much warmer than now. Foraminifer numerous in cretaceous limestone rocks. Plentiful in the white chalk of England, and still lives in enormous numbers in the Atlantic Ocean, forming at the bottom a grey ooze not unlike chalk. Sponges lived in great numbers, and sea-urchins were numerous. The fishes of the cretaceous period include the earliest known representative of our herring, salmon, and cod. Reptilian life is on the decline, and only one type of deinosaurs is found in cretaceous rocks—iguanodon. Of this in recent years a number of almost entire skeletons have been found. It was a herbaceous and probably an amphibian creature, able, no doubt, to walk along the shores with an unwieldy gait on its long hind legs, balancing itself by its strong massive tail. Several kinds of crocodile also found in cretaceous rocks. From rocks in Western America have been found a long, snake-like animal, 40 feet, with swan-like neck, which it could raise 20 feet out of the water or dart to the bottom to catch its prey. Sea serpents were also especially numerous.

Remains of true birds have been found in cretaceous rocks. Chalk is presumably pure limestone, composed chiefly of crumbled foraminifera, urchins, molluscs, and other marine organisms. It must have been laid down in a sea singularly free from sediment, but not necessarily in deep seas. Cretaceous rocks cover large areas in America, commencing at the Eastern States with no great thickness, but deepening to westward until in Texas, Colorado, Utah, and Wyoming they attain gigantic proportions, with a maximum thickness of 11,000 to 13,000 feet. In their upper parts, called the Laramie group, they contain many land plants, half of which are allied to still living American trees, and in some places these plants are aggregated into valuable seams of coal. In Canada the interior continental plain contains these rocks largely. In them 179 species of plants and 394 species of animals have been found. The coal-beds of Anthracite and Crow's Nest Pass are of this age. It is believed that about the beginning of the cretaceous period the Rocky Mountains began to be uplifted, whilst the plains sank beneath the sea. Then were deposited on the gradually sinking floor the sandstones and shales of this series in which occur the remains of deinosaurs, fresh-water shells, land plants, with occasional beds of coal. In the interior continental plain the sandstones and shale of the Laramie series are 5,000 or 6,000 feet thick.

Cainozoic: During this period the continents began to take their present shape. That great series of mountains extending from the Pyrenees across Europe and Asia to Japan were thrown up, carrying up rocks of this period from the sea-floor to 16,000 feet high. The generally warm climate indicated in former periods now gradually changed into modern conditions of graduated temperature from the Equator to the poles. At the beginning of the Cainozoic period the climate within the Arctic circle was mild, but before its close it became so cold that snow and ice spread far southward over Europe and North America. Plants and animals are now strikingly modern. We may imagine meadows, woodlands and forests similar to those of the present day. The mammals of this period reached a variety of type and magnitude of size far surpassing that of the present day. Rocks now begin to be studied with reference to the present day—hence names, Eocene, Miocene, Pliocene, Pleistocene. The western plains were still under water, but it changed from a sea water area to a fresh water lake. During this period the entire West rose several thousand feet by a slow oscillating movement, so that the land mass above sea level was increased at least tenfold. During this period also there was great volcanic activity shown by immense peaks and masses of lava scattered through the Cordilleran region from Mexico to the Arctic. Along the shore of the Baltic in North Germany 2,000 species of insects have been found in amber, a fossil gum from ancient coniferous trees. The vertebrates form the great feature of Cainozoic life. The majority of fishes are like the food-fishes of the present. Teeth of sharks are very abundant in marine deposits. The snakes of this period have interest because they are degenerate forms, having lost the limbs which their ancestors possessed. Primitive whales occur in the sea deposits—one about 70 feet long being found in Alabama. The whale is also believed to have degenerated from a mammal which lived on land. Miocene beds in Western America contain several representatives of carnivorous animals—the panther, dog, cat, wolf and tiger. Rodents began their history in this period and were abundant before the Alps were formed. Of the species of elephants the mastodon was of immense size. The pig is found in the Eocene beds; the earliest oxen in the Pliocene; camels also as far back as Eocene. The earliest known horse is from the Eocene deposits and was about the size of a fox. It had three toes on the hind feet and four on the front feet. In succeeding periods these toes gradually changed —one disappeared up the leg as a splint, and two side ones shortened up, lost their hoofs, and are now mere splints. Monkeys go far back into the Eocene period. Apes appear in the Miocene. No human remains, either bones or implements, are found in these deposits.

Then should follow a history of the Glacial period and of Prehistoric man—Palæolithic and Neolithic ; but this paper, already too long, must be brought to a close with a bare reference to some thoughts suggested.

Does the study of geology discredit the story of creation? Does it do away with the necessity of a Creator? To my mind it makes the work of creation all the more wonderful. The account of creation in Genesis is the nearest popular account in literature. It suggests a gradual development. The latest idea put forward by eminent scientists is that all Force is an expression of the will of God.

" In the beginning God created "——" God saw that it was good."

" How manifold are thy works, O God ! In wisdom hast thou made them all."

[*The above is a report or summary of an address delivered on Nov. 9, 1905—not Nov., 1906, as inadvertently stated at commencement.*]

Rivers of Canada

By Prof. Coleman.

DECEMBER 14, 1905.

Mr. President, Ladies and Gentlemen: About three months ago I was in a country where the rivers are dry, many of them being but rivers of sand and rocks. The rivers I shall deal with to-night, however, are not of that kind.

There is no country in the world better watered than Canada. Our rivers are of tremendous importance to us, not only through their scientific aspect, but also from an industrial standpoint, for the development of our west is carried on by reason of them.

There would be no use of my describing all the various rivers of Canada, so I shall take only those which are of the most interest or the greatest importance.

There is a peculiar thing about our language,—we have only two modes of expressing a stream of running water, viz., creek and river. In some parts of the country if you can get across a stream without wetting your feet it is a creek, if not it is a river. In other parts of our country, however, this latter would not be considered a river at all. Take British Columbia for example. Here Kicking Horse Creek, so called, is so large that the only way we could get across it was to swim our horses across and take a boat ourselves. And the horses had quite a time swimming across, too. That is called a creek in British Columbia. So, you see, definitions are variable according to the country.

We have so many rivers in Canada that it will be necessary to make some classification or distinction. They may be classed according to the direction in which they flow. There are those great ones in the east, the St. Lawrence, the Restigouche and the St. John, which latter is noted for that peculiar reversing of the current near its mouth. The current here flows up or down according as the tide is high or low. We have a great many rivers in Labrador that we never hear about. There is a whole set that flow into Georgian Bay. There is also a great set of rivers which cross into the great plains and flow out in all directions. Astonishing as it may sound, there are some of our rivers which flow into the Gulf of Mexico itself. A little consideration will make this clear. These rivers are tributaries of the Missouri and the Missouri is in turn a tributary of the Mississippi, which, as you of course know, empties into the Gulf of Mexico. Thus all people receive the waters from our rivers.

Of the rivers that flow into Hudson Bay one is of great importance and interest. These rivers have not many falls and impediments in their course, but have a great many "flat rapids" as the canoe-men call them. They are shallow but have a great many stones in the bottom. It takes double the time to go up one that it does to come down. The Grand Trunk Pacific will cross these great rivers. The river I referred to is a huge one that we hear very little about, the Nelson. There is another river in the west of Ontario, Rainy River, that I had always thought of as a rather wild and unexplored region. It was a surprise to me to find that it was quite well settled and that here you could travel nearly 250 miles by steamer. The Government was once going to build a lock on this river, but the project fell through.

Then there are two other rivers of great importance. Those are the Red River, which starts in Dakota and Minnesota and flows into Lake Winnipeg, and largest of all the Saskatchewan. Eighteen or nineteen years ago I visited the headwaters of the Saskatchewan. The snows of the rockies all pour into that stream.

Perhaps I should tell you something further about these western rivers. There was a time when the Red River was the only way of getting into Manitoba. You had to cross over into the United States and take a steamboat from there. It is the characteristic river you get in flat places. Flowing through the mud, silt and sand, the river gets very crooked, winding and doubling upon itself.

There is a story told of an engineer who was called upon to draw a map of this river. When it was completed he found that he had tied a knot in it, making it cross itself. Of course this is an exaggeration, but it goes to show how very crooked the river is.

These rivers that flow through soft material are very muddy. They are in great contrast to the St. Lawrence in this respect. There is no river to compare with the St. Lawrence for deep vivid green. But the western rivers are very muddy—the farther down one you get the muddier it becomes. The higher the water the muddier they are. In the flood season you need to let the water stand some time and settle before you can drink it, though there is no truth in the saying that you have to close your teeth tightly, when drinking, to keep the pebbles out. The water, however, is very wholesome after it has been allowed to settle.

The rivers flow through flat countries for some distance, but they are somewhat navigable. There is one region along the Saskatchewan that is very interesting, for the reason that it is gold-bearing. No very large quantities have been found, however. The gold found there is very fine, for it has to come a long way. The fact is that the Saskatchewan gold never came from the Rocky Mountains, and in fact its origin has never yet been accounted for. A theory is that this gold came from the Selkirk Mountains, which are gold-bearing everywhere, that it came down before the Rockies existed. It is not an improbable theory. The Rockies have been raised since the Selkirks, and the Saskatchewan cut its way down through mountains rising many thousand feet.

The greatest river of the plains is still to be mentioned. That is the Mackenzie. It is the greatest river of Canada and carries more water than the St. Lawrence, the only one in America to surpass it being the Mississippi, and that only in length, but not in volume of water. The Mackenzie has the same bad habits as the St. Lawrence. A glance at the Great Lakes will show what those are. It passes under many different names. This gives rise to disputes as to the headwaters. Some say that Athabasca is the headwater of the Mackenzie—it carries out the direction better. Perhaps the Peace River is its origin, and not the Athabasca.

Here is a river that masquerades under several names like the St. Lawrence, and is much over two thousand miles long.

I was one of the two men who discovered one of the main branches of the Athabasca, so perhaps I should be an authority on it. It starts in the mountains much as the Saskatchewan does. It changes greatly with the season. The volume of water is large. In spring, it is a raging torrent, but about the early part of July it begins to fall again and can be forded.

The Mackenzie has one peculiarity: it flows due north. It is one of the worst rivers for flooding its banks in the country, because the snow and ice begin to melt in the south, while the lower part of the river is still frozen and blocked with snow and ice. When it comes near its mouth it really loses its way. Near the mouth it is three or four miles wide, and, as I said before, is the greatest and longest river in Canada, nearly eleven hundred miles long.

The rivers so far all have their beginning in the Rockies. When travelling westward you have perhaps noticed, when you got to the peak of the Rockies, a sign, "The Great Divide." Below that sign there used to be a trough. Years ago a stream flowed through this trough and actually divided, one part flowing down one side of the mountain, the other flowing down the other side. It is the greatest divide in the world. Its summit, a sharp peak, brings to one's mind in a very striking way the division of the waters. Take, for example, a snowstorm falling on this peak. Its flakes, when melted, might run thousands of miles apart.

When the Hudson Bay Company were masters in that region, there was one point where the men from the east used to meet the men from the west. Now that parting point in the headwaters of the Athabasca is still called "The Committee's Punch Bowl." The reason was this. They were nearly all Scotchmen, and as water, of course, is dangerous to drink, a punch bowl was necessary. This Punch Bowl is not much larger than this building, and into it comes dropping the melted snow from all sides. You will notice a little stream flowing out of it, and if you go to the other end of the pool you find another stream flowing in the opposite direction.

Thus this one little pool sends part of its waters to the Arctic and the other part to the Pacific. And there are many other striking examples of the division of the waters. A little farther up streams empty into the Saskatchewan, and a little farther south you find the Milk River. This region is the greatest water parting in the world.

If you go to the Pacific coast you find a very different type of rivers. The others, the Saskatchewan, etc., are not very rapid. These have a gradual slope and pass through muddy country. The moment you cross the mountains, however, you come across rivers which are in a hurry because they have only a short distance to travel. They have more than five thousand feet of fall and only three or four hundred miles to do it in. So they must be rapid.

The Kicking Horse Creek I referred to before is a very nice river. It acts like a boy at play, jumping, dancing and leaping over its course—a very striking river indeed. As it approaches the Columbia, of which it is a tributary, it seems to be put on its good behaviour before joining the great river.

The Columbia has one or two very curious features that must be brought out. There is a very wide valley between the Rockies and the Selkirks. You find that all the greatest rivers in Western Canada seem to take their rise in that ravine. The Columbia flows north-west for a while, then goes south two or three hundred miles, with a lake or two on the way, then turns out into the United States. It has a tributary called the Kootenay, which starts about a mile and a half from the Columbia in the same valley, flows south-east and goes down into the United States, gets tired of the United States and comes north and joins the Columbia, practically enclosing the Selkirks. The Fraser has the same peculiarity.

When I first reached the Columbia the water was not very high. However it was a fine bright season and all the snow fields began to thaw. It depends on these snows for its supply of water, and it began to rise, the hotter the sun became, the faster it rose. I was at what is now the town of Revelstoke. It is where the Canadian Pacific crosses the river the second time. I wanted to go to see some mines at the Big Bend, but the question was, how could

I get there? The British Columbian forest is one of the most formidable things you can meet. What with the thick underbrush, huge trees lying flat on the ground, and the immense cedars, there's no chance of getting through by horses, even if I could get them. For a while I watched with interest two men in the vacant lot next to the log hut where I was staying who were building a boat. They took every possible opportunity to leave the work in order to get a drink, etc., so I concluded the boat would never be built. I was in despair, when one day, while walking on the river bank, I found three fellows with a boat, a beauty. I bought a quarter share in it for $12.50. As I paid so much for my share I had the choice of direction, so we made ready to go up stream. My friends told me that there would shortly be fewer prospectors in that part of the country and that an empty canoe would soon be coming down the river. But we made a good pair of oars, put in a little tent, got our supplies ready and started from about a quarter of a mile up the shore. The two of us who had the least skill in boating took the oars, while the other two took paddles to steer our course. We pushed off, the oars and paddles began to work, and we went straight down stream faster than we had expected to go up. So we made for the shore and the two of us who had been rowing took a rope, fastened it to the canoe, and while the others steered, pulled the boat up stream. Then the river began to rise, and rise, and what with trees blocking our way and compelling us to cross over to pass them, we had a pretty hard time of it. It afterwards became cloudy, the river fell again, and we made better progress.

That was the kind of work that the early gold miners used to do—haul their supplies up with great labor. They ate lots of beans in those days. That kind of river is in some ways a drawback to the development of the country. But now railroads are taking the place of boats for transportation, except on some of the lake expansions where a few steamers are used.

Another important river is the Fraser, one of the most headlong in the country. The best canyon in the country is to be found there. It is more than two thousand feet high.

I suppose there are some of you who have no idea of what a canyon looks like. If you have not yet done so, go out some time and see that valley near Dundas. It is one of the prettiest pieces of scenery in this part of the country, and is almost two hundred feet deep, I believe. Imagine a valley ten times its depth and you will have some idea of the magnitude of the canyon of the Fraser.

Along this canyon the Canadian Pacific Railway picks its way. You travel along for quite a distance till you come to the little town of Yale. I stopped off at Yale once because I was attracted by the name. It reminded me of the university. I found it to be occupied mainly by Chinamen. It was the head of navigation and therefore of some importance. Farther down the Fraser becomes quite a broad stream one or two miles wide.

We now come to the Skeena and Stickeen, and the other important rivers. The Skeena is a very much slower river than the Fraser. The other rivers, Peace and Athabasca, are still and shallow. There are some big areas of coal along some of the tributaries of the Skeena.

I took a steamship from Port Simpson to Essington, and then on up to Hazelton. The first thirty miles of the river is tidal and therefore slow. Above that it is a series of rapids, and I wondered how we would get up in a steamer. The steamers on the river are all stern wheelers and use wood for fuel. They draw very little water and, while they cannot sail across a meadow in a heavy dew, still they are able to get along in pretty shallow water.

It was interesting to see how they fed the fire. The engineer would open the door, throw in a couple of sticks of cordwood, close the door, take a look around, then open the door and throw in more wood. A cord of wood did not last long. The fire would roar up the smokestack and send up great flakes to fall hissing into the water behind us.

The steamer would burn several cords of wood a day. There were great piles of it at intervals along the bank, and when the supply on board got low the steamer put in to shore, a gang-plank was thrown out, and the crew—who, with the exception of the captain and mate were all halfbreeds—all went ashore, and carried a supply on board.

It was wonderful how the steamer could climb the rapids. Occasionally on coming to a steep place she would be brought to a standstill by the current. On these occasions she drew back, took a rest, as it were, and rushed at the rapid again, then crept slowly up, up, till the level water was again reached. Sometimes, however, we came to a place where she really could not climb. Then she would draw out to shore—she could go ashore anywhere—and the crew would climb out on the bank carrying one end of a cable. This they would carry some distance up the river and make it fast to a cottonwood tree. The other end of the cable was wound around a drum on the boat. The power was then turned into this drum instead of the paddle-wheel and the boat would literally haul herself up. This is how we got up the steepest rapids. It took me three days to get up to Hazelton.

I wanted to go back by the same steamer, but she left too soon and I missed her. What could I do? It was not a question of a train being two or three hours late; it was a question of days, for it was late in the season and there was only one boat plying. I got a missionary—he was a halfbreed and a very fine fellow indeed—to procure a canoe for me. He came along late the next morning with three Indians, peculiar looking fellows. He introduced me to Solomon the captain. I found that Solomon could talk only Indian and Chinook—that sort of universal language in that part of the country, which consists of only about 400 words and is known to nearly all the inhabitants. We therefore did not get along very well from a conversational standpoint. However, I concluded that the missionary had arranged everything.

We then went down to see the canoe. I wondered what kind of one it would be to stand running those rapids. I thought of what chance an ordinary Indian bark canoe would have in them and felt rather anxious. But when I saw the boat I felt reassured. It was one of those beautiful cedars cut into a canoe with beautiful lines, like the lines of a yacht, and was at least forty feet long.

We started out, and after going a short way I was struck by the peculiar actions of the oarsmen. They paddled very slowly, and I was afraid at times that they would stop altogether. I began to worry for fear I would miss my steamer. The night came on bitterly cold. We went ashore, and the Indians threw down wood from one of the piles belonging to the steamers and built a roaring fire. Solomon was a good Christian, but he did not scruple to take the wood. I lay down in the boat and fell asleep.

I woke up in the night alarmed. Something seemed wrong. My bed did not feel steady and a splash of water came over the side into my face. Then I saw that we were afloat and whizzing down those rapids at about three o'clock in the morning. I tell you I was delighted to be down and have it over with. I caught my steamer all right, and found when I came to pay off the Indians that it would take them ten days to go back. They had to pull their boat up.

We are rather proud in Eastern Canada of our canal system, by which boats can pass from Lake Ontario to Lake Erie and on up into Lake Superior. Lake Superior is 600 feet above sea level. Hazelton is 700 feet above Port Essington. Imagine a steamer climbing up without a single lock.

A word or two about the Yukon. This river is more than 2,000 miles long. It was at this river that we had a dispute with our neighbors about the boundary. Its watershed is the White Pass. That watershed is only sixteen miles from the salt water, but the river flows 2,000 miles before it reaches the sea. It is by the Yukon that we reach the Klondyke. By traveling north on it you come to Dawson, St. Michaels, etc. This river is not entirely ours, however. A large part of it is in American territory.

The St. Lawrence is the great river of Eastern Canada. If you measure from the Straits of Belle Isle it is more than 2,000 miles long. There is some dispute about the headwater of the St. Lawrence. Some say that it is the St. Louis River ; others claim that Lake Nepigon is the headwater.

This is the most astonishing river in the world. It is the one river in the world that does not change its level. It does not rise or fall more than three feet from one year's end to the other. It is the clearest river in the world. It is never muddy after leaving Lake Ontario. The reason for this is plain. The Great Lakes form settling basins, and all mud and sediment are deposited in them.

It is unique in other respects. Steamships of the largest tonnage can go up it 1,000 miles, to Montreal in fact. Another unique feature is Niagara fall. I do not need to describe the Falls to people in Hamilton. I was rather annoyed to see the many ugly buildings they are putting up to disfigure the Falls. But I suppose we must make use of the great power going to waste there.

A vertical fall of 160 feet is not found in any other large river in either America or Europe. How is this one to be accounted for? A river always cuts its way farther and farther back, wearing off first the upper edge of the cliff and becoming a cataract, then a rapid, then in time a smooth stream. Why has the Niagara not done this? There are two things we can say about that. Niagara is a young river. It did not build the canal in which it flows. There was a time when the Upper Lakes flowed out across from Lake Huron to Lake Ontario at Scarboro Heights and Toronto. However, the last Ice Age that came along built up a great morain of hills, 700 feet high, across the bed of the stream. The outlet of that river was turned. When the ice departed the river went a new way, and found a place at Queenston where it could fall over a cliff. The Falls were at Queenston then. They have since cut back to their present location, and are still cutting back.

That the Falls are vertical is due to the geological structure. The cliffs are composed of hard limestone on top. Under that there are soft rocks. When the fall comes tumbling over it makes a great eddy. The soft shale is undercut, so that the last part to wear away is the top. If things go on long enough without interference it will in time wear its way back to Lake Erie.

Immunity

*How Nature Protects Her Subjects Against Bacterial Invasion.**

By J. Edgar Davey, M.D.

FEBRUARY 8, 1906.

"No people exists without medical views and regulations of some kind, and medical efforts and conceptions, though only under the form of rude superstition and belief in witchcraft, belong among the earliest manifestations of the infancy of human civilzation. Indeed, it may be said that medical defence against disease and death is a fundamental characteristic of man, even in primeval periods, and one which distinguishes him from all other beings. Medicine in the early history of man was regarded partly, if not entirely, as a kind of religion, and its practice was a religious occupation, while its results were the work of God and man. Among all nations diseases were considered originally visitations or punishments from some God or other who must be propitiated and called upon for aid or cure."

Let us briefly follow the advance of medical thought from the earliest times of which we have record.

Thot, an Egyptian god living four to five thousand B.C., was the author of the oldest medical work, containing prescriptions for all parts of the human body. Any deviation from these by a physician was sacrilege, and punishable by death. He showed a knowledge of anatomy, pathology and dentistry (artificial teeth having been found in mummies).

Much of medical superstition was derived from the Babylonians and Assyrians.

Among the Jews, disease was a punishment by Jehovah for the breaking of commandments. After contact with the Chal-

*I am much indebted to Baas' History of Medicine and to the Journal of the American Medical Association for the matter contained in this article.—*J. E. D.*

deans diseases were ascribed to demons. Oracles were sought from Beelzebub. The Talmud, A. D. 200-250, ascribes diseases to evil external influences, constitutional vice or magic.

Indian medical records are fourth in the roll of antiquity. Diseases were natural or supernatural—the latter due to demons. Disease was also caused by the unequal action of the five elements — ether, air, fire, water, earth.

The Chinese attributed disease to spirits, wind, cold and warm humors, etc. By feeling the pulse the cause and seat of the disease might be determined.

Various gods presided over the physical destinies of the Japanese. Disease was treated by appealing to these gods or by employing conjurers to cure with their charms.

In Africa, all the negro tribes had magicians who employed talismans or magic potions to overcome the malign influences from which the sick suffered ; or witch doctors were employed to search out the witches who caused disease and death.

To the Greeks, however, belongs the honor of assimilating the crude medical ideas of the more ancient nations and of elevating and developing them into a liberal science. Like all other people, they assigned to medicine as its founders and supporters certain ever ruling gods and godesses, Æsculapius being the proper god of medicine.

Hippocrates (B. C. 460-370) was the creator of profane medicine. He based his views on the assumption that the body and its constituents were composed of the four elements—water, fire, air, earth, with their cardinal properties—dryness, warmth, moisture, coldness. The body constituents were the cardinal fluids—yellow bile, blood, mucus and black bile. Health consisted in a uniform action and reaction of these, one upon another, while irregularity of action produced disease. The fundamental condition of life was heat, the evaporation of which produced death.

The Humoral System of Pathology was followed by the system of Solidism propounded by Asclepiades (B. C. 128-56), in which matter consisted of extremely small, fragile, formless collections of atoms, between the pores of which moved a multitude of the finest particles, giving rise to sensation. If these particles moved quietly and regularly they produced health. If the movements were irregular, feeble or boisterous, then sickness existed.

Galen (A. D. 131-210), like Hippocrates, attributed disease to an improper mixture or an unnatural condition of the four cardinal humors—blood, mucus, yellow bile, black bile.

Mediæval medicine varies little in theory of causation of disease from ancient medicine. Leaders of medical thought taught the Humoral theory with but slight modifications. During this period, Christianity began to exercise her influence, and hence disease was an evidence of God's displeasure or the work of the devil. Priests and monks formed a large proportion of the practitioners.

Modern medicine dates from the discovery of America. Paracelcus (1493-1541), of German-Swiss birth, attributed health to a due proportion of sulphur, salt and mercury in the body, together with the correct action of the vital spirits.

Sylvius (1614-1672), of the Netherlands, accepted three cardinal humors only—saliva, pancreatic juice and bile. These presided over by the vital spirits produced a condition of fermentation. If fermentation occurred without the presence of acid or alkali, health resulted ; otherwise, disease.

Sydenham (1624-1689), of England, regarded disease as a natural effort of the body to remove morbid material from the blood.

During the eighteenth century, Hoffman (1660-1742) claimed "that certain forces are inherent in the body and express themselves by movement. The regular occurrence of these movements produced health. Too strong or too weak action leads to disease."

Bordeau (1722-1776) regarded the stomach, heart and brain as the tripod of life and as the three great centres of the body. Health was the undisturbed circulation of motion and sensation from and to the vital centres. Disturbance of this circulation produced disease.

Bichat (1771-1802) attributed to every bodily tissue its specific vital properties of sensibility and contractility. Alterations in these properties gave rise to disease.

Rush (Philadelphia—1745-1813) regarded disease as due to a morbid excitement induced by irritants acting upon a debilitated body.

During the nineteenth century we find Schonlein (1793-1864) stating that disease is an independent entity or parasite sojourning temporarily within the body. Against this entity the body finds itself constantly in a state of defence.

Henle (1809-1885) regarded disease as a deviation from the normal typical process of life.

Virchow (1871-190–) defined disease as altered impressions of the vital force either in the body or its fluids.

The improvement of the microscope now led to fresh discoveries and new theories.

Heuter (1873) claimed that all diseases, whether external or internal, depended upon the entrance of fungoid monads into the body.

I have given this brief introduction on the history of medicine just to show how near to, and yet how far from, the theories of health and disease as we understand them to-day, these early masters were, and while we, at the beginning of the twentieth century, ascribe a great many diseases to germ causation, we are not quite so sweeping in our assertions as was Heuter in 1873. There are, however, even to-day some who would strive to attribute all pathological conditions to bacterial causes.

What are these organisms to which so much of human ill, yea, of human welfare, also, is due?

Bacteria, germs or microbes are minute, unicellular *plants*, existing in three chief forms, viz.:

1. The Sphere or Coccus—1-80000 to 1-8000 inches in diameter. They are non-motile, and some have capsules. Examples are the germs causing erysipelas, pneumonia and those producing pus.

2. The Rod or Bacillus—longer than broad—straight or slightly bent. Some are motile, *e.g.*, typhoid germs. Others have capsules and form spores, *e.g.*, anthrax. Others are clubbed shaped, *e.g.*, diphtheria.

3. Spiral Forms or The Spirillum. These occur in spirals or segments of a spiral. The most common example is the spirillum, causing cholera.

Bacteria live on organic matter, either living or dead. Germs existing on living organic matter are called parasites. Those dependent on dead organized matter are called saprophytes.

Saprophytes form the great majority of bacteria. They are harmless to living organisms and are necessary to life, performing many important functions in the economy of nature, *e.g.*, sewage disposal, putrefaction and fermentation.

The parasites are harmful invaders. They are the pathogenic or disease-producing bacteria and give rise to infectious diseases.

Bacteria reproduce themselves in two ways—

a. Fission or simple division is the more common method, requiring 20 to 30 minutes in favorable environment, so that a single bacillus, if left under absolutely favorable conditions, would in three days multiply to seven tons of matter.

b. Spore formation is a special adaptation of certain bacilli to unfavorable environment. Where conditions of growth are unsatisfactory the bacillus develops a spore which is exceedingly tenacious of life and able to resist the destructive effects of the most unfavorable surroundings. In this condition the life of the bacillus is sustained until more acceptable conditions favor its return to the original form. The spores of anthrax have been known to survive a period of twenty years.

Like the higher plants bacteria depend for nourishment on O. H. C. N and salts of Na. and K. as food elements. They thrive best at body temperature—35 to 37° C. Heat at 55 to 70° C. destroys, while cold merely inhibits growth. Moisture is absolutely necessary for most forms and desiccation is almost uniformly fatal. Some require oxygen. Others die unless oxygen is excluded from their feeding grounds. Light, especially direct sunlight, is one of our most important germicides. In the laboratory we are able to grow bacteria on such media as beef broth, gelatin, potato, litmus, agar, glucose bouillon and blood serum. In growing, the bacteria give rise to various products, some of which are poisonous to the human system, and on this account are called toxins, while the parasites producing them are called pathogenic bacteria. These pathogenic forms are the cause of such infectious diseases as typhoid, diphtheria, pneumonia, cholera, tuberculosis, meningitis, etc.

Germs are found everywhere—in the air we breathe, in the water and milk we drink, in the food we eat, in our homes, on the streets, in the cars. They attach themselves to our clothing, books, papers, etc. We carry them around on our hands, in our hair, in our mouths. They come through the mail in our letters, they cling to dollar bills even closer than we are apt to ourselves. They ride on our bread tickets and milk bottles. They lurk in cellars and on street corners. They play around back yards and public alleys. They float up through the manholes from our sewers. They freeze up in our ice and occupy our refrigerators in the summer. In short, they are everywhere, ready to seize for prey any living organism that offers them a foothold. Truly, we are as "sheep in the midst of wolves."

But this dark picture has a brighter side and this brings me to my subject proper, Immunity.

By immunity, we understand that phenomenon in which an individual or a whole class of animals exhibits such resistance to an infection as to withstand it, while under the same conditions another individual or another class of animals may yield to it.

Immunity may be natural or acquired. Many diseases, which attack man, cannot be inoculated into the lower animals, *e.g.*, scarlet fever, measles. Neither is man susceptible to many of the lower animal infections, *e.g.*, chicken cholera. The negro is less susceptible to yellow fever than is the white man ; while different families in a community, and even different individuals in the same family, vary in the power of their resistance to various infectious diseases. Some families are strongly resistant to tuberculosis ; other families are strongly susceptible. One member of a family contracts every infectious disease that comes along ; another member of the same family is equally exposed with impunity. Even the same person may vary greatly in his individual immunity. During childhood he is particularly susceptible to children's diseases. If he reaches adult life without having contracted measles, scarlet fever, or chickenpox, he is not then very likely to become a victim, even though frequently exposed to them. But, on the other hand, he is now more susceptible to typhoid fever than he was in childhood or than he will be in old age. Again, an individual may be exposed continually and directly to tuberculosis, and yet his general health being good, he suffers no infection. But let his system become debilitated from any cause, then, his resistance being lessened, he readily becomes a prey to the most accidental exposure. In these foregoing examples we have a condition in which Nature has already endowed her subjects with the necessary equipment, in whole or in part, wherewith to ward off the onslaughts of bacterial invaders. This is a condition of *natural* immunity, and is, for the most part, inherited. When a person, once susceptible to a disease, becomes non-susceptible to the same disease, we say he has an *acquired* immunity. We see frequent daily examples of this phenomenon. An individual contracts measles, mumps, scarlet fever, smallpox, typhoid fever. In the great majority of cases, no matter how much he may afterward be exposed to these same diseases, he resists invasion. The one attack has brought about some change in his system that renders him immune to further infection, *i e.*, he has *acquired* an immunity.

Now, bacteria attack an individual in different ways. In diphtheria, for example, the germ first gets a foothold on the inner wall of the throat. The ground being favorable, it starts to multiply. In growing, a toxin or poison is produced which, being absorbed into the system, gives rise to the symptoms of the disease. The germs themselves, however, remain on the throat wall and do not enter the blood stream. Similarly with the germ of lockjaw or tetanus. Now, if after the disease has subsided, we take some of the serum of the patient's blood and mix it with some of the germs causing the disease, we find it has no effect on them whatever. If, however, we mix this serum with some of the toxin secreted by these germs, we find that the toxin is neutralized, *i.e.*, the system has produced an antitoxin, or an antidote to the toxin, and we say the immunity in this case is *antitoxic*.

On the other hand in a typhoid infection, the germs first enter the intestine from which they are taken up into the blood stream and by it carried to the various organs of the body, particularly the spleen. They multiply within these organs and in the blood stream. They carry their poison along with them wherever they go, and liberate it only when they themselves die or disintegrate. Their poison is not secreted in soluble or diffusible form as was the diphtheria toxin. Now, if in this case, when the attack has subsided we take some of the serum from the patient's blood and mix with it some typhoid germs, we find that the germs are destroyed but the toxin is not neutralized, *i.e.*, the system has not produced an antitoxin, as in the case of diphtheria, but has rather produced some substance destructive to the bacteria, *i e.*, the immunity is *antibacterial.* Accordingly, if a person is *naturally* immune to diphtheria and typhoid fever we would say he possessed a natural antitoxic immunity in the case of the former, but a natural antibacterial immunity in the latter ; or if, having taken these diseases and thereby having acquired an immunity, we would say he possessed an acquired antitoxic immunity for diphtheria, but an acquired antibacterial immunity for typhoid fever.

An immunity may be acquired in two ways. For instance, a child takes diphtheria. His system immediately sets to work to produce an antitoxin to overcome the toxin of the disease. If his constitution is strong enough or if the disease is not too virulent he may succeed in mastering the infection, and because his tissues have produced the antitoxin by their own activity, we say he has acquired an *active* immunity. But suppose we decide to assist the child in his battle against the infection by injecting into his system an antitoxin which we have obtained from some outside source, and in this way render the toxin harmless, we say the child has an acquired *passive* immunity, *i.e.*, an immunity not due to any activity on the part of the tissues.

Nature has provided the human body with a splendid armamentarium wherewith to resist the continuous onslaughts of its microbic enemies. Surrounding the outside of the body is the skin, which, when unbroken, forms an impenetrable barrier to the millions of germs normally residing on its surface ; and as the outer layers of the skin are being constantly thrown off from the body, they carry with them the invading microbes. When the skin is broken there occurs a serous exudate that not only forms a scab, and thus mechanically protects the injured surface, but also contains germicidal substances. Should the bacteria alight on any of the mucous surfaces of the body, here again they meet resistance. Not only does a layer of mucus offer mechanical protection to underlying parts, but it has also an attenuating effect on the virulence of many organisms, and being constantly excreted, embedded organisms are continuously removed from mucous surfaces.

The mucous lining of the eye—the conjunction—has an outside guard of eye brows, eye lashes and eye lids. Should a microbic invader carry these outer defences, it has yet to encounter the tears, which neutralize its poison and wash it away from its dangerous position.

Should we breathe contaminated air, the germ elements have many difficulties to overcome before they find a lodging place suited to their purpose. At the opening of the nostril the hair filters out many invaders at the start. Those that successfully pass this barrier travel along a very tortuous highway where they strike against moist mucous surfaces, become embedded in mucus and are thus expelled. Should any pass still further and reach the lung passages they are caught on the ciliated epithelium and gradually carried toward the exterior or are expelled by coughing.

At least thirty varieties of micro organisms flourish in the mouth. Many are removed with the saliva, which inhibits their growth and weakens their poisonous properties. Others are eliminated during the process of mastication. When bacteria reach the stomach they are readily destroyed by the gastric juice.

Thus it is seen how many lines of defence a micro-organism must overcome before a foothold is obtained within the human system.

Now let us imagine that a colony having overpowered the outer guard has secured a foothold within the tissues of the individual. Has the body exhausted its means of defence? Examine what happens.

A person suffers a wound of the hand from some septic instrument. Germs pass from the instrument to the exposed tissue and immediately begin to grow. Perhaps the wound is not thoroughly cleaned. It is bandaged and left undisturbed for twenty-four hours. When next examined the hand and perhaps the arm is reddened, swollen and painful—inflamed, we say. What does this inflammation mean?

Inflammation is a reactive process on the part of the tissues, induced by some injurious agent. Interpreted this means that the body reasons on this wise: "Something has happened to the tissues of my hand. There is there some irritating injurious agent. I must make an investigation. If necessary, I'll send down a squad of policemen to remove the offender; or I'll turn on a hydrant and flush out the intruder; or I'll forward an increased supply of antitoxin or antibacterial substance so that the invader may be destroyed." Accordingly the blood vessels around the wound are engorged with blood conveying to the part the serum with which to bathe it, the white blood celled policemen to attack and destroy the germs, and the antitoxin and antibacterial substance to render the overthrow complete.

Or again: A germ of tuberculosis obtains a foothold in a section of lung tissue. The same inflammatory reaction is organized to remove and destroy the germ, but in addition the body says: "We must build up a barrier around this diseased focus that the germs may be prevented from spreading further through the lung ;" and so surrounding the field of battle, the connective tissue cells of the organ are stimulated to proliferate and in so doing build up an impenetrable wall around the diseased area.

Or we have an inflammation of the appendix which threatens to suppurate, rupture and infect the whole abdominal cavity. Then the body throws out from the engorged blood vessels a serum containing a tenacious substance called fibrin, which cements together the tissues surrounding the trouble and thus prevents a more serious infection of the general cavity by locking up the dangerous area.

But now suppose the body fluids do not contain a sufficient amount of *natural* antitoxin or antibacterial substance and that consequently a local inflammation is not capable of withstanding the progress of the advancing enemy. The germs, or their toxins, or both, get into the blood stream and are carried by it to all parts of the system. How now? Surely the case is hopeless. The body must at last give up the conflict. Not so. Again the vital consciousness reasons : "This invasion is more serious than I at first supposed. My ordinary defensive equipment is insufficient. I must draw on the reserves." And so the infection stimulates the tissues to an increased production of policemen, a larger quantity of antitoxin and a more abundant supply of antibacterial substance.

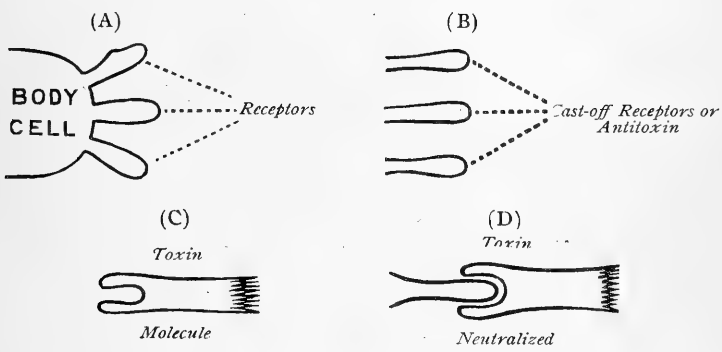
What are these policemen that played such an important part in immunity? How and where are the antitoxin and the antibacterial substances produced and in what manner do they act? And here we must proceed carefully, for many are the theories advanced to explain the various phenomena of immunity.

The policemen are the white blood corpuscles or leucocytes and are of two kinds—those which have a single nucleus each or lymphocytes, and the multinucleated forms. The lymphocytes are found most active in chronic infections such as tuberculosis, while in acute invasions, *e.g*, pneumonia, the multinucleated forms seem to play the most important role. These cells have the power of moving about in the body to places where they are most needed. They act as the body scavengers, attacking, ingesting and destroying foreign elements—*e.g.*, bacteria—that may invade the body.

Metchnikoff ascribes to these cells the sole honor of providing bodily immunity. They ingest and destroy the bacteria. They absorb and neutralize the toxins.

Ehrlick, on the other hand, has a more extensive and complicated explanation of immunity which in brief is as follows :

First, regarding *antitoxins*. The various body tissue cells have a multitude of processes called receptors, which serve as connecting links between the cell and the other elements, such as food molecules, etc. These receptors are of various kinds and can be produced by the cell at will. Not only so, but under special stimulation, *e g.*, the presence of toxins in the system, there can be an overproduction of these receptors, which, being cast off from the cell into the circulation, act as an antitoxin, combine with the toxin molecule and render it inert.



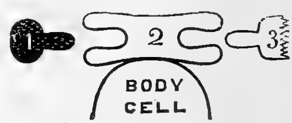
The presence of these floating receptors in the circulation after an infection is over accounts for the subsequent immunity.

Each separate toxin in the system stimulates the cell to the production of its specific receptor, so that the receptors of one infection cannot act as the antitoxin for a second different infection. *E.g.:* An attack of measles does not immunize against an attack of scarlet fever since their receptors are not alike.

The formation and method of action of the *bactericidal* substance admits of no such simple explanation. Suppose an individual has become immune to an infection, say typhoid fever. Let us take some of his blood serum and mix it with some typhoid germs. We find they are immediately destroyed. Now let us heat this serum to say 55° C. and repeat our experiment and we find our typhoid bacilli remain unharmed. To this inert heated serum let us now add a little fresh serum from the blood of almost any animal, whether immunized against typhoid or not, and once again the germs are immediately destroyed.

We see, therefore, that our bactericidal or antibacterial substance is a complex material, part of which—the complement—is destroyed by heat at 55° C., but which can be replaced from the serum of almost any animal; and another part—the amboceptor—which withstands heat at 55° C., and which is found only in the serum of those animals immunized against the special disease.

Neither amboceptor alone, nor complement alone, can destroy the invaders. Each is required to complete the action of the other. Moreover, they have a definite mode of attack. The amboceptor attacks the organism first, and thus prepares it for the attack of the complement, by which it is killed and dissolved.



1. Germ
2. Amboceptor
3. Complement

When germs invade the system, they attack the body cells through the amboceptors and complement, and, if not immediately destroyed, the cells are stimulated to a great overproduction of amboceptors and complement, which are thrown off into the circulation as the bactericidal substance. These

Germ

Amboceptor thrown from Body Cell

Complement thrown off from Body Cell

Germ Sensitized by the Amboceptor and ready for the Complement

Complement attacking and destroying the Sensitized Germ

over-produced amboceptors and complement remaining in the circulation after the attack has subsided, produce the immunity against a second attack of the same germ. The amboceptors for typhoid are *special* for that germ, and will not do for the destruction of any other. The complement, on the other hand, seems to work with any amboceptor. All authorities are not agreed on this, however.

In conclusion, these are the main facts and the most generally accepted theories of immunity as it is understood to-day. What may be taught fifty years, yea even five years, hence no man can tell. This is an age of rapid advancement. Theories to-day are history to-morrow.

Yet it must not be understood that I have given you in any sense a full account of the various phenomena that arise in connection with investigations on this subject. The fringe only has been skirted. The less difficult parts of the route have been selected, with due regard, however, to the main line of travel. I have purposely avoided difficulties, contradictions and theories which are still largely in dispute. Enough has been said, however, to illustrate how fearfully and wonderfully we are made, and how little man yet knows and how much has yet to be learned regarding the human body—the most wonderful of all the great works of the Great Creator. Truly, "The greatest study of mankind is man."

J. EDGAR DAVEY, M.B.

With the Canadian Government Eclipse Expedition to Labrador, 1905.

Rev. D. B. Marsh and G. Parry Jenkins.

We left Hamilton at 12 o'clock noon on July 31st by the S.S. Turbinia for Toronto. Leaving Toronto at 10 p.m. by the C.P.R. accompanied by Messrs. DeLury, Chant and Collins, we arrived at Quebec at 3 p.m. on the day following and put up at the Chateau Frontenac.

On Aug. 2nd we visited the Quebec Observatory, finding it to contain an 8-inch refracting telescope, the objective lens having been made by Alvan Clark. This telescope once belonged to the late Captain Ash, and with which he took several photographs of the sun by the old wet plate process. In addition to the telescope the Observatory contains a "transit" instrument for time service, both of which are in charge of Mr. Arthur Smith.

On Friday, Aug. 4th, our party, consisting of Dr. W. F. King, Chief Astronomer, Ottawa; Dr. C. A. Chant, University, Toronto; Prof. A. T. DeLury, University, Toronto; J. R. Collins, Secretary Royal Astronomical Society of Canada, Toronto; Rev. Father I. J. Kavanagh, Loyola College, Montreal; E. W. Maunder, F.R.A.S., Royal Observatory, Greenwich, England; Mrs. E. W. Maunder, London, Eng.; Wm. Menzies, Magnetic Observatory, Toronto; J. S. Plaskett, B.A., Dominion Observatory, Ottawa; J. Macara, Dominion Observatory, Ottawa; L. Gauthier, Dominion Observatory, Ottawa; W. P. Near, B.A., Dominion Observatory, Ottawa; Chas. Upton, Stroud, England; Frank P. Jennings, C.E., Derby, England, J. A. Russell, Windsor, N. S.; Rev. D. B. Marsh, Sc.D., F.R.A.S., President Hamilton Astronomical Society, Hamilton; G. Parry Jenkins, F.R.A.S., Hamilton; Miss W. King, Ottawa; and Mrs. D. Codd, Winnipeg, left

Quebec on the S.S. King Edward, a small vessel of about 500 tons, and in charge of Captain Bellanger, who proved to be very competent, especially on the north shore of the Gulf and coast of Labrador.

During our sail down the Gulf the King Edward made a number of calls which were interesting to the party. The principal places were Natasquan, Seven Islands and Blanc Sablong.

The early morning of Aug. 10th found us amid the icebergs of the Atlantic, off the dreary, treacherous coast of Labrador. At day dawn Rev. Father Kavanagh and Mr. Jenkins counted 101 floating monsters around our ship. At 9 o'clock, the sky being exceedingly clear down to the horizon, we saw a grand mirage. One vessel appeared upside down and several icebergs had the same effect and appeared hanging down in the sky. In the early part of the afternoon a perfect solar halo was visible, the circle being complete for one and a half hours. It was about 22½ degrees in diameter and the coloring very visible—red inside and violet outside. Dr. Marsh photographed this phenomenon, while he in turn was photographed by Mrs. Maunder, who described the attempt as "Astronomy under difficulties." Mr. Maunder told us that the Babylonians had accurately observed solar halos (according to the evidence of Strassmeyer) and measured the diameter. 22⅓ degrees, while they also had observed a second circle and computed the diameter at 45 degrees.

Arriving at Rigoulette about 3 o'clock in the afternoon we went ashore. When standing on the fishermen's wharf we recognized the spot where Hubbard and Wallace were photographed on their arrival, as appearing in "The Lure of the Labrador Wild." We photographed Lord Strathcona's old house, where he lived for over twelve years when but a young man, now occupied by Mr. Fraser, the present factor.

On the morning of the 11th at 3 o'clock the King Edward took up her anchor from Rigoulette and steamed almost directly westward up Lake Melville for 90 miles, when just before noon we got sight of North West River outlet, the site for our camp, and we realized that our journey was almost at an end.

The ship anchored about one mile from shore in five and a half fathoms of water. A party, consisting of Dr. King, James Plaskett, Prof. Chant, and E. W. Maunder, went ashore, in company with Prof. Stewart, of Toronto, who had arrived four days previously, surveyed the ground, and selected the site for the camp, after which a boat belonging to Revillion Frere was commissioned to take all the instruments and other stores ashore, which were landed about three-quarters of a mile up the North West River. Dr. Marsh and Mr. Jenkins went ashore in this boat and assisted in putting up the tents.

The exact position of the camp was soon ascertained and found to be 53° 31′ 31″ north latitude and 4 hrs 00′ 41″ west longitude—very nearly in the centre of the shadow.

The spot where our camp stood has been a camping ground for the last 90 years for the Indians. To this place the Mountaineers or Montagnais Indians come down every year to trade fur with the Hudson Bay post. Mr. Cotter, the present factor, is a fine fellow, an old Kingston boy, and is vested with authority both from church and state. He not only trades in furs, but baptizes, marries and buries Indians, Esquimaux and Liveheres. He is police, justice of the peace, and even the whole parliament when occasion requires.

On Aug. 12th at 5 o'clock in the morning by the sound of the siren all hands rise and prepare for shore. By 10 o'clock Labrador is our home and the King Edward off for the second edition of our party.

After landing we started immediately to unload the little French schooner and remove our belongings to the site of the camp, about half a mile distant, and here everyone worked. Our instruments, tents and provisions, etc., weighed about 50 tons, and to get order out of chaos taxed our capacity to the utmost. The afternoon of Aug. 12th was occupied by digging the foundation for the pier of the 5-inch Brashear telescope to rest on, also in making the pillars to hold the instrument. After supper, being very tired and smarting from the effects of mosquitoes and black flies, we turned to our tent about 11 o'clock, and it certainly was a new experience to both of us, as well as to all of our party, and in spite of the mice that scampered over us by the score, and the howl of the great Esquimaux dogs of the Hudson Bay Company, sleep was sweet.

Sunday morning broke fine and we saw a magnificent panorama of the great Labrador hills from the doorway of our tent. Thoughts of home and of friends came to our minds while we admired the scenery around us.

Accompanied by Mr. Jennings, we walked along the bank of North West River till we came in sight of Blake's Camp, at the opening into Grand Lake, and thoughts of poor Hubbard and Wallace's hard experience on this same spot were vividly recalled to our minds. No sign of animal life was apparent around us, and if we had had to subsist on what we could shoot or catch with the line for our daily bread, it became evident that starvation would well nigh have stared us in the face. The banks of the great river were lined with small spruce on both sides, and in attempting to penetrate into the forest primeval we found how difficult it was to wend our way through a pathless wild.

At 10 o'clock a.m. all attended mass conducted by Rev. Father Kavanagh. We gathered into an old church building constructed by a Jesuit father in 1648 when with a party looking for the North West passage. Father Kavanagh was the second Jesuit priest to visit these shores. This church was without windows, door or floor.

In the afternoon at bugle call, Rev. Dr. Marsh conducted divine service in the marquee. All the Protestant members of the party assembled and entered heartily into the service, feeling grateful for the many mercies vouchsafed during our long and perilous journey. Far away from civilization as we were situated, it was with no small pride that our party appreciated the fact that our first public service in the wilderness was conducted by one of our own ministers in the person of Rev. Dr. Marsh, Presbyterian minister of Hamilton, and President of the Hamilton Astronomical Society. The text was Hebrew ix., 28: "So Christ was once offered to bear the sins of many." At the close of the service Dr. Marsh suggested that a contribution be taken up in aid of the Deep-Sea Mission operating on the coast of Labrador by Dr. Grenfell, the well-known head. Dr. King, our chief astronomer, delighted with the suggestion, took the leading part and had a nice little sum to hand Dr. Grenfell when meeting him on our way home.

On Aug. 14 we began again our toil, shoveling sand, gravel and cement, making foundations for the instruments, after which came the adjusting, and arranging for the supreme moment when the sun would be blotted out.

Aug. 15. The whole day was spent in adjusting telescope to the latitude of the camp. In the evening we got an observation of Vega and Epsillon Lyrae.

Aug. 16. Erected a dark room for photographic work.

Aug. 17. Dr. Marsh made his first photograph of the sun. He also photographed the moon, with good results.

Aug. 17 was spent in making solar shutters. In the evening the Hamilton contingent held a long consultation with Mr. and Mrs. Maunder relative to equipment, exposures for the eclipse, and kindred topics.

Aug. 20th was the Lord's day again. We went to mass in the morning, and to service in the afternoon. Dr. Marsh preached a sermon on The Thief on the Cross, Mr. E. W. Maunder reading the lesson.

The night being clear and time for preparation short, all hands went to their instruments as soon as it was dark. Dr. Marsh and the writer photographed star trails from Eta Ursa Major, and also some in Cassiopea.

The next day, Aug. 21st, was given to instrumental adjustment and fitting on Rowland grating to a lens lent by Dr. Gaviller, of Hamilton. At night we succeeded in getting proper focus from star trails from Mizar and Alcor ; we also took two photographs of the moon—one at the prime focus of the 5-inch Brashear, the other with the enlarging lens inserted—exposure 15 seconds. Mr. James Plaskett also photographed the moon with the 45-foot camera.

This evening four natives were shown around the camp, and they expressed much astonishment at the fact that the white man could make stone (the concrete for our piers). This astonished them much more than the instrumental equipment.

On the 22nd a small tug boat "Aid" called at North West River at 10 o'clock and took a party over to Gillisport. Dr. King, Mrs. Codd, Miss King, Dr. Marsh, Mr. Macara, Mr. Near, Dr. Chant and G. Parry Jenkins were invited to luncheon on board the S.S. Brierdeen (Captain Crowe in charge), anchored outside the harbor. Mr. and Mrs. Maunder, Father Kavanagh, with Messrs. Upton, Jennings, Collins and Russell, were invited to luncheon with Captain Girvan aboard the steamship Londonderry, of 2,800 tons burden, loaded with lumber valued at $35,000, just ready to sail for Manchester, England. After luncheon we all went ashore and were shown over the Grand River Pulp and Lumber Company's possessions, the only lumber company operating in Labrador. Here we saw a horse, which is the only place on the coast where such an animal is to be found. Mr. Gillis told us that this company was the first to import a horse to the country, and that three years ago, when the natives first saw it, they ran away, thinking it was a wild animal. On reaching our camp at night we found that during our absence a terrible storm had swept our canvas village and only for Prof. DeLury's careful attention our loss might have been heavy. As it was, Mr. Maunder's largest tent, including his equatorial telescope, was blown over, and his dark room demolished.

Aug. 23rd Mr. Cotter harnessed his Esquimaux dogs and drew lumber for our camp, afterward hitching them to his komatic and gave exhibitions of their power and skill. These dog teams travel great distances and draw heavy loads. In driving the team the words generally used are: Ouk—to the right, Rara—to the left, Wit—go ahead, Ah--stop. Most of this day, however, was spent in timing the driving clock; fitting on Dr. Chant's photo polariscope, and attaching the camera to the 3-inch Dollond telescope. For the last four nights most glorious auroral displays were seen, but to-night clouds intervened. But before we close the day just a word about the sunsets. What artist could paint such a sight as this evening presented? The mountain ranges were lit up with the most brilliant lines in red and violet, whilst others were a deep blue. Then it all blended into solemn solitude as night threw her sable garments around.

On Aug. the 24th we were awakened by the sighing of the forest trees and the moaning of the sea, each increasing in violence as the day proceeded. Our work to-day consisted in mixing cement for the pier to carry the lens lent Dr. Marsh by the Chas. Potter Co. of 85 Yonge Street, Toronto, Dr. King providing the equatorial head to mount it on. Also the 3-inch telescope camera was finished, and the sun was photographed with it.

Aug. 25th was a miserable day, wet and cold. No work was done during the morning. We had a fire built on the floor of the old church and our party lay on the sand with feet toward the fire. This humble position was preferable, for the old belfry proved a poor smokestack. Dr. Marsh and the writer, after being smoked out, paid a visit to Mr. Cotter, the Hudson Bay factor. He told us many things of interest about himself, Lord Strathcona, and Labrador. Mr. Cotter was educated in old Upper Canada College, Toronto, and has been factor for seven years in North West River. He told us that Lord Strathcona was stationed in North West River for about thirteen years, in the fifties. We met with old Joe Goudy and his wife, who told us of their wedding day over 50 years ago. The ceremony was performed by Lord Strathcona. North West River is loyal, but isolated. Although Queen Victoria died on Jan. 22, 1901, Mr. Cotter, as a loyal subject, hoisted the flag in front of the Hudson Bay Post in honor of her birthday on May 24, and did not hear of her death till July of that year, when a fishing vessel from Newfoundland brought the news.

Aug. 26th we finished fitting up the Thorps grating camera, and photographed the sun with it. Also took a photograph of the sun with the 3-inch Dollond refractor. Both images were very neat and satisfactory. We also photographed the sun with the Potter lens. Then made some star trails with excellent results.

Aug. 27 was a beautiful Sunday. Dr. Marsh conducted divine service at 3 p.m. Mr. E. W. Maunder preached a very excellent sermon on the book of Job. The principal point brought out was: Man should serve God at any cost. The night was very cold. The mercury came down almost to freezing point.

The 28th of August was taken up in the forenoon by regulating the driving clocks, photographing the sun with all the instruments, proving the shutters and drilling. In the afternoon Dr. Marsh repaired the driving clock for the Matthew equatorial telescope belonging to the Greenwich Observatory equipment. During the afternoon we welcomed the return of the King Edward with the second edition of our party, consisting of Mr. Joseph Pope, C.M.G., Under Secretary of State; M. Aldous, Winnipeg; Father Choquette, St. Hyacinthe; Rev. A. Lajunesse, Ottawa; J. E. Maybee, Toronto; D. J. Howell, Toronto; A. S. Johnson, B.A., Ph.D., Chicago, editor of *Technical World*, and Father Seymour. Mr. James Plaskett photographed the sun with the 45-foot camera, but the sky was not conducive to perfect results. At night the sky clouded, but clear in the north, when a fine aurora was visible.

Aug. 29. Rained all day and weather very cold. We lit a fire in the old church again and warmed ourselves by its welcome glow. Night after night we had sat around the open camp fire, sang songs and cracked jokes, but to-night no fire, no jokes. We retired with deep forebodings as to the weather on the morrow, as the sky was densely overcast and the prospect of seeing the eclipse was very poor.

Aug. 30. The Eclipse Day. Dr. Marsh was the first in camp to turn out. At 1.30 and 3.30 a.m. he turned out to look at the sky, but came back to the tent each time with gloomy news. We both got out of bed at 5 o'clock, and had all our instruments in perfect working order, hoping to the last moment that the clouds might break. All the photographic astronomers filled their plateholders and took their places beside their instruments, whilst Dr. King went to each man ready to convey the least sign of hope.

When the time for the first contact had arrived we had not yet seen the sun, nor could we have said from appearances what part of the sky it was situated in. But as we had observed how very variable the weather had been during our stay in Labrador we still had a hope that the clouds would break and that we would yet see the totality.

When about two minutes before the computed time for totality a very perceptible change in the light was noticed. It appeared to gradually but swiftly diminish until as if with a few jerks totality was upon us, and the camp was covered in a strange, mysterious gloom, very much darker than any thunderstorm we had ever seen. I took out my watch and could just see the hour hand, but could not see the minute hand. We realized that we were indeed in the shadow of the eclipse. The spectacle around us was a most weird one. Everything was as silent as the grave, the only exception being the solitary chirp of a bird in the woods near by. We exposed plates to the landscape, but got a mere outline of the surroundings.

The time of third contact arrived without even a glimpse of the sun being seen by any of us, and we now realized that our hopes of witnessing a total solar eclipse in Labrador had vanished. Towards the end of the eclipse, however, the sun struggled faintly through the clouds and we could make out the last stages of the moon's shadow. Dr. Marsh, Dr. Johnson, and Mr. Jenkins exposed a few plates, hoping to catch a trace of the eclipse, but the light was not sufficient to leave any image of the phenomenon.

The fourth contact now arrived and the clouds again obliterated the sun from our view. Thus ended our laborious preparations in utter failure—that is, from a photographic standpoint. However, important magnetic observations were made and a base of survey to that great lone land established.

The Dominion Government Observatory sent an excellent outfit, creditable to our country, and ably manned by Mr. James

Plaskett, B.A. It consisted of a 20-inch coelostat (made by Prof. John A. Brashear, of Allegheny) feeding (1) a 5-inch Grubb telescope, 45 feet focus, producing a solar image five inches in diameter; (2) a 4-inch Grubb, 10 feet focus, giving an image of the sun 1⅛ inches in diameter; (3) a Cooke photovisual, 4½ inch aperture, 8 foot focus, giving a solar image ¾ inch; (4) prismatic cameras.

The Greenwich outfit consisted (1) of one-half of one photoheliograph used in the transit of Venus expedition, 1874, aperture 4 inches, focus 5 feet, used with one enlarging lens so as to give an equivalent focus of 22 feet, and resulting in an image of 2.4 inches diameter. This was mounted on an equatorial stand, clock driven. This instrument was operated by Mr. Maunder. (2) Abney lens; R. R. 4 inches, aperture 34-inch focus mounted on equatorial, clock driven, belonging to Mr. F. Jennings—Mr. Jennings in charge. (3) Cooke photovisual, 3⅛-inch aperture, 4-foot focus. This was equatorially mounted, clock driven, and was operated by Mr. Chas. Upton, of England. (4) Dallmeyer lens, 1½ inches in diameter, used by Mrs. Maunder in India in 1898, mounted on small equatorial, clock driven, known as the pocket equatorial. It was with this instrument that Mrs. Maunder succeeded in photographing the longest coronal streamer ever known, during the Indian eclipse of 1898. (5) Goerz lens, 2½-inch aperture, 2-foot focus, mounted as a fixed camera. Prof. Turner had an identical instrument lent by Mr. Goerz with which to photograph the eclipse in Egypt at the other end of totality.

The Hamilton contingent had the following equipment, a cut of which accompanies this article:

1. A 5-inch Brashear, 75-inch focus, equatorially mounted, clock driven. This instrument gave an image of the sun ¾ inch in diameter at prime focus, but by the introduction of a negative enlarging lens, which could be introduced or removed in five seconds, the solar image was increased to three inches. With this it was intended to photograph the partial phases of the eclipse, especially at the moment when the lunar limb came in contact with sun spots, in order to contrast the darkness of the sun spots with

the lunar shadow. At the time of totality to remove the enlarger and photograph the outer and inner corona with the hydrogen flames. Operated by Dr. Marsh.

2. A 3-inch Dollond telescope, 45-inch focus, with camera attached, for photographing the phases. Also the coronal streamers. Operated by Mr. Jenkins.

3. A prismatic camera attached to the driving clock of the 5-inch Brashear. The lens was loaned by Dr. Gaviller, of Hamilton; the grating by Father Kavanagh. The arrangement was to photo on a 5x8 plate at totality the eclipse in entirety, the streamers, flash spectrum, and the first and second order of spectra. Operated by Mr. Jenkins.

4. The Potter lens, 2½-inch aperture, 2-foot focus. Equatorially mounted, the equatorial head loaned by Dr. King, fitted with negative enlarging lens. Dr. Johnson, editor of the *Technical World*, of Chicago, operated this instrument.

5. A compass transit carefully adjusted, operated by Dr. Marsh. Gave magnetic deviation of 36.52 N.W. and a fluctuation of the magnetic needle, during totality, of some six or eight minutes. It was too dark to read the verniers.

We must not forget to say that the little metronome lent us by Miss Jessie Williams, of Hamilton, was set in a prominent place, and beat the seconds, not only for the Hamilton contingent, but for the 45-foot camera, and Mr. J. R. Collins, of Toronto.

In addition to the instruments above named others were installed. Mr. J. R. Collins, of Toronto, secretary of the Royal Society of Canada, had a 10-inch reflector, constructed after his own device, with which he expected to make a continuous photographic record of the eclipse.

Prof. Chant, of Toronto University, had a polariscope for visual purposes and a photopolariscope mounted on Dr. Marsh's 5-inch equatorial.

Rev. Father Kavanagh had a very ingenious device attached to a 3½-inch telescope, by which he was to draw the corona.

Prof. DeLury had an elaborately equipped electroscope.

Whilst Dr. King was in charge of the entire expedition and had an eye upon all, nevertheless he had a 4-inch Cooke telescope for visual work, and was to note the time of the various contacts. Mr. Pope was to give time signals. Mr. Plaskett required the assistance of Messrs. Near, Howell, Maybee and several others.

But the clouds came between whilst God passed by. It was all over. Dr. King stood the shock of disappointment manfully. No murmur came from his lips. He said: "You have all been faithful. We have done our best."

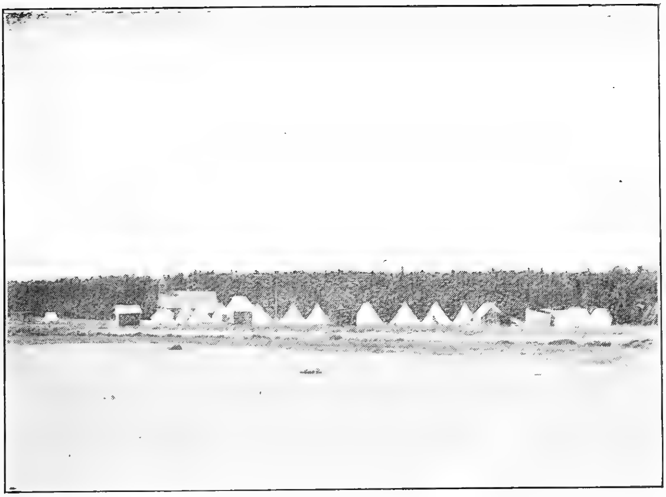
It was not long till the instruments, which had taken us weeks to install, were in the hold of the King Edward again and we were off for home. Captain Crowe, of the S.S. Brierdeen, and Mr. Buchan, chief engineer, took Dr. Marsh, Mr. Howell, Mr. Maybee, and Mr. Jenkins for a spin in a little steam launch. We passed out of North West River into the waters of Grand Lake, going sufficiently far enough to see the bold point of Cape Corbeau.

Aug. 31—our last night on shore—will not soon be forgotten. The kindness of Mr. Cotter will never be forgotten. Mr. and Mrs. Maunder occupied the only bed in the post. Bear skins without number were spread on the floor, and on these six of us slept—Dr. Marsh against the wall, Mr. Jenkins next to him, Prof. Stewart, Rev. Father Kavanagh, Dr. Chant and Prof. DeLury. A number of others fared the same way in other rooms. Mr. Collins, the speechifier-punster and singer—the man who dug a hole in the sea to bathe in—slept with Mr. Maybee in the old church. (Some people sleep better in church than elsewhere.) Mr. Plaskett and Mr. Near slept in one of the dark rooms and drew one of the curtains of night over them. But even with that they were uncomfortable and developed a cold, but not taking a hypo bath to fix it, it vanished.

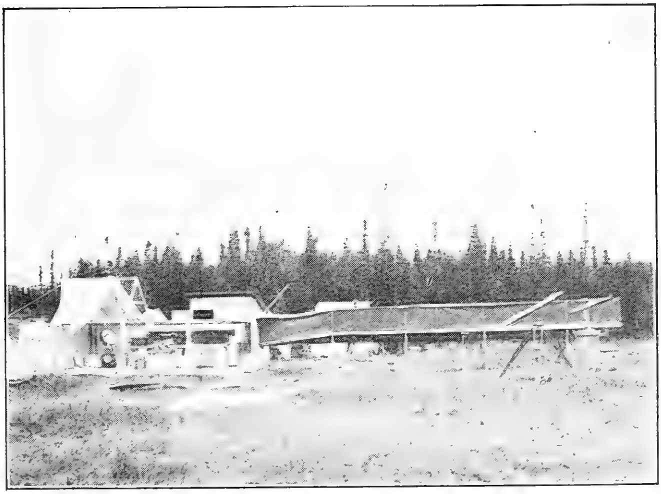
On Sept. 1st we arrived at Rigoulette and met Dr. Grenfell, who is doing a noble work for a thousand miles along the Labrador coast. Here Dr. King handed over to Dr. Grenfell the cash collected at our Sunday services, and Mr. Jenkins discovered that he and the doctor were from the same part in Wales and knew the same people.

In the evening Dr. Grenfell boarded the King Edward and Dr. Marsh asked him to allow us to make him an honorary member of the Hamilton Scientific Association, to which he assented. In like manner Dr. King, Mr. and Mrs. Maunder were also invited to honor our Association.

We left Rigoulette on Saturday, Sept. 2nd, at 3 a.m. At 3 o'clock on Sunday afternoon Dr. King conducted the service. Dr. Marsh preached a sermon on "The Sun," making special reference to the sun eclipsed, its awful grandeur, and the awful grandeur of that eclipse when the "Sun" ("Son") of God went out upon the Cross—when He said, "It is finished." The glory of God in man's Saviour was manifest. We arrived at Quebec Sept. 7th and in Hamilton Sept. 8th, having traveled close on 4,000 miles in pursuit of a shadow.



THE CAMP AT NORTH WEST RIVER.



DOMINION OBSERVATORY OUTFIT.
INSTALLED BY J. S. PLASKETT, B.A.

THE OUTFIT OF THE HAMILTON CONTINGENT.

INSTALLED BY REV. DR. D. B. MARSH, PRESIDENT OF THE ASTRONOMICAL SOCIETY OF HAMILTON, ONTARIO. DR. MARSH IS IN THE CENTRE OF THE PICTURE; ALFRED S. JOHNSON, OF CHICAGO, ON THE LEFT; AND G. P. JENKINS, F. R. A. S., OF HAMILTON, ON THE RIGHT.

Archæology and The Origin of the Hebrew People

Rev. Logie Macdonnell, B.A.

MARCH 8, 1906.

No matter what subject a man takes up it seems to require an infinite amount of reading and study before he is able to give any judgment or information about it that is vital and definite, so that one hesitates to say there are special difficulties connected with archæology. And yet it does seem to present some difficulties that are not met elsewhere. The archæologist must have a gift for scientific research, and also for literary interpretation. He must be able to formulate some theory as to the history of the country whose archæology he is studying in spite of the fact that specialists differ on almost every conceivable point. Add to this the fact that archæology as we now understand it is hardly a century old, so that the great majority of the facts with which the archæologist deals are new, and you have some conception of the difficulties under which the men work who are are trying to re-write the history of times which until recently were regarded as prehistoric. The evidence has only just come in—it has not yet been properly sifted, and more evidence is still coming in in such quantities that it baffles the ingenuity of translators and publishers to convey it to the public in an intelligible form. The great bulk of the information that we now have from the Babylonian and Egyptian monuments has come to us within the last fifty years. Many of the most valuable and startling discoveries have been made within the last fifteen years. So much is this the case that when one reads a book published say three years ago he is inclined to wonder if new discoveries have not been made since the book was published showing that its theories were founded on insufficient evidence and putting us to ignorance again. For example, it was a great point with many archæologists at one time that no tomb was to be found in Egypt of the Pharaoh who was supposed to have pursued the Israelites and perished in the Red Sea. One man who wrote a book in 1899 and referred to this fact learned just in time to add a foot-note before his book went to the press that the tomb of this Pharaoh had been discovered. When one considers how difficult the simplest case in a law court is, no matter how copious the evidence, it is little wonder that definite decisions are hard to reach when dealing with a mass of evidence that has only come before the jury of competent criticism yesterday.

If one could confine his reading to some one of the specialists on archæology the matter would be simplified. Prof. Sayce, for instance, never seems to find difficulties. Every new discovery seems to be just what he was looking for and to prove the accuracy of the Old Testament narratives. But one is apt to have an uncomfortable feeling when one finishes a book of Sayce's that difficult problems have been disposed of a little too easily. At the same time it may be confidently asserted that archæological research has tended in a marked way to confirm the historical character of the early narratives of the Bible.

What we are particularly interested in just now is the archæology that will throw light on the origin of the Hebrew people. Now this can be secured for the most part only in an indirect way for this reason: Hardly any discoveries have been made in Palestine of writings that belong to the early time with which we are dealing. The early inhabitants of Canaan did not leave written memorials in stone—at least none have yet been discovered—and this is a fact to be kept in mind when weighing the arguments of archæologists who infer that the Israelites were a race of scribes possessing all the culture of Babylonia and Egypt. Explorations have been made, and are being made, in Palestine, but the results have affected New Testament rather than Old Testament study. It is to Babylonia and Egypt that we must look for any light that is available in reference to so early a period as that of Abraham.

A great many expeditions have been made to Babylonia, but a brief account of the results reached by the expedition sent out in 1888 from the University of Pennsylvania will illustrate the kind of information that is now available from many different sources. The expedition was made under the charge of Professors Hilprecht and Peters and was thoroughly equipped in every way. The ancient city of Nippur was the scene of its operations, near which the soil is cut up by hundreds of old Babylonian canals. About two thousand cuneiform documents were secured within a very few months, but after two or three seasons' continuous work the number of cuneiform tablets in the possession of the excavators numbered something like 32,000. Besides these there were found inscribed bricks, vases, door sockets, drain tiles, domestic utensils in stone and metal, jewellery in gold, silver, copper and bronze, in fact a great variety of things which shed light on the civilization of the age to which they belonged. The cuneiform tablets referred to contain letters, chronological tests, historical fragments, inventories, contracts, accounts of law suits, astronomical and religious texts. The interesting thing to notice is the date to which these things belong. As the excavations proceeded the Temple of Ekur rose out of the mass of rubbish, and soon the platform of the first king of Ur was reached. This platform was built about 2800 B. C. More wonderful still, numerous bricks were discovered bearing the name of Sargon I., 3800 B. C. This Sargon was for a long time supposed to be a purely mythical character, a creation of the time of the Sargon whom we meet in the Old Testament. There is not merely a solitary fragment or two, but a vast accumulation of evidence from the cuneiform tablets to prove that this supposedly mythical creation was a king of real flesh and blood who ruled over a vast empire thirty-eight centuries B. C. From two inscriptions found at Nippur it is clear that his son, Naram-Sin, conquered North and South Babylonia, a large part of Arabia, and the whole west country even as far as Cyprus. Hilprecht has undertaken the publication of documents found at Nippur and the complete series will number about sixty large volumes. He claims that the documents from Nippur are the oldest that have yet been brought to light, and in the Sumerian legend of creation Nippur is spoken of as the oldest city in the world. It is interesting to note that in the ruins of Nippur inscriptions have been found not only of Sargon I. and his successors, but of the dynasty of Ur of the Chaldees. This would go to show that Nippur was subject first to North Babylonia, then to South Babylonia. It was coveted as a possession by the ruling dynasty because of its religious renown and the dwelling place of the great god Bel.

The first result, then, of even a superficial study of the Babylonian monuments is the knowledge that at that period which was long supposed to be the dawn of history a civilization existed in Babylon which indicates clearly that milleniums of development lay behind it. Seventeen centuries before Abraham left Ur of the Chaldees there were scattered over Babylonia not only populous cities, with all their complex human interests, but libraries, canals, works of art and literature of a kind to stagger one in trying to estimate what length of time must have preceded. Hilprecht's words in reference to a monument erected by Naram-Sin, the son and successor of Sargon I., about 3750 B. C. are worth quoting: "Although the monument is broken and the preserved fragment defaced, yet it shows that the artisans of that very ancient time were skilful in using hammer and chisel on the hardest materials. We are faced with the strange but undeniable fact, which we also find in studying the oldest stone vases and seal cylinders that Babylonian art, 4000 B. C., shows a knowledge of human forms, an observation of the laws of art, and a neatness and fineness of execution far beyond the products of later times. The flower of Babylonian art, indeed, is found at the beginning of Babylonian history. In the succeeding milleniums we find here and there a renaissance, but on the whole the art of this entire period disports itself in the grotesque and exaggerated; it is only the degenerated epigone of a brilliant but bygone time." In this connection it may be noted that Sayce and others claim that there was a wealth of literary culture in the islands and coastlands of the Eastern Mediterranean centuries before Homer told of its departed glories, and that the art of classical Greece in the fifth century B. C. was as much a renaissance as the European renaissance of the fifteenth century.

The question that faces us now is: What is likely to have been the influence of this highly advanced civilization of Babylonia on the races inhabiting Canaan? Perhaps the best way to deal with this question is to consider some of the events that took place in the reign of Khammurabi, king of Babylon, a name that has become familiar to all Old Testament students. Khammurabi seems to have been the first king who made Babylon the chief city of Babylonia. His became the ruling dynasty of the country. He threw off the yoke of the non-Semitic Elamites and from this time forward the central authority for the whole country was settled, not at Accad in the north, nor at Ur in the south, nor at any of the cities which dominated temporarily, but at Babylon. Khammurabi was not only a great leader in war. He was also a great ruler in time of peace. He promoted commerce, manufacturers, literature and religion. Temples, palaces, canals were all built on an extensive scale during his fifty-five years of rule. The dynasty to which Khammurabi belonged had eleven kings in all. Khammurabi himself was the sixth and his son, Samsu-iluna, the seventh king of this dynasty. Professor Fritz Hommel of Munich has an ingenious and most interesting theory with regard to this dynasty, namely, that the etymology of their names proves that they were not of Babylonian stock but of Arabian. The following is a sample of the kind of proof he gives. "The seventh name is 'Samsu-ilu-na'; namely, 'Samas' is our deity. In Babylonian this name would be 'Samsu-ilu-ni'; in Canaanite it would be 'Samsu-ilenu'. Only the Arabs would say 'Iluna' for 'our god.'" Hommel has a mass of proof of this kind which only an expert in oriental languages would be in a position to test. Hilprecht maintains that Hommel has "convincingly proved" his point. If this is granted, Hommel's deductions are worth noting. "This completes the chain of evidence which goes to prove that every one of the eleven kings of the Khammurabi dynasty was from first to last of Arabian origin." Also, "we are warranted in assuming that what has been said about South Arabian names applies with equal force to the Arabian names of the Khammurabi epoch: these names indicate that their owners possessed a far purer religion, in short, of an essentially monotheistic character. It was from out of such surroundings as these that Abraham, the friend of God, had gone forth. By his migration from Chaldæa Abraham's higher and purer creed was preserved from absorption into the Babylonian polytheism, a fate which must otherwise have inevitably befallen it." Hommel and Sayce are both considered unreliable by many Old Testament students, but at the same time there is this to be said in favor of Hommel's theory: it is generally conceded by those who have studied Semitic problems that Arabia was the original home of the Semites. Robertson Smith concurs in this view.

To return to Khammurabi. One of the interesting things about him is that he has been identified by some archæologists with one of the kings mentioned in the 14th chapter of Genesis, and a statement of some of the different views held in regard to this chapter in Genesis will show something of the influence which Babylonian civilization and conquest exercised in the land of Canaan.

In 1869 Theodore Noldeke attempted to prove the fourteenth chapter of Genesis the biassed invention of a later age. Then when archæology had proved that the titles used were genuine Babylonian and Elamitic names, other ground had to be taken. Meyer, in his *History of Antiquity* 1884, says, "The Jew who inserted the account (Gen. xiv.), one of the latest portions of the whole Pentateuch in its present position, must have obtained in Babylon exact information as to the early history of the country and for some reason, which we are unable to fathom, mixes up Abraham with the history of Kudur-Lagamar; in other respects his version of the story accords perfectly well with the absolutely unhistorical views held by the Jews in regard to primitive ages." Wellhausen in 1889 declared that Noldeke's criticism remained unshaken, adding, "that four kings from the Persian Gulf should in the time of Abraham have made an incursion into the Sinaitic Peninsula, etc. All these incidents are sheer impossibilities which gain nothing in credibility from the fact that they are placed in a world which had passed away." Now it may be confidently asserted that recent archæological research has proved that these critics spoke rather too hastily and that whether Gen. xiv. is absolutely historical or not, Wellhausen was certainly quite mistaken in thinking that the events there recorded were impossible in that age.

We shall next take Sayce's view of the matter. It is interesting and it will show that even the methods of archæologists are not above reproach. Sayce says: "There is only one way in which our studies are likely to end in true results, and that is by excluding from them as far as possible, what the Germans would call the 'subjective element.' What we want are not theories but facts. 'Literary tact' is but another name for a purely subjective impression. Literary evidence may be explained away—the evidence of potsherds and forms of art constitutes a solid foundation of fact upon which to build. Where art or archæology informs us which is the earlier and which the later link, it is not difficult to bind them into a single chain. In dealing with the history of the past we are thus confronted with two utterly opposed methods—one objective, the other subjective; one resting on a basis of verifiable facts, the other on the unsupported and unsupportable assumptions of the modern scholar. The one is the method of archæology, the other of the so called "higher criticism." "It is not archæology and not philology that has to do with history. The more archæological and the less philological our evidence is, the greater will be its claim to scientific authority." In view of this scathing denunciation of philology and literary tact notice Sayce's proof that Khammurabi is the Amraphel of Genesis xiv. Between Khammurabi and Amraphel the difference is considerable. The kings of the dynasty of Khammurabi were of Canaanitish and South Semitic origin, like Abram the Hebrew, and their ancestral deity was Samu or Shem. Though the language spoken by them was Semitic, it differed from the language of the Semitic Babylonians who found some of the sounds which characterized it difficult to pronounce. The first element in the name of Khammurabi is the name of a god which enters also into the composition of Hebrew names, Amminadab, Jeroboam. More usually this was spelt "Khammu" by the Babylonians, but we often find the spelling

"Ammu" or "Ammi" as well. In Babylonian "ilu" is "god," the Hebrew "el" and "Ammu-rapi-ilu" would be "Khammurabi, the god" (he did claim divine honors). "Ammu-rapi-ilu is letter for letter the Amraphel of Genesis." Sayce proves the identification of Chedorlaomer and Arioch with names found in the cuneiform tablets in exactly the same way. His proof is interesting and may be correct, but it comes rather strangely from one who a few minutes ago told us that "the more archæological and the less philological our evidence is the greater will be its claim to scientific authority." In fact, one of the great difficulties in estimating the value of archæological evidence is, that so much proof rests on the identification of proper names and in many cases expert linguists are not agreed that such identification exists. Prof. McCurdy, for instance, considers it much more likely that Amraphel is to be identified with Sinmuballit, Khammurabi's father, and gives a philological proof of the same kind and quite as good as Sayce's.

Let us next consider Hommel's view. He is quite as anxious as Sayce to prove the historical accuracy of the Genesis narrative, but strangely enough he proves conclusively to his own satisfaction and that, too, in opposition to McCurdy, Sayce and Hilprecht, that Abraham and Khammurabi were contemporaries, not in the twenty-third century, B. C., but in the twentieth. He does this by an appeal both to Babylonian and Biblical chronology. Hommel considers the date an important point in his argument, and he not only disagrees with Winckler, Hilprecht and Delitzsch, all of whom are practically agreed that Abraham and Khammurabi lived about 2250 B. C., but he believes that the later Babylonian historians made a mistake of three centuries. If archæology gives such self-evident proof as is claimed, it is disconcerting to have archæologists differing among themselves on so radical a point. At one time Hommel had agreed with the other critics as to the date. I give the conclusion to Hommel's proof in his own words: "If we admit that Khammurabi reigned not from 1947 to 1892, but from 2314 to 2258, then the period between Abraham and Moses would be not 650, but 1000 years, and between Abraham and Joseph not 200, but 550 years: we should in that case be obliged to assume one of three things. Either that a later generation, looking back on the vistas of the past, was deceived by some optical illusion which which makes two hill-tops that are really separated by spacious valleys seem to stand quite close to one another ; or else that there may possibly have been two patriarchs named Jacob who lived at periods centuries apart from one another, one of them the grandson of Abraham, the other the father of Joseph, and that a later tradition merged these two individuals into one ; or lastly, that Abraham did indeed flourish about the year 1900 B. C., but that his association with Khammurabi is apocryphal. I need hardly say that the acceptance of any one of these hypotheses would be merely bringing grist to the mill of the modern critics of the Pentateuch." Notwithstanding his aversion to the higher critics Hommel finds it necessary to alter the account of Melchizedek as we have it in Gen. xiv. and to suppose the importation of a Babylonian document ; so that even the straight path of the archæologist is beset with difficulties.

Prof. Paton of Hartford Theological Seminary also regards the chapter as a genuine piece of history. Like Hommel he has a difficulty with the dates, but he proposes a different solution. His words are as follows : "It is now generally admitted that Amraphel is the same as Khammurabi, the sixth king of the first dynasty of Babylon. Arioch is probably the same as Eri-aku of the monuments. Whether the other kings are mentioned in the Babylonian records is much disputed. Pinches identifies all the names with names on the monuments, as also does Sayce, but all these readings have been called in question." Paton deals with the chronological difficulty as follows : "We know from recent archæological discoveries that the Aramæan migration did not occur as early as 2230 B. C., the date to whch Abram must be assigned by his synchronism with Khammurabi. With our present knowledge of the ancient orient it must be pronounced incredible that an ancestor of Aramæan Israel should have lived in Canaan as early as the time of Khammurabi. Does not this prove, then, that the narrative of Abram's conflict with Chedorlaomer in Gen. xiv. is unhistorical ? No, unless it can be established that the traditional identification of Abram with Abraham is correct. This identification has nothing in its favor. These two names must have belonged originally to distinct personages. Abraham was the collective name of a group of Aramæan peoples, including not only the Hebraic clans but also the Ishmaelites and a number of other desert tribes. Abram (eight centuries earlier) was a local hero of the region of Hebron."

This statement of different views will be sufficient to show the nature of the evidence that archæology affords for the value of the Book of Genesis as history. It is not as irrefutable as Sayce would have us believe. It does, however, tend to confirm the historical character of the book.

I shall complete my sketch of Babylonian archæology by a short reference description of Ur of the Chaldees, the early home of Abraham. Babylon is the most important city historically of Babylonia, but there was a time when the city of Ur far outshone it in splendor. It was a famous centre of commerce, religious worship and political power two thousand years before the time of Abraham, many centuries before it could have been called Ur of the Chaldees. Temples were numerous and splendid, polytheism was rampant. The political sway extended over a vast area. Ships carried merchandise to all parts of the world. The idea that the home of Abraham was a land of barbarism is about as far from the truth as it could be. So much for Babylonia.

Egypt. Very little need be said of archæological discoveries in Egypt. It is confidently hoped by archæologists that documents will be brought to light in Egypt which will give direct information about the sojourn of Israel in Egypt, the Exodus and perhaps even on the patriarchs. But so far the discoveries in Egypt have been chiefly valuable because they show that the historical setting of Genesis is true to fact. Any inferences that can be made from reading Genesis as to Egyptian customs, social ideas, government and court life are found on comparison with the documents unearthed by archæologists to be quite correct. For instance, in the course of excavations at Pithom a building in the form of a parallelogram was discovered which had been built of bricks made out of Nile mud. Upon the bricks were found the stamp of Rameses II., generally supposed to be the Pharaoh of the oppression. The following is part of the description given by Miss A. B. Edwards: "It is a very curious and interesting fact that the Pithom bricks are of three qualities. In the lower courses of these massive cellar walls they are mixed with chopped straw; higher up, where the straw may be supposed to have run short, the clay is found to be mixed with reeds—the same kind of reeds which grow to this day in the bed of the old Pharaonic canal and which are translated stubble in the Bible. Finally, when the last reeds were used up the bricks of the uppermost courses consist of mere Nile mud, with no binding substance whatever. So here we have the whole pathetic Bible narrative surviving in solid evidence to the present time. We see the good bricks for which the straw was provided. Some few feet higher we see those for which the wretched Hebrews had to seek reeds or stubble. We hear them cry aloud, 'Can we make bricks without straw?' Lastly we see the bricks which they had to make and did make without straw, while their hands were bleeding and their hearts were breaking."

If anything, Egyptian civilization is older than Babylonian. Sayce makes 5000 B. C. the latest possible date for Menes, the first king of United Egypt. Moreover the civilization seems to have been perfect even at this remote time. There was not only comfort, but luxury. According to Prof. Flinders Petrie some of the blocks used in the construction of the pyramids were cut by means of tubular drills fitted, if not with diamond points, at all events with a similar material.

Only one direct mention of Israel has been discovered. The discovery was made by Prof. Flinders Petrie in 18,6. It belongs to the reign of Merenptah, son of Rameses II. It reads as follows:

"Wasted is Libya. Hittiteland is brought to rest. Canaan is captured with all his tribes. Led forth is Askelon. Gezer taken. Jenoam is brought to naught. Israel is laid waste and his seed destroyed. Everyone that prowled around has been chastized by King Merenptah, who is gifted with life like the sun every day."

A variety of deductions have been made from this inscription. Prof. Orr of Edinburgh thinks that Israel must have already been settled in Canaan, but it is difficult to see how this could have taken place so early. Hommel thinks that Asher and one or two other tribes had preceded the main body. Sayce as usual is quite certain of his own interpretation. He concludes from the fact that there is no geographical reference in the mention of Israel that the tribes had been lost in the desert.

A few words must be said about the Tel-el-Amarna tablets. The expulsion of the Hyksos kings from Egypt in the sixteenth century B. C. was followed by the conquest of Asia Minor, and this in its turn brought Asiatic influences into Egypt. Finally the throne was occupied by a Pharaoh whose mother and grandmother had alike been Asiatics. More than that, he had been brought up in the Asiatic faith. This king is known as Amenophis IV. He was much under the influence of his mother and soon declared himself a convert to her religion and established the worship of the solar disk. This naturally meant trouble with the priests of Thebes, and the result was the removal from Thebes to Tel-el-Amarna of the court and all the royal archives. Some of these royal archives form part of the collection of cuneiform tablets discovered at Tel-el-Amarna in 1888. The strange thing is that the writing is in the cuneiform character of Babylonia, not in Egyptian hieroglyphics. Babylonian was evidently the language of diplomacy and correspondence that was extensively carried on between the courts of Egypt and Babylon. From the banks of the Euphrates to those of the Nile letters were constantly passing to and fro, sometimes on matters of little importance. Canaan was therefore the centre of a stream of literary activity. Not only professional scribes but military commanders are shown to have possessed a ready knowledge of writing. Perhaps Sayce goes too far when he says that it would have been a miracle if Israel had not been a race of scribes, but at any rate these critics have certainly gone too far who have asserted that writing was not generally known in the time of Moses.

In connection with the Tel-el-Amarna tablets it ought to be mentioned that a remarkable discovery was made in 1892 at Tel-el-Hesy, the site of the ancient Lachish in Canaan. A document was found there of precisely the same character as the Tel-el-Amarna tablets. The remarkable thing was that the name of Zimrida, the Prince of Lachish, was written on it, and this name was already known from the tablets dug out of Tel-el-Amarna itself. Sayce's words are interesting :

"The discovery of this document is one of the most remarkable ever made in archæological research. Cuneiform tablets are found in the mounds of an ancient city in Egypt which prove to be letters from the governors of Palestine in the fifteenth century before our era, and among them is a letter of the governor of Lachish. Hardly have the letters been published and examined before the excavations of a distant mound in Palestine which the archæological insight of Dr. Petrie had identified with the site of Lachish bring to light a cuneiform tablet of the same age and nature on which the name of the same governor is mentioned more than once. It is a veritable archæological romance."

As to archæology in Palestine itself, although a great deal of research has been made, the results have affected New Testament study rather than Old. Though archæologists are quite hopeful that before long their efforts will be rewarded, at the present time it is acknowledged no names of any very great antiquity have yet been discovered. The one tablet referred to above written in cuneiform characters is the only Palestinian document yet discovered that bears on our present subject, but it is to be observed that even before the discovery of this document at Tel-el-Hesy, Sayce and others had been of opinion that in the mounds of Palestine archive chambers might one day be discovered yielding information that would throw Tel-el-Amarna into the shade. A few words from Dr. F. J. Bliss, who discovered the cuneiform tablet at Tel-el-Hesy, shows the situation in Palestine : "In the various towns disentangled from the apparently formless mass of rubbish I found store-houses, ovens, wine-presses, a public hall, private dwellings, a smelting furnace and mighty fortifications. The library, alas! I did not find, though how I came across one booklet from it in the form of a precious tablet in cuneiform has already been described. By chance the objects left in Tel-el-Hesy were few; by another chance the objects left in other Tells may be many. Nay, in the two-thirds of Tel-el-Hesy left standing there may be the rest of the library of which we found one small example. Scores of Tells wait the excavator, many of them three times the size of Tel-el-Hesy. I paced with impatience the summits of these Tells and thought of the secrets their hearts must contain. What lay beneath my feet? Any relics of the great world-battles fought at this spot? Any signs of the various civilizations that met at this point—Hebrew, Egyptian, Babylonian, Syrian? The spade alone can give us the answer, and I believe it will be an *emphatic affirmative.*"

The Progress of Photography

Abstract of Paper Compiled and Read By Jas. Gadsby, President of the Camera Section.

MARCH 22, 1906.

In reviewing the progress of photography before the officers of this Scientific Association and the friends assembled, I would perhaps be only following precedents applicable to its tenets were I to wade back thousands of years in an endeavor to show, either directly or indirectly, that photography in some form or other was known to the peoples of prehistoric ages. But this would not serve the purposes of this worthy Association or our kind friends assembled, who in concert with the tendencies of the times demand that themes and theories relative to the sciences, to art, and to literature, when expounded, should be brief, practical and explicit. When the subject of this paper was suggested at a meeting of the Association Executive, it did appear that it could be attempted without fear of trespassing upon the first essential, brevity ; but ere I had gone far with the subject I saw at once that to cite within these limits the whole story of the evolution of photography and the incidents relative to the great mass of concurrent theories advanced and developed whereby it has come to be universally conceded to rank foremost in those of the practical sciences from which the great masses of civilized people benefit, would tax the time and ability of one more adapted to the task than an humble bookbinder.

The qualities of mirrors have always been recognized as due to the action of light. It was the function of the imagination to supply the idea of some substance that when used as a mirror would retain the image, or when applied to an ordinary reflecting surface would retain it. Thus there are to be found in Chinese tradition, we are told, "the legend of the sun sometimes making on the frozen surface of lakes or placid rivers the images of trees and other objects along their banks."

In a mythological work published by a French bishop about 1690 there appeared this passage by which the imaginative aspects are further fed, and goes to show that master minds of that day grasped the theme and portrayed future possibilities. It is as follows: "There was no painter in that country. But if one wished to have the portrait of a friend or the picture of a beautiful landscape, or any other effect, water was placed in great bowls of gold and silver and the object desired to be painted was placed in front of that silvered water. After a while the water solidified and became a mirror on which the image remained."

Such, then, is a glimpse or two that goes to show the thoughts of the generations preceding us. The limited time will not allow of the recitation of similar paragraphs. But we must hasten along to the time when photography had passed these stages and assumed more practical aspects, and more akin to photography as known to us. And while we appreciate all that we owe to photography, we may with both pleasure and profit go back and ascertain to whom we owe the more practical suggestions which by the untiring process of expansive evolution day by day drew us nearer and nearer the goal of present-day perfection.

During the seventeenth century we find many writers giving attention to these themes. In 1763 was published a work by Dr. Wm. Lewis, M.D., F.R.S.: "Investigations Into the Cause of the Discolorations of Ivory, Bone, Wood, or Stone, Treated with a Solution of Silver Nitrate and Exposed to Sunlight." In 1772 Dr. Joseph Priestly contributed a work, "The History of Discoveries Relating to Light, Vision and Color." In 1777 appeared "The Experiments on Air and Fire," by Carl Wm. Scheele. Following came Senebier, Berthollet, Mrs. Fulhame and Dr. Black, with valuable contributions, adding additional data before the new century dawned. In 1800 Hershall, and in 1801 Ritter, contributed their investigations respecting the spectrum, discovered respectively the ultra-red and the ultra-violet rays, the latter being demonstrated by means of silver chloride, which darkened under their action.

We now come to one who came very nearly being the first discoverer of photography—Thomas Wedgwood. Born May 14th, 1771, being the fourth son of Joseph Wedgwood, the famous potter. Investigations by one Schulze and his successors had demonstrated the properties of nitrate of silver and the chloride of silver. The optical works by Priestly and Hershall had suggested the employment of the lense. It yet remained for someone to combine these factors. This is what Wedgwood claimed to have done.

His method was to soak paper or white leather in a solution of silver nitrate and to expose this sensitized material under a fern or engraving to the action of light analogous to our printing methods of to-day. And in this the first requisite of photography was supplied. But the difficulty of preventing the object thus obtained from fading remained for some years, for Wedgwood we find states in reciting the details of his method to "Davy" that nothing but a method that would prevent the unshaded parts from coloring when exposed to light would complete and make his process successful.

Wedgwood was, we find, also the first to experiment with the camera-obscura. But found that the image thus obtained was too faint to affect in a moderate time the sensitized material employed. Whether or not these pessimistic conclusions deterred Wedgewood is not made clear, for we cannot find any further record of his achievements.

We now come to Niepce and the first photographic record of permanency. This man first attracted attention by his attempt to substitute the usual lithographic stone for the production of a local quarry. Finding this stone unsuitable, he next tried polished metal plates, his object being to supplant the method of engraving upon the stone by first oiling or varnishing or otherwise making the line engraving transparent, placing it upon the metal plate previously coated with various substances and then exposing the whole to light. Of what these first substances were we have no record. Later at the estate at Gras we learn that he had recourse to the camera, for in a letter to his brother he relates the use of paper to receive the image, to the fixing of the colors and to the fact that the highlights came out black and that the shadows were white.

In 1826 he makes mention of the use of bitumen of Judea, a kind of asphaltum spread upon metal plates. When exposed under a transparent engraving this solution suffered a change on those parts upon which light had acted most vigorously—a change that became evident by the resistance to the solvent properties of the essence of lavender. A menstrum in which the unchanged bitumen which the opaque part of the engraving had protected from light was still soluble. It is therefore specially worthy of notice that this process is really the first known negative image.

In summing up Niepce's achievements one must credit him with the first "*Fixing of the Image*," in a way strangely suggestive of development, though not strictly such because of physical, not a chemical nature. By his asphaltum method he thus obtained the first direct photographic records that have any claim to permanency and the first indirect results by photo-engraving—possibly the most important phase of the subject in the present day aspect. Niepce's memory is honored by a portrait statue in one of the squares of Chalons. On the estate the stone marks his grave.

We now come to " Dagurre," a name with which we are perhaps more familiar, and to whom we, the fellows of the craft and the few others, owe so much. We find that the author of this process known by his famous name was born at Corneilles, about ten miles from Paris, on the 18th day of November, 1787. In the early days of his education and development he showed an aptitude for drawing. In 1803 it is recorded that he was employed by a famous scene painter at Paris, and that his work was then attracting general admiration. In 1821 Dagurre got the idea of the " Dioroma," which he at once put to good effect. In 1824 he was engaged with experiments by which he hoped to fix the image of the camera obscura.

In 1826 communication between Dagurre and Niepce led to the exchange of methods then employed, and Dagurre having the details of the latter's methods, investigated the process and continued the experiments along the lines thus mutually obtained, and soon made many modifications. After the death of Niepce, Dagurre abandoned these experiments and resolutely worked along with his own. Later it was recorded that a partnership was formed between Dagurre and a son of Niepce and efforts were made to float a company to take over and develop the process in consideration of 200,000 marks. In 1838 Dagurre decided to appeal to the government for aid and succeeded in interesting Arago, the celebrated scientist and astronomer, whose endorsation was sufficient, and the government awarded pensions to the partners—4,000 francs to Niepce and 6,000 francs to Dagurre—in exchange for the secrets of their photographic process, and the details of this process, before secret, were laid before the Academy of Science on Aug. 19th, the new art being christened "The Dagurreotype," and the first photographic process was a reality.

The process was based upon the use of a highly-polished surface of metallic silver, which had been exposed to the vapors of iodine. An extremely thin film was formed on the plate, the iodised plate was exposed in the camera, but no image was seen until the developer was applied, the developer being vapor of mercury, often called quicksilver. After removal from the camera the plate was placed face downwards in the upper part of a light tight box, in the lower part of which the mercury vapor was generated by heating the liquid metal with a spirit lamp.

William Henry Fox-Talbot was, we learn, a country gentleman living at an ancient residence—Lacock Abbey, in Wiltshire—which it is said his family inhabited since the sixteenth century. He was educated at Harrow and Cambridge, and was for two years a member of the House of Commons. In 1828 he is said to have settled down and devoted himself entirely to scientific pursuits at the Abbey at Wiltshire. On Jan. 25, 1839, about one month after the publication of Dagurre's process, some of Talbot's photogenic drawings were shown to the members of the Royal Institute.

A little later Talbot read a paper before the Royal Society with details of his process. Talbot refers, in this paper, to Wedgwood and Davy's work. He improved on their results in two particulars : he obtained greater sensitiveness, by coating his paper first with a solution of common salt, then with a nitrate of silver, thus producing silver chloride within the fibres of the paper, in the presence of an excess of the nitrate ; and he used with partial success, potassium iodide and also salt solution as fixing agents.

Talbot's first process—the "Photogenic Drawing"—was thus what we call a "printing-out" process for producing by contact in the same manner that Wedgwood had done—or in the camera, which Wedgwood did not do, although he recognized the possibility.

This application of the development principle to his process was an immense advantage, and the calotype paper could be made rapid enough for landscape and portrait photography. The negatives were printed on his original "photogenic" paper, and the whole process was such that in 1844 Talbot issued the book of actual photographic views, entitled "The Pencil of Nature." In the following year he published a collection of 23 views under the title "Sun Pictures in Scotland."

Talbot was an indefatigable patentee. He patented the waxing of paper prints to make them more transparent ; he patented the use of a colored backing paper to improve the appearance of transparent prints, and he patented a hot solution of hypo for fixing.

It is to Sir John Hershall that we owe absolutely the hypo fixation which was the actual consummation of all the photographic processes heretofore mentioned. The first scientific paper of Hershall which possesses photographic interest was written some 20 years before Talbot and Dagurre gave separately to the world distinct photographic processes. It was entitled, "On the Hyposulphurous Acids and Its Compounds." In one passage he states that muriate of silver newly precipitated dissolves in this salt when in a somewhat concentrated solution in large quantities, and almost as readily as sugar in water, and pointed out a fact that to convert the silver bromide, or chloride, a considerable excess of hypo must be used. He also showed that the latter reaction excess of silver salt on hyposulphite constituted a most delicate test, so much so that he calculated that he could detect one part of hypo in 97,800 parts of water. It is also clear that although not applied he was the first to discover a process analogous to coating clear glass with silver emulsions. It is also to Hershall that we owe the blue print. Thus, he experimented much with mercuric salts in devising a process for using them in his cyanotype process. He discovered that an ordinary blue print placed in a solution of mercurous nitrate is gradually bleached. The paper having been dried, the picture can be restored by passing a smooth hot iron over it when it reappears, not blue but brown, but soon fades out.

To summarize: Hershall gave us thiosulphate fixation. He independently discovered a process almost exactly similar to that devised by Talbot some five years previously. He was the first to use the terms "positive" and "negative," and to obtain a negative on glass.

It is interesting to note that Hershall's experiments with the platinum salt is in a sense the forerunner of the platinotype process, to-day so widespread and popular for the more artistic sorts of renderings of photographic subjects. The "blue-prints" that have played such an important role in the present-day development of all the vast industrial enterprises that involve mechanical and engineering drawings, enabling hosts of duplicates to be placed in the hands of workmen, superintendents and the like, are also the direct result of his investigations of the iron salts.

His career is thus a most instructive example of the world-wide benefits that a man of science can confer on humanity and progress.

Thus in looking back we find one great characteristic, namely, that it was the custom of each of these pioneers to take something already in practice and to brace something different of his own onto it. Dagurre used iodine; Talbot the hypo prescribed by Hershall; St. Victor, a cousin of the late Niepce, used glass on which to take his negatives, using albumen and starch mixed with iodine, sensitized with silver and developed and fixed with potassium bromide. This in 1847. Then comes the great stream of progress. Blauquart Evraud introduced albumen on paper, still in use greatly perfected.

Next in the great march of photographic progress, Le Gray of Paris employs in place of albumen on glass a solution of gun cotton in alcohol and ether. His method was given practical shape by Scott Archer, henceforth known as the wet collodion process—practically the wet collodion process of to-day.

The great uncertainty of the silver bath in this former process soon led to further modifications. Sayce and W. B. Bolton in 1864 produced the collodion emulsion process, which has lasted until now. First came the washing of the soluble nitrates from the emulsion after coating; then washing of the emulsion in bulk, and more recently the color sensitizing of the emulsion.

First a word on Archer's process, practically a "dry plate bath" process, according to the prescriptions of Taupenot, and others, about 1855, and from that date many other "preservatives" (pyrogallic acid, sugar, beer, etc.) were used.

The next advance is linked with collodion emulsion. In 1871, Dr. Maddox substituted aqueous gelatine solution for the spirituous collodion and found the same a possible photographic preparation. This "gelatino-bromide process"—so momentous in the history of photography—was worked out by Burgess, Kennett and Wratten, to name only three of the investigators, and Kennett, about 1874-1877, put gelatine plates upon the market. Of the further history of gelatine emulsion little need be said.

We have thus traversed three quarters of a century in our brief review of photographic progress, in which have been noted in general the physical and chemical developments of so many of the pioneers of this useful art, from which so many of us derive so much pleasure, and which is immeasurable in its widespread benefits. We include the several concurrent methods of the preparation of the dry plate akin to its present adaptability; to the preparation of the earlier varieties of paper, until now we find that to enumerate the various brands of photographic papers prepared and on sale would be quite a task, and to dare say which in our humble judgment is the best is altogether too dangerous to attempt.

From the crude plate of a quarter of a century ago to the double-coated non-ablation color sensitive lightning speed dry plate of to-day is a great stride, and I am afraid that the best of us little appreciate the great difficulties that confronted our predecessors, for if the present-day "fiend" was required to follow the manipulations as in the Dagurre process, our membership would be limited indeed.

The paper dealt with photographic lenses and the many useful applications of photography and suggested many new fields. Some 50 slides were shown, illustrative of early photography and methods, together with comparative views of modern appliances, methods and work of local members.

Prince Albert to Fort Churchill—In Advance of the Locomotive

J. W. Tyrrell, C.E., D.L.S.

April 19, 1906.

The present article is intended to briefly depict some of the points of interest noted upon a 2,000 mile boat journey recently accomplished by the writer and three companions with the able assistance of four native voyagers all equally and thoroughly at home in the use of the paddle, the pole and the packstrap, each of which in turn provided our means of locomotion, as did also our "white wings" on several more happy occasions.

Our point of embarkation was the beautifully situated town of Prince Albert on the North Saskatchewan River, and our craft were two Peterborough canoes of about one ton capacity each, which meant ample accommodation for our party, our supplies, camp outfit and necessary baggage. The season was advanced to the latter part of the month of June and the moon was at its full and added to the glory of the night, though lacking in the luster of the southern skies because of the almost continuous light of the northern midsummer sun.

Thus with a native guide "Norman," a fine specimen of manhood, we launched upon the mighty Saskatchewan, and commenced the descent of the great and rapid but very muddy river. As we passed down, the banks were high and heavily wooded and these characteristics continue for many miles, but towards Cumberland Lake a change was observed, the country becoming lower, more swampy and devoid of the more valuable descriptions of timber. Large areas were quite wet and covered only by grass, which affords feed for great numbers of wild fowl, as well as deer and other descriptions of game. Cumberland House, a trading post of the Hudson's Bay Company, is situated upon a slightly elevated point on the south shore of Cumberland Lake and is also the site of a Church of England mission.

The population, outside of missionary and trader, is composed of a few Indians, who subsist by fishing and trapping, no attempt being made at the cultivation of the land, or the raising of field or garden produce. And this fact has proved unfortunate, for at the time of our visit imported supplies were exhausted, and fish alone furnished the village provender. This description of food in the shape of sturgeon was, however, plentiful, and could be bought in any quantity for 4 cents a pound, and this was in fact being done on a larger scale, by a local company, and shipments made to American markets by way of Lake Winnipegosis.

Proceeding down the Saskatchewan about 70 miles below Cumberland House, the "Pas" was reached, where is situated another small Post of the Hudson's Bay Company. The "Pas" is of special interest at the present time as being the proposed crossing place of the Hudson's Bay extension of the Canadian Northern Railway, and on this account may ere long be a place of some importance, though of but little now. One hundred and fifty miles below Cumberland House the Saskatchewan passes into Cedar Lake, a beautiful expanse of water about 30 miles in length from west to east, and half from north to south. Here the low, swampy character of country so predominant to westward is lost sight of and replaced by rocky shores and well timbered uplands, said to be favorite resorts of big game. In passing through this lake we observed two fine moose standing in the shallow water near a point on the north shore, but as we could not exactly claim to be in need of food, we refrained from committing a violation of the law, and passed on to Grand Rapids, where the great Saskatchewan is discharged into the waters of Lake Winnipeg.

The Grand Rapids are not navigable for canoes or other craft, being very rough and having a heavy fall. They thus form the only serious obstruction to navigation between Edmonton and Lake Winnipeg, a distance of about 950 miles, during seasons of high water, for indeed steamers of the Hudson's Bay Company ply between these two points and have done so for perhaps half a century. Until recent years, when railways have revolutionized methods of transportation, Grand Rapids was an important transhipping point of the Hudson's Bay Company, and this fact is very apparent, for the several large but abandoned warehouses and an old wooden tramway still remaining bear silent testimony of byegone days when hundreds of tons of goods were here transported annually, for this place was one of the principal stations on the main highway from the sea coast into the great interior country.

The old Hudson's Bay Company's post and warehouses are located upon the left bank of the river above the rapids and have a lovely outlook to the south and westward, but not a soul now remains at the once busy hamlet.

Below the rapids five miles farther down stream the conditions are different. Here is a quiet but picturesquely situated little village of a hundred or more whites and halfbreeds who occupy themselves in trading, trapping and fishing, the latter forming the chief local business until the present year, when the catch becoming small, the local fish company removed its quarters to Eagle Island, some forty miles distant.

Grand Rapids village, if such it may be called, faces on the river as well as on Lake Winnipeg, and possesses a most beautiful white quartzit gravel beach and should become a very popular summer resort, being easily accessible by steamboat from Winnipeg and other points.

Large game such as moose and black bears are said to be common, one hunter alone having killed nine of the latter last winter. Fish in the river is also abundant, and can be obtained in great quantities at the foot of the rapids by the simple use of a scoop net. One resident of the place, who has a family of eleven children and sixteen dogs, told me that he had no trouble within a very few minutes to catch enough fish to supply his outfit for the day. It would therefore seem to be a most desirable resort for some of our "short hour" men.

Having selected a site for my own summer cottage we reluctently bade farewell to Grand Rapids and set out upon Lake Winnipeg, a shallow but very large lake about 300 miles in length by 100 in greatest breadth.

One might well be timid about crossing such a lake in canoes, so we directed our course up the west shore for the first day and then crossed over to Eagle Island and paid a visit to the large fisheries recently removed from Selkirk Island and Grand Rapids. They were being carried on by two separate companies (both of them American), *viz.:* The Dominion Fish Company and the Northern Fish Company. Both have large refrigerators, packing houses, ice houses and wharfs upon the island, and each employs eight or ten fishing boats at this point, besides several steam tugs, which collect the fish from other stations and take them to Selkirk for shipment to Chicago, Detroit and other American cities.

The most valuable variety caught is the famous Lake Winnipeg whitefish, averaging about six pounds in weight, but with it are also taken toolibies, pickerel and pike, gill nets being employed for their capture. Two different methods are adopted in the packing of the fish for shipment: the one company freezing the fish in metal boxes from day to day as they come from the nets, then keeping them in refrigerators until shipped or indeed until marketed, but the other company prefers to merely pack the fish in boxes with ice and thus to market them, claiming that unfrozen fish have the better flavor and command a higher price than those that have been frozen. The freezing method has, however, one advantage over its rival in that, from the time the fish are packed in boxes they do not require further attention until finally disposed of, whereas with the unfrozen fish the boxes have to be opened once or more during transport for the addition of ice.

It is greatly to be regretted that the fisheries of this lake, once thought to be inexhaustible, have been so sadly depleted. Where one thousand fish were taken a few years ago, about fifty are caught to-day. The hatcheries established on the lake by the government have doubtless done much to check this depletion, but they have not proved sufficient to meet the enormous drain, and it would seem that nothing short of a complete cessation of the "wholesale fisheries" for a term of years will suffice to prevent the extermination of the fish.

Leaving Eagle Island, we proceeded to Warren's Landing, at the outlet of the lake, where there are two other large fishing stations. One of them, that of the Dominion Company, where we put up over night, is managed by a Mr. Tate, one of the finest types of men it has been my pleasure to meet in the north country.

Warren's Landing being only two days' travel by direct route up the lake from Winnipeg, we here had the pleasure of receiving the latest news of the world, and the last that it would be possible for us to receive for many weeks to come, since from hence our road led to the northward and directly away from the haunts of men. Thus far our course had been easterly and about parallel to the borders of civilization, and our distance travelled by boat since embarking at Prince Albert was about 550 miles.

From the Landing we passed through Playgreen Lake and into the east branch of the Nelson River, which was descended as far as Norway House, a large and important post of the Hudson's Bay Company presided over by Mr. McTavish, but at the time of our visit in charge of Mr. Charles Sinclair. Fresh supplies were obtained here for our journey to the coast of Hudson's Bay, and on the 10th of July, availing ourselves of a fishing tug, we embarked and returning to Playgreen Lake, descended the west branch to "Wiskey Jack" portage, six miles in length, which we crossed by the help of horse teams employed by the Nelson River Fish Company in the transportation of sturgeon. At the foot of the portage I came upon an old retired friend resting from her labors in the shade of the woods close to the shore of Cross Lake. She was an old sail boat now abandoned, named "Pteridactil," in which my brother J. B. had years ago carried on extensive geological research on and about Lake Winnipeg.

Passing through Cross Lake, where the Hudson's Bay Company has a trading post in charge of Mr. McLeod, we re entered the Nelson River and descended to the first rapid, where we had the good fortune to overtake a brigade of three Hudson's Bay Company York boats en route to Split Lake, whither we were also bound. During the temporary absence of Mr. Flett, of the Hudson's Bay Company, the Rev. C. G. Fox, of Split Lake, who with Rev. J. Lofthouse had accompanied us from Norway House, assumed charge of the brigade, with the able assistance of the native Indian guide, William Kitchekisik.

The boats' crews consisting of thirty Indians, we now formed altogether a party of forty men, and a more interesting, good natured and jolly party I never travelled with. Each of the York boats was loaded with about 6,000 pounds of supplies, such as flour, sugar, canned goods, hardware, etc., all being securely packed in boxes or bales of from 100 to 150 pounds in weight for convenience in handling on portages, and in loading and unloading of boats. When favored by fair winds these boats are propelled by single square sails, but at other times by great wooden oars about twenty feet long and of the diameter of small telegraph poles. Nine oars are commonly used to a boat, one man to each oar, and thus with a strong and well timed stroke they pull the heavy craft along at a good rate of speed—from four to five miles an hour. The men at the oars, standing as they row with one foot braced against a box or cross bar, rise and fall to their work as one man, and for the space of half an hour at one time keep up a beautiful but most vigorous motion. Then a five minutes' rest and smoke followed and the rowing is resumed.

Whilst they are content to, and do, keep up this violent exercise all day, if by good fortune a fair breeze springs up, the oars are shipped in a second, a rush is made for mast and sail, and as is common with the Indian, work is turned into play, and a race follows between the several crews. Sails being set, a bowsman and sternsman alone remain on duty, and the others of the crew do as they please—smoke, eat, sleep, sing or play cards until recalled to the oars if the breeze fails them or aroused by the call "tea boy" so often made by these travellers. The Indians are very fond of their tea lunches, and no wonder, from the slavish way in which they work when on duty; nor are their labors limited to eight hours a day, but usually extended from twelve to fifteen. The daily round of the red men as we saw them was as follows, and in some respects we might do worse than follow their example: They turned out from their blankets at five o'clock in the morning as a general rule, though there be a fair wind they were liable to start at three o'clock or earlier. Fires were kindled and whilst tea was being made morning devotional service was audibly conducted by the guide. This beautiful feature of their daily routine was never overlooked, and at the conclusion thereof, tea with a light lunch was partaken of. A start was made about half-past five o'clock and the oars were kept going until eight. Then in response to the call of "tea boy," a stop of an hour was made, and a substantial breakfast prepared. This included the making of bread, which was never kept on hand from day to day, as is usual with white travellers. Their methods of making bread are very simple and are as follows:—A sufficient quantity of flour is placed in a birch bark or other dish and stirred up with cold water to form a stiff batter. This is then spread out on a flat stick or twined about a round one and set up before the open fire to dry rather than bake, for it is always eaten in a scarcely half-cooked condition. No wonder if the poor Indian often suffers from stomach troubles, which he does, and this suggests what a mission field we have in the north for our schools of domestic science.

After breakfast has been disposed of, there being no dishes to wash, rowing or perchance sailing is resumed until noon, when a second stop of one hour is made for dinner, and happy are the men if a stray moose, cariboo or black bear has fallen a prey to their guns, for then marrow bones are roasted and otherwise their cup of happiness is filled to overflowing.

Once more inwardly replenished, they merrily take up the labors of the afternoon and continue until four o'clock, when if rowing, a brief stop is made for tea only. If sailing, no stop is made until the completion of the day's journey about seven or eight o'clock in the evening, when camp is made and the evening meal partaken of. Following this devotional services are again conducted by the guide, and the poor tired red men roll up in their blankets beneath the vault of heaven, or perchance in the leafy shadows of a friendly wood, to find rest in slumber and dream of the happy hunting grounds where toiling is no more.

En route from Cross Lake to Split Lake several long and difficult portages on the Nelson River were met with, and it was on these that our Indian friends showed themselves to greatest advantage. Without any urging other than rivalry amongst themselves they worked like slaves or demons, and by simple brute force managed in very short space of time to transport not only their nine tons of supplies, but also their heavy boats over portages often steep and precipitous. One of these portages, that at the Grand Rapids on the Nelson, though not long, was about 100 feet in height and quite steep on either side. Others though not so high were equally steep and much longer, but were all crossed in the same way—by the strenuous use of the tow line and rollers.

At several of these portages the natural scenery of the river was very beautiful, and this was notably the case at the White Mud Falls, one of the wildest and most beautiful I have ever seen. The falls come in from three directions between islands in the river, and unite to form one great, seething, boiling cauldron of marvellous beauty and grandeur. My photos of these falls convey no true representation of their appearance, for I could find no point from which more than a part could be photographed at one time.

Split Lake Post, on a lake of the same name, 225 miles below Norway House, was reached on July 15th, and here we were to part with our friends of the York boat brigade, who had reached home and the end of their present journey. Our arrival taking place on Saturday, we had the opportunity of spending the next day (Sunday) at the post and mission, and our brief visit proved to be an exceedingly pleasant one, both because of the very kind reception given us by Messrs. Fox and Lofthouse, and on account of the very interesting and exemplary character of the local Indians, who bore abundant evidence of the good teaching and example of the missionaries.

From Split Lake, which is an expansion of the Nelson River, our objective point lay to the northward in the direction of the Little and Great Churchill Rivers, and the following of this necessitated the making of numerous portages separating a succession of small lakes, which presented a practical route sometimes followed by the Indians. For the purpose of assisting us over these portages we gladly availed ourselves of the offered help of six additional local Indians, and thus supported, on Monday, the 17th of July, with a fresh guide in the person of Daniel Kitchekisik, we bade farewell to our good friends at Split Lake and made a fresh start for Hudson's Bay. The chain of small lakes above mentioned, as well as the Little Churchill River, form part of an Indian hunting route, but the Great Churchill is never descended, even by the natives, so that when I informed the guide that it was my intention to go down the "big" river, he promptly declined to accompany us, stating that the "Great Strange" river, as it is called by the Indians, is said to be never free from ice, and that should we attempt to descend it, we should be swept down and carried to certain destruction. I assured him that we had no desire or intention of running into such danger and that if it were necessary I would abandon my purpose and adopt his proposed alternative, which from a point a short distance below the mouth of the Little Churchill switched off onto a winding portage route by way of what is known as the Little Deer River.

With this understanding we proceeded, crossing several large portages, as many small lakes, and descending the Little Churchill until on the morning of the 25th we entered upon the Great Churchill (Strange) River, and an hour later arrived at the head of the portage route to the Little Deer River—the "parting of the ways." Here a halt was made for lunch, chiefly that the question of routes might be again brought up for argument, for I was very desirous of seeing the big river, but could scarcely descend it without the assistance of Daniel. He was free to admit that the Little Deer River route was long and difficult, so taking advantage of this admission I argued that a fine large river, though not known to him, would almost certainly prove to be a better route than one that was known to be bad, but it was when I appealed to his pride that I touched the first responsive chord.

I pointed out the great honor that he would achieve were he the first Indian to run a canoe down the Great Strange River, and suggested that it would probably be the means of electing him chief of his band. Before receiving a reply I felt that my shaft had pierced a joint in his armor, and that the day was won. When the answer came it was a very clever one, and was presented as follows: "I would like very much to see the Great Strange River, and I know that the portage route by way of the Little Deer River is very difficult, so much so that I fear the 'old gentleman' (a senior member of our party) would not be able to stand the journey. When you engaged me, I undertook to guide you safely to Churchill, and now the way you wish me to go is quite unknown to me, but if you will assume all responsibility in case of meeting with disaster, I will comply with your wishes and do my best to guide you down the Great Strange River." I could ask nothing more, but congratulated him for his courage, and we proceeded to dispatch our mid-day meal with a feeling of great satisfaction, believing a great victory to have been won.

Since leaving our friends at Split Lake we had travelled only about 150 miles, and not counting Sunday, which we had spent in camp, we had been seven days in accomplishing the trip and had therefore averaged a little over 21 miles per day, this being accounted for from the fact that the waters of the route had been very shallow, making travel tedious and difficult. In many places it had been necessary to lighten the canoes and for all hands (or rather feet) to walk down the bed of the stream, to plod through the muddy flats of some shallow lake or slough, or at other times to leave the canoes to the voyagers and for the remaining four of us to take to the woods and work our passage through forest and scrub whilst they worked a passage through the shallow rapids; but now we were once again upon a great noble river, similar in size to the Nelson, with prospects of more lively experiences ahead of us. For the first afternoon at least, though we made much faster time, our voyage was smooth and uneventful. The next day, however, interesting features began to appear. The stream became very swift, and rapid after rapid was reached and run in quick succession, and before noon sure enough the guide's traditional ice fields began to make their appearance and then only did I hear a brief murmur of discontent.

As we continued down the rushing river, the ice became continuous and soon abundant, until the solid massive banks on either shore attained heights of not less than forty feet above the river, but in no place was it found to obstruct the river channel and, therefore, with the exception of making landings difficult in many places, it formed no serious obstacle to canoe navigation. The explanation of its occurrence in such large quantities in mid-summer is that the river is exceptionally narrow and swift at this part and causes great floods and ice jams to occur here, the ice met with being the remnant remaining since the spring flood.

One interesting feature in connection with the occurrence of these ice banks was that they were associated with swarms of black flies and mosquitoes so that the uninitiated members of our party found it necessary even when passing beside or walking upon the ice banks to keep close within their mosquito nets. One of my photos shows a member of our party bedecked with his mosquito veil and standing within an icy cavern formed in the great ice wall by a small tributary stream. Though essentially continuous for twenty-five miles or more, these ice walls were in many places cut away altogether or tunneled through by the action of tributary streams of greater or less dimensions, and it was at such places only that landings could be effected. Upon one occasion when a terrific rain and wind storm overtook us upon the river we were glad to avail ourselves of one of these *possible* landings. I say *possible* as it was little more, for the mud was very soft and ankle deep from the melted ice, and all we could do was stand in it until the storm abated.

Our unhappy condition in the mud bank upon this occasion reminds me that although we might seem to have been the only geese in that inhospitable region *there were others* and in no small numbers. Within a few minutes at one island where we landed for lunch we killed seventeen, and at another place we shot fifteen fine fat birds within as many minutes.

Though moving rapidly northward, the great ice banks were all passed during our second day's travel on the Churchill and the country assumed a much more habitable appearance generally, though but thinly wooded with small spruce and tamarack. With the disappearance of the ice, we also lost the high velocity of the current and our third day upon the river was a pleasant though uneventful one excepting that we shot several more, and saw great numbers of wild geese. We reached Fort Churchill at one o'clock on Friday, the 28th of July, just three days from the time we had left the portage to the Little Deer River, and had averaged a distance of about fifty miles per day, and during the trip, excepting to camp at night, we had not once unloaded our canoes. We had encountered many rapids, but none so bad as to prevent us from either running or passing our canoes down by hand and thus by descending the "Great Strange River" we had saved ourselves about five days of the most slavish kind of travel, and no one was more pleased with our success than Daniel, the guide, who disclaimed any further use for the Little Deer River route.

Finding ourselves at Fort Churchill, the natural sea-port for Western Canada, we had reached our objective point and had completed a boat journey of about eleven hundred miles, making an average of thirty miles per day, including stops at several H. B. posts and fishing stations on the way. This I consider an exceedingly good rate for such a distance with canoes.

Of Fort Churchill much has been written and more may be said regarding its past history, its present condition and its future prospects, but of these I must of necessity be brief.

Fort Churchill as we find it to-day is merely a small trading post of the H. B. Co. and Church of England mission station, containing three white men, Mr. Ray, his clerk, and Mr. Sevier, the young missionary. Mr. Ray, the chief trader, has his wife and two children with him, and these, together with two or three halfbreed families, besides occasional bands of Indians and Eskimos, form the whole population of the place. They are domiciled in in three or four small, and some of them very old frame dwellings, and in addition to these residential buildings there is the Company's little store (at the time of our visit conspicuous for its emptiness), a very neat and highly creditable corrugated iron church, built by my old friend Bishop Lofthouse in 1885-86, and lastly a "blubber house," which does not appear in my photos, as without a telescopic lens one could scarcely approach sufficiently near to obtain its picture. Besides, in one respect, it is much like some of our automobiles, the most conspicuous part of which is not capable of being photographed and when not realized can only be imagined.

Porpoise fishing, from which the "blubber" is derived, salmon fishing and fur trading constitute the entire industries of the town, and these are still prosecuted as they have been for the past two hundred years. The most striking and valuable feature about Fort Churchill to-day is its very fine natural harbor just within the mouth of the Churchill River, and it is almost entirely upon this that its future destiny must depend.

There is little doubt but that within a very few years Canadian enterprise will make of Fort Churchill an important railway terminus as it is a fine sea-port, and with such a connection I believe it is likely to play an important part in the development of the grain, cattle and other industries of Western Canada.

The accompanying photograph of map made from my own recent surveys is the first and only correct chart of the harbor and may therefore prove of interest.

Vacation Rambles in the Old Land—*Illustrated.*

By P. L. Scriven.

MAY 10, 1906.

It may seem odd, and is, to those of us who have always lived in this newly-settled country—which has no written history prior to the latter part of the fifteenth century—to stand in the presence and environs of tombs, crypts, churches, cathedrals, castles and palaces whose beginnings are so remote in point of time as to be shrouded in the maze of antiquity.

To us at least it was a new, strange and novel experience to tread the soil of our forefathers where, according to history, one is led to conclude almost every acre has once been a battlefield, every new vista more or less celebrated in song or story, and sad to relate, where very many homes were the abodes of cruelty and oppression, where the chief vocation of mankind was war, and where men spent the most of their time, thought and energy in devising means to slay each other. One has only for a short time to study the thousand and one weapons, such as swords, spears, lances, tomahawks, cutlasses, and cleavers, of all shapes and sizes, pistols and guns of every description, besides other instruments of torture, stored within the old tower of London, to fully realize that this is no idle assertion.

But we gladly turn from this dark picture to a brighter, for Britain is a land of beauty as well as of history. Biography also teaches us that no nation on the face of this footstool has been more prolific in giving to the world illustrious names to grace the realms of literature, poetry, science, art, mathematics and philosophy than has Great Britain. I need not here and now be more explicit in naming her heroes who have been victorious in the arts of peace no less than those who were mighty in war. Suffice it to say that the tablets erected to their memory all over the United Kingdom are mute witnesses of their worth, their celebrity, or at least of a nation's gratitude.

In making comparisons of customs and usages of the people, transportation facilities, and manner of doing things in the old country and the new—one is soon ready to admit there is room for improvement in both countries. We will mention first a few of these noticed in the old land that struck us as being sadly in need of renovation, yet are apparently so deeply rooted in the strata of public opinion that unborn generations may yet come and go before a change for the better has become universal. As an example, take the drinking custom. Our Canadian girls and young womanhood would doubtless consider themselves irretrievably disgraced were they to place their feet inside a saloon where men are in the habit of congregating to talk, jest and drink, yet, as we have already described in a letter published in the Hamilton Times, we have seen in the city of Bristol, England (on a Sunday evening, too), a saloon or drinking place literally packed with men and women, chiefly young persons, jesting, talking and taking their grog like old veterans, the fact of the baneful influence of promiscuous drinking by the sexes seeming to have no deterring effect whatever, but in our estimation can only result in gross immorality and vice. Very few in this audience we think would be prepared to say this practice did not need reformation.

The Railway Compartment Coach, over there, is claimed to possess many advantages over our American system of centre aisle coaches, yet, to our way of thinking, is away behind the age, and were it permissible in a mixed audience for the writer to relate a unique and droll experience he had while traveling between Scarborough and Manchester, you would all probably agree with me that the compartment coach has at times very pronounced disadvantages.

Again, the tipping system so much in vogue in the mother country proved an abomination to us. You are scarcely in sight of land before you feel it in the air. The ocean liner that bears you onward is permeated by it, and from the chief steward to the table waiter and cabin boy, all expect to share in the distribution of your coin, and if you can manage to leave the vessel for less than twenty shillings in addition to your fare you are fortunate indeed. In fact, so far is this reprehensible practice carried, that we were told on fairly good authority some of the stewards ship on board ocean vessels for the nominal wage of $15.00 per month, others for nothing except the privilege of preying in this manner upon the passengers. Upon crossing the landing stage at Liverpool you are spotted for a stranger The street arab and lounger are persistent in proffering their services for which you do not ask, and for which they expect from the universal penny to sixpence. If you demur, they insist doggedly upon the receipt of the penny, apparently because they have paid you that much attention. After getting your "luggage" (not baggage) to the "left luggage room" at the railway station, and want to enjoy a half hour in the city before train time—you must not expect to get trunks checked upon strength of your railway ticket (as here) and have no further care on that score, but you deposit your luggage, pay the fee asked, take a receipt, and when you return for your property a porter stands ready to carry it to the luggage van of the train upon which you are to continue your journey, for which he expects and gets the "nimble sixpence." When your destination is reached another porter carries your belongings to the carriage, tram or bus, and as you have never seen this porter before his sixpence comes out of your pocket quite readily, and it is astonishing how noiselessly and undemonstratively it glides into his.

Thus, early in your visit, you become imbued with the idea that a small amount of service in this country demands liberal compensation, that the Railway Co. is responsible for nothing more than to pick you up at one place and set you down in another, irrespective of luggage which you have personally to see is aboard the train by which you travel, or you may find yourself in one place and your change of raiment in another.

We cannot pretend to enumerate all the inconveniences and petty annoyances to the traveler resulting from the tipping system, but some of the demands struck us as being very queer if not amusing, for instance: Upon reaching Stirling by steamer from the old town of Leith in Scotland, a penny per head was demanded from passengers as harbor dues for crossing about six pine planks. Again, at Inversnaid, Loch Lomond, two pence per head was the fee for crossing the planks to board another steamer. On inquiry, however, we found this was kept up simply as a time honored custom—honored because it was old. All these and other old practices impressed us as rather antiquated and very susceptible of improvement.

Not least among the time honored institutions of Britain is the tallow candle—it may not be large, but to the good people over there it is universal and seemingly indispensable. For artificial lighting they have, first, the electric arc and incandescent light, also gas as we have, then there is a drop all the way down to the tallow candle. Such a thing as a coal oil lamp is so seldom seen, that, during the whole course of our peregrinations through England, Scotland and Ireland, we can recollect of seeing but two oil lamps, and one of these out of commission.

As most of you are doubtless aware, stoves and ranges, as we know them, are not in general use, but the range is built into the wall, partly in the shape of a fire-place, necessitating, we should judge, considerable skill and experience on the part of the housewife in preparation of the daily meals.

On the other side of the question, the New World has some things to learn from the Old, and very much, we fancy, in the matter of road making. It was his practice, when off on some side trip and the railway did not favor his line of travel, for the writer to favor himself by five, ten and fifteen mile walks over superb hard roads found everywhere throughout the country, the like of which would put to shame the roadways on most of our city streets, and are not to be seen in our rural districts anywhere that we know of. It is said the ancient Romans, when leaving Britain, bequeathed to them, as a legacy, the art of road making, and assuredly, if this be so (and they left no other), the British people have in their carriage roads and driveways a luxury of transit worthy of imitation.

We would mention, also, the touch of completeness and finish given to everything newly built (in towns and cities), even to the minutest detail—not a stone or brick too much, not a stone or brick too little, remnants and refuse carted away somewhere out of sight, the roadway uniformly rounded in centre, paved or cemented to the curb where the flag or cement walk begins, and is wide enough to complete full range of the street between neat, low, brick or stone walls running along either side in the residential portions, and backed by neatly built stone or brick dwellings in rows usually at a uniform distance from the street.

Not a blade of grass is to be seen where it has no business, and where hedges predominate instead of brick walls, it is scarcely too much to say, one is given the impression that the attendant or gardener who kept the hedge in trim had once been a professor of the tonsorial art, and had learned the symmetrical "close cut" well. The visitor at Liverpool has only to cross the Mersey to the towns of Seacombe, Egremont and New Brighton on the west shore to witness for himself an illustration of the facts above stated.

We have already said Britain is a land of beauty, and judging from the appearance of many portions we have traversed in the north and south of England, in Scotland, also in Ireland, we would say that it well deserves the name.

The beneficent influences of that remarkable ocean current, the Gulf Stream, preserves the land, especially the southern portions in a state of almost perpetual verdure, consequently the picturesque, we might say romantic looking hills and dales are garbed in green for the greater portion of the year, and are best seen during the sunny months of June and July.

From the town of Stretford, a suburb of Manchester, England, which we made headquarters during our stay of three months, we visited points of interest in various cities and country districts. Much could be written, said and pictured of London, Liverpool and other populous centres, but we propose, at this time, to throw upon the screen, principally, illustrations of localities less frequently visited by those going abroad, consequently less heard of at this distance. Some points of scenic beauty, however, and landscapes of surpassing loveliness that came under observation, we regret our inability to obtain an illustration of. We will, therefore, endeavor to substitute a few word pictures of same.

The vale of Pickering in Yorkshire has many notable examples of charming rural scenery, but a walk of a mile or two up the Ellerburn Valley from the village of Thornton Dale struck us as being just ahead of, and considerably more romantic looking than any spot we had yet had the good fortune to behold. Imagine a cool, quiet, shady walk on first of July, on a smooth grass-fringed road overhung with trees, along the western hillside of this glen-like vale, the sun shining brightly in the west lighting up the recesses of the valley lying far beneath us on the right. The opposing hills still further to the right, rising, we should judge, to the height of 500 to 700 feet, while a stream of water like a silver cord threaded its way until it was lost among the blue hills in the distance to the north-east, whose bases were seen to inter'ock each other at apparently different angles and elevations. In the foreground of this picture at the foot of the "everlasting" hills nestled the little village of Ellerburn—with its square towered parish church, its few unpretentious country homes, and here and there occasional farm houses surrounded by fields of ripening grain, fields of vegetables, or pasture lands with cattle grazing, every field hemmed in by the ever present living hedge or a stone wall, and many presenting a varied tint or shade of coloring helped to form a combination producing one of the most enchanting panoramas seen in a lifetime.

From Thornton Dale, near Pickering, we made the return trip to Scarborough, 15 miles, on foot, having our railway paid ticket in our pocket, our object being solely to obtain a closer and more intimate acquaintance with the country and villages than could be had from a railway carriage window, and we considered ourselves well compensated for the sacrifice as every turn in the road opened up a new and, to us, attractive feature of the landscape. In our railway journeys we had noticed many fields of grain with large areas or patches in the surface, blood red in color, and wondering what could be the reason of this (to us) unusual appearance, our curiosity was gratified during this country walk by finding the color occasioned by the prevalence of a single petal red poppy, which grows in the Yorkshire district as a weed and evidently difficult of extermination by the farmer.

On our trip through Somersetshire, another magnificent view opened up to us while crossing the Mendip Hills. When within two miles of the city of Wells a turn in the road removed a veil of rock and woodland exposing what was, in every sense of the term, a bird's eye, if not a balloon view of the country on a lower level. For many miles to the east, south and south-west lay a comparatively level plain, spread out like a map with farms, fields, hedges, stretches of woodland, with towns and villages scattered about as far as the eye could reach, the ever varying shades of green, yellow and brown, combining to make a kaleidoscopic picture seemingly without a parallel.

But, again. In the western end of the range of Mendip Hills are elevations probably 1500 to 2000 feet above sea level, from which we obtained other superb views. With a friend, we struck out from Cheddar to visit "Black Down," said to be the highest point of the Mendips, and after a wearying tramp of six or seven miles, up hill all the way, reached the summit, the last mile or so walking through heather to our knees in depth, and although the wind blew a gale and the air chilly, the atmosphere was quite clear and the view unobstructed from every point of the compass except south-east. Twenty miles away to the north-east Brandon Hill and Bristol could be distinctly seen, to the north the city of Newport in Monmouth, to the north-west beyond Bristol Channel the smoking chimneys of Cardiff in Wales, to the west the fashionable watering place of Weston Super Mare, and to the south, fifteen miles off, the Mount and Glastonbury Tor.

While on this bleak, high ground, where no one lives, we noticed several strange looking mounds, and upon going to the top of them, ten or fifteen feet above the general surface, found a cavity in each, in the centre of which had been dug a small pit which was covered by a large flat stone, or several stones. Uncovering some of these no relic or tool of any kind could be found that would indicate the purpose for which the mounds were made, so the solution of the question to us remained a mystery. Here in the western end of the Mendip Hills is situated the somewhat celebrated Cheddar gorge and cliffs, which appears to be a rift or chasm cut in the mountain side by action of the elements through the lapse of countless ages. The gorge is very irregular in shape, with solid walls of rock on either side rising from 200 to 400 or more feet in height, in many places almost perpendicular, with overhanging cliffs. A fine road and carriage drive winds down through the gorge, and at the lower end near the town of Cheddar are located the wonderful caverns known locally as Gough's and Cox's Caves, views from which will be shown on the screen.

We would be remiss in our duty were we to confine our remarks regarding the beauty of this, our fatherland, to England alone. The mountain scenery and rugged grandeur of the Scottish Highlands, with their heath-crowned domes, precipitous crags, mountain glens, valleys and placid lochs, has really to be seen before it can be appreciated or enjoyed, while the same thing can be said about Ireland—that land usually stigmatized as the land of Paddy Whack, Donnybrook fairs and shillalahs.

A coach ride up the Boyne River valley and to other parts of the Emerald Isle proved to us the fallacy of supposing Ireland in any way destitute of charming, rural landscapes, worth going many miles to see.

GEOLOGICAL SECTION

Report of the Section for the Year Ending May, 1906.

During the summer vacation quite a large number of fossil specimens were collected, some of which were placed in the Museum of the Association, and other specimens were sent to different museums, such as the British Museum at London, the Ottawa, the Albany and Washington. Letters from W. D. Laing, of the British Museum of Natural History, were received of the following dates, acknowledging the receipt of fossil specimens: On May 24, 1905 (15); June 14, 1905 (7); Sept. 18, 1905 (20); Oct. 5, 1905 (8); Jan. 6, 1906 (15); Jan. 16, 1906 (26); Jan. 30, 1906 (6); March 6, 1906 (4); March 26, 1906 (5); April 11, 1906 (11); also from Prof. E. Ray Lancaster from the same museum, Sept. 18, 1905 (4); Dec. 12, 1905 (2); March 13, 1906 (7); also from Prof. J. F. Whiteaves, Assistant Director of the Geological Association of Canada, Nov. 14, 1905 (5), Feb. 27, 1906 (6); also from Prof. J. M. Clark, of the Science Division of the New York State Education Department May 17, 1905 (a box); Sept. 29, 1905 (a parcel). Requests have been made for specimens from the Niagara formation. The attention of professors of science has been drawn to the number of graptolite and fossil sponges that are obtained here.

The Section learns with much regret that Prof. Georby of Washington, who was busy on a number of graptolites sent to him for description and identification, has been stricken with blindness. These specimens, says a former member of the Section, are likely to be handed over to the Albany Museum, where Prof. Ruedman, who has already described a large number of fossils from the State, will describe and name the graptolite specimens that are new to science and identify those that have already been described.

The Section regrets to have to place on record the withdrawal of Col. C. C. Grant from its membership. He has been closely identified with the work of the Section since its formation, and has contributed largely to its success He has been a most untiring worker, spending all his spare time in the pursuit of this branch of science and has contributed the greater number of the specimens now in the Museum. He has by his generous contributions to other museums in different parts of the world as a member of the Section brought into prominence the Hamilton Scientific Association. He has the best wishes of the Section in his retirement from active co-operation in it, and the members express the hope that they may some time in the near future again have the benefit of his matured experience and counsel in the work of the Section.

The Section had hoped that the usual number of meetings would have been held during the past session, but owing to a circumstance which is fully explained, we held only two meetings, at which papers of geological interest were read by Col. C. C. Grant.

Following are the dates of meetings and titles of papers read :

Nov. 24, 1905—Notes on the Past Collecting Season.

Dec. 30, 1905—Additional Notes on the Past Collecting Season.

March 8, 1906—The following paper was handed in to the Chairman : Notes Geological and Antiquarian.

Respectfully submitted,

A. T. NEILL,
Chairman.

Notes on the Past Collecting Season

By Col. C. C. Grant.

NOVEMBER 24, 1905.

Many of the well-known fields for sponges and chert-fossils about the city presented a favorable appearance for collecting in the early spring. Unfortunately, this writer found his sight little improved from the previous year, and he had considerable difficulty in distinguishing complete specimens of the former, although the sections from their bright colors were more easily detected. He therefore concluded to handle every round lump on the surface that bore any resemblance at all to what he was searching for. This proved laborious, but highly satisfactory. From two of the fields examined he extracted fine specimens of the late Prof. Billings' *Aulocopina*, and Dr. Head's *Ruroscegnewan*, a grooved globular fossil which would come under the head "Astylospongea," since it was furnished with a point of attachment for mooring it to the sea-bottom. Perhaps the latter was one of the Niagara sponges which a member of the section (A. E. Walker) forwarded to Prof. Rauff, the famous German spongiologist. The three above stated were sent to the British Museum. Another of these specimens displaying a poriferous surface some of the members have already seen.

I wish to call your attention to another singular shaped sponge which I supposed several years ago represented a form distorted by pressure or accident. At present I entertain doubts regarding the correctness of this view. Three have been found here presenting a similar appearance. So it seems difficult to suppose pressure could have caused all to present a like resemblance.

Dr. Rauff, the German scientist, in his great work "On the Spongidæ," states that the Aulocopina family are peculiar to Ontario. This distinction no longer can be claimed. A Chicago gentleman lately submitted for inspection one he found in the Niagara rocks there. It possessed all the leading characteristics of the group, and may be a different species. He was greatly interested in the case containing the Hamilton sponges, and accurately described the transverse section of another species, which displays a large "osculum" encircled by many smaller ones. I fear we have not even a section in the museum. As the Chicago professor was a friend of Dr. Head's, who has already named and described "Aulocopina Walkeri," and other Hamilton sponges, the writer availed himself of the opportunity to furnish him with duplicates of a few forms which may not have been described already by Prof. Rauff. As well as I can remember the parcel sent by Mr. Walker to Germany consisted chiefly, he remarked, of sections, not complete sponges.

While congratulating ourselves in spring on the nature of the crops planted, in some of the best places for collecting unfortunately later on, when the oat crop was harvested, it was ascertained that clover, grasses and weeds had entirely concealed the surface of the field adjoining "the corporation drain," the one which for many years furnished us with numerous flint-flake fossils, from the glaciated Niagara chert beds, corals, brachipods, bryozoons. A portion of the next field close to the fence afforded me some fragments of bryozoon (*Lichenalia*) recently. Many years ago on turning over some of the flint-flakes there, I discovered a fine specimen of Hall's *cornulites bella striata*, and another more flexible form equally well preserved. We cannot expect much success in securing many specimens until the cows, horses and sheep are turned into the stubble fields and frost puts in its appearance to cut down the weeds which the cattle decline to eat.

Your Curator has at last succeeded in getting one of the Parasite Lichenalias attached to one of the plain globular sponges. He thinks, however, it may prove to be a different species from the ones previously found in the upper portion of the flint-flake fossil field adjoining the corporation drain. This specimen is from the brow of the escarpment beyond the Hamilton reservoir. The difference as regards distance may not amount to much, since nearly all the sponges are obtainable at both places. Yet you may remark our Niagara chert lichenalias present an appearance widely differing. The bryozoons, however, may be the same. For instance, where the epitheca (outer skin) of *Lichenalia Concentrica* is removed by the weathering process, you can hardly recognise it unless from its circular shape. In like manner internal layers, as it were, may possibly present differing aspects when parts are removed.

The writer can only submit to this section a few of the sponges and sections obtained since our last meeting. Some of the former and several of the latter (duplicates) were presented to gentlemen from Chicago, Toronto, Bradford, etc. No doubt if all could be placed before you for inspection, you may conclude there does not appear to be any falling off in numbers there. We must not forget since the new city quarry was opened and found to be deficient in graptolites and other fossils, every day is now employed in field researches. A few years ago the writer obtained from a single field near the city fourteen complete sponges. None were found there during the past two seasons. Six, eight and ten were not uncommon finds in others. The buckwheat strip in a field near the drain was favorable for collecting when the crop was removed, being quite bare and there the majority turned up of late. Even places miles from Hamilton, where one had no difficulty formerly in getting a score of sponge sections in a day, seldom furnish us now with more than a few, previously rejected probably as hardly worth collecting.

CLINTON AND MEDINA.

The abandoned Medina freestone quarries to the east of Hamilton are so completely concealed by a dense forest of a weed called sweet clover that I fear we have little to expect in the shape of a collection in that direction in future. The Clinton shale contained many well-preserved corals, stromatoporæ and brachipods, and the impure sandstone flags a little above the freestone building beds presented great numbers of fucoids with the conical roots embedded in an upright position. The late Dr. Nicholson, F.G.S., in his work, "Palæontology of Ontario," could never have seen even an ordinary specimen of the plant, or he would not have expressed any doubts regarding its nature. I am perfectly satisfied he could

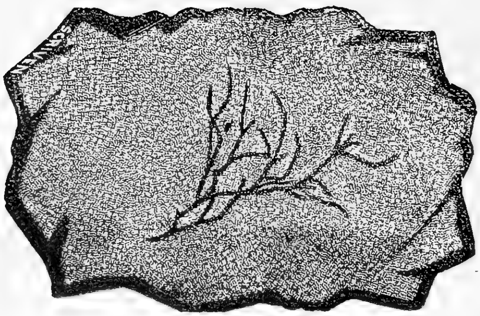


PLATE No. 1.

Represents a small Dradrographus discovered by Mr. Nichol in the Corporation quarry. It was found in an upper chert layer, which was much decayed round the edges, but unweathered in the centre where it occurs. This was the specimen for which a new species of Lichenalia was accidentally substituted in our late proceedings.

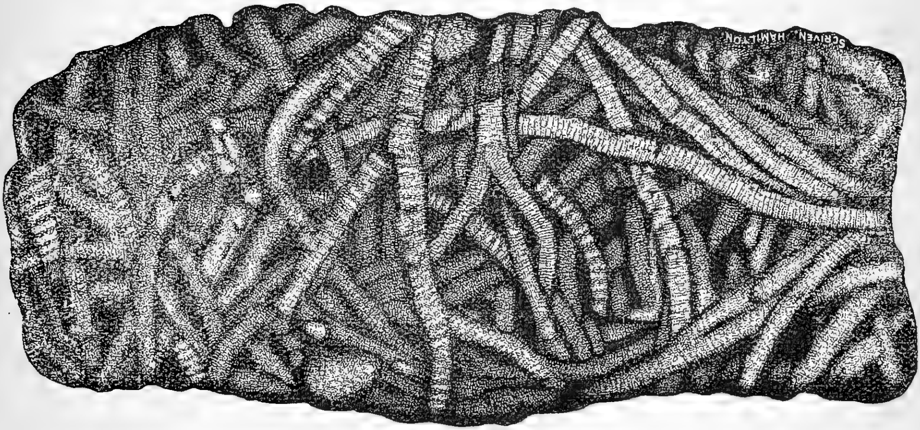


PLATE NO. 2.

Is the figure of a small Arthrophycus which, I am informed, has not been found outside the Clinton upper bed at Grimsby. Many Palæontologists in this continent and in Europe seem inclined to question its classification among the plants. By some, the original Fucoid of Conrad *Arthrophycus Harlani* Hall was said to represent worm burrows refilled by sediment. A writer declares that worms are found in Australia two or three feet in length. A specimen recently sent to the British Museum from Hamilton, unlike any hitherto found at Grimsby, was the one which was supposed to be the worm itself.

never have observed the impression of the main stem with the branches attached gradually getting thin towards the top. One of the layers, but not the large flag, contains apparently detached or broken off branches, in addition to Hall's *Lingula oblata*, which is white, not colored, as in the Clinton Iron-band.

A cliff at the foot of the Jolley Cut, near the small reservoir, presented many interesting specimens from the Clinton (May Hill) sandstones. A plant now in the Dominion Geological Survey office represented what the late Prof. E. Billings described as "a tangled mass of a cord-like alga in the shape of a pyramid." It was the only one of the kind found here; but in one of the quarries beyond the East-End Incline, where stonecutters were working on the Medina freestone, I found a nearly allied form (slighter, however) which had been chipped off from the surface of a thick block of sandstone.

The cliff in rear of the reservoir furnished me with some fine slabs of colored Linguleæ (*Lingula ungulata*), described and figured by Dr. James Hall, occurred in a thick iron hard rock which I had to break up with a sledge. The lower green band holds at least three graptolites. One of them I recognized as found previously in New York State. Retiolites Venosus was figured by Dr. Spencer, F.G.S. The frost penetrates the face of the cliff and large quantities of the material fall down in spring. Unfortunately this year it was carted away before it had been examined.

LAKE SHORE DRIFT, WINONA.

My old friend and fellow-worker, the late President of the Geological Section (A. E. Walker), called my attention to a well-preserved tail of a lower Silurian trilobite, *Asaphus Platycephalus*, which he had just extracted from a slab of shingle embedded in glacial clay, which underlies the ancient lake beach, now known as the Burlington Heights. This discovery was recalled to recollection by noticing some glaciated limestone shingle in the lower part of the drift a little above the lake level near Winona Park. Some others which were lying loose on the strand presented a similar appearance, so it seemed quite natural to conclude that many of the fossiliferous slabs were originally combed out of the clay there.

On extracting some of the limestone shingle embedded it was found to be exceedingly hard under the hammer, and the fossils inside were more or less injured, but on selecting a few of the softer ones I succeeded in obtaining a considerable number in fair preservation corresponding with others obtained from limestone lying loose along the lake shore.

Mr. Bartlett, a member of the Geological Section, noticed recently how exceedingly difficult it was to break up some of the rocks on the shore at Winona. If we can believe that much of the material has been derived from the glacial drift there it may account for it. Only the hardest rocks, with few exceptions perhaps, were likely to resist the crushing force of the glacier. The writer has much pleasure in submitting for your inspection a few of the specimens extracted from the boulders of the clay. The tail shield of the Trenton trilobite, *Asaphus Platycephalus*, was found in loose shore shingle. It may have been washed out of it, however, for two others were discovered embedded in the blue clay. These were not as well preserved as the one produced, but could be easily recognized. Some of the members may recollect I laid before you last year another Trenton fossil, *Avicula Trentonenses*, an internal cast, I think. Fortunately this summer I succeeded in obtaining one of the valves displaying the grooving—ornamentation.

Another interesting specimen is the small *Lingula*, derived also from the same series. It probably seems new to me. During my stay at Winona Park in June and July to the first of the latter, inclusive, I paid two visits to the abandoned quarries at Grimsby, chiefly with a view of obtaining a few Niagara bryozoons for Dr. Whiteaves. I felt satisfied no crinoids were obtainable, since my predecessor in office, Mr. Schuler, had raked in such a large number previously by means of the claw-like rake, which proved to be a capital implement for working in the soft Niagara shales which had been detached by my friend and fellow-worker, the late Dr. Johnson Pettit, formerly or had since fallen from above.

The upper Clinton green band, so rich in fucoids, hardly afforded a better prospect than the overlying shales themselves. We had in former years removed every specimen that we could reach, until merely the one was left. This was in such a dangerous position that we concluded it would be wiser to await the action of the winter frost, which assuredly must bring it down sooner or later. Even then, I fear, it will prove impossible to remove it. The plant was on the under surface of the thick sandstone layer. Contrary to expectation, on the writer's first visit to Grimsby it remained in the old place undisturbed. However, on the second visit it was found lying at the foot of the cliff after heavy rains. Although an exceedingly fine specimen of the large fucoid, *Arthrophycus Harlani*, I discovered a still more remarkable one concealed by withered leaves and bushes lower down on the sloping debris. It is considerably larger than the one first pointed out by Mr. Schuler. Even that I fear is too heavy for removal.

In a former paper published by the Council of the Association, the writer stated the upper green Clinton band at the Grimsby quarries held at least three distinct species or varieties of Conrad's fucoid, which Dr. James Hall subsequently re-named *Arthrophycus*. They are represented on distinct layers with partings of soft shale between. Could the plant have degenerated on passing up from the Medina Sandstone beds, where it was first discovered in New York State to the sedimentary rocks of the upper Clinton, some 70 feet above, and then resumed a similar appearance to what it originally presented?

On the writer's first visit to Grimsby in June the heavy rain forced him to return to the camp before he completed his examination of the more distant quarries, which frequently afforded us specimens of that singular little brachipod, *Dictyonella reticulata* (Hall). No doubt Prof. Scuchert, in *The Fossil Brachipoda America*, has good reasons for separating it from *the eichvaldia* of Billings, the late Palæontologist of the Canadian Geological Survey. Perhaps *Rhynchonella reticulata* of the former had priority of description. Hitherto we were under the impression the brachipod in question was confined to the most distant quarry, where Mr. Schuler obtained several, but the last one I found was discovered in the Niagara shale of another, and I forwarded it in a package addressed to the British Museum, England. As some consolation for the wetting received I succeeded in securing a very fine medium sized *arthrophycus*, the only one now in my possession, which I was very anxious to obtain.

Additional Notes on Late Collecting Season

By C. C. Grant.

DECEMBER 30, 1905.

When I placed before the Section recently some notes I had taken during the past collecting season in submitting for inspection the specimens discovered, I think I mentioned I had a few additional ones, which perhaps had better remain over for the present.

On consulting A. T. Neill, Chairman of the Section, we concluded, as there appeared some chance of getting a few new members, to bring to their notice any further facts respecting the Palæontology of the district, which may have been inadequately represented in former papers.

Now while it is generally known that the Silurian rocks about this locality have produced an extraordinary number of graptolites and fossil sponges, very few, I believe, imagine that it is also rich in other organic remains—fucoids, lamellibrauchs, corals, brachipods, bryozoons. Before grasses and weeds covered the soft Clinton shales which the quarrymen dumped down the hill-slope to get at the Medina freestone beds for building and ornamental purposes, one experienced little difficulty in securing many fossils in fair preservation.

For several years past the writer noticed a smooth skinlike process—generally on a plain globular sponge—which he supposed may have represented a portion of the organism itself. Later on, he felt inclined to imagine it may have been a parasite bryozoon attached in the same way as the brachipod *Whitfieldella naviformis*, so often found in a like manner. The latter appears to be the correct view judging from specimens recently obtained and submitted for examination.

In the same field where the bryozoon produced turned up was discovered a chert sponge bearing the large and deep depression or osculum of the Tennessee *Palæomanon Cratera.* Hitherto only a single specimen of the Tennessee sponge has been found here, recognized by Dr. Head, Chicago, who informed the writer that it was quite a common form in the States.

It was only when your Curator was re-arranging the fossils of our local rocks in one of the new cases that he recalled the many deficiencies in organic remains. Some years since the writer forwarded to the Redpath Museum at Montreal a collection of "annelid burrows"—footprints, tracks, etc., which furnished the late Sir Wm. Dawson with the materials of a paper he read to the Royal Geological Society in London. Only one—a beaded track—has since turned up, which he then named and described. Our Niagara sponges were found to be rather poorly represented, but this deficiency has in some measure been made good by acquisitions during the late collecting season, and others previously put aside owing to the overcrowded state of the flat cases. Many of the Hamilton graptolites described by Dr. Spencer, F.G.S., unfortunately are not forthcoming. The quarries now are not likely to add many to the ones we possess. The bryozoon Rhinopera resembles sometimes one of the graptolites. Indeed they are frequently mistaken for hydrozoa by many acquainted with the latter. The black matter, you may perceive, is confined to this particular part of the bryozoon. In some cases the leaf-like expansion is faintly outlined by a hardly perceptible stain on the surface. A question was put to the writer a short time ago to this effect: "What is a bryozoon, and how can it be distinguished from other coral building polyps?" In answer to that I stated it was by no means an easy matter to give a satisfactory reply, for even yet there is considerable difference of opinion regarding the organisms among palæontologists of much experience. I lately found among other extracts taken years ago the following on the subject in question. "What is a bryozoon and how can it be distinguished?" was asked by a student to a learned professor of the university. We fear his reply was ill calculated to enlighten the young biologist. He was recommended to study the works of Huxley, Allman, Forbes, and then by means of the microscope he may be more successful in distinguishing it than he himself had been, "despite many wasted hours he had spent over that same problem." The story may be true, and certainly in many cases great difficulty exists in regard to classification, and connecting links are seldom obtainable, even though their existence can scarcely be denied unsuspected. Now since evolution has been firmly established, we may expect to find an increasing number looking after the missing ancestral forms. I think it has been stated that the late Prof. Forbes, of Edinburgh, was the first writer to express an opinion that this class of organisms, considered anatomically, should be regarded as belonging to *the Mollusca.* However, the note adds, he merely recommended it without actually adopting it himself. The view appears to be generally accepted now.

Hancock and Milne Edwards, widely known palæontologists, thought the bryozoons were closely related to the *Funicarus*, classed by Woodward as the lowest order of Acphalous Mollusca. The Niagara shales at Grimsby will be found exceedingly rich in the class referred to in this paper. The glaciated chert beds of the Niagaras afforded me many specimens also. In natural history they rank above the corals and are numerous in all the modern seas. Many are commonly called sea-mats, or mosses, mermaids, lace, etc. Sir Archibald Grikie, in The Class-Book of Geology, under the division VII., Molluscoida, groups tunicata (sea-squirts), polyzoa, bryozoons, brachipods together. When Agassis claimed that his researches led him to believe the graptolites belonged to the soft-bodied Acalepha (Medusæ), as well as some of the lower forms now classed as corals, I forget if he alluded to this division of the polyzoa.

We have recently been informed that one of our city clergy has once more been warning his congregation against the unscientific conclusions of modern geologists—Darwin, Huxley, etc. We may congratulate Hamilton on possessing a reverend gentleman so competent to teach the late Dean Farrer and scores of the Anglican clergy the error of their ways—Dean Farrer, of whom the author of "The Warfare of Science" wrote: "His noble protest against the theological vilifiers of Darwinism deserves perpetual remembrance." In our day, when evolution appears to be universally and firmly established, it would seem only a mere waste of time on the part of the average parson to arrest its progress by appeals to ignorance and prejudice. Attacks on Darwinism have merely led to a very great increase in its followers, and a wider and more extended study of the writings of the great scientific men on the subject. The clergy of the various Christian denominations have always been admitted to be an advertisement which science certainly appears unwilling to ignore. In discussing the matter recently the writer's attention was directed to the following paragraph occurring in an English publication :

" A certain Bishop, as he was going about his diocese, asked the porter of a lunatic asylum how the chaplain, whom he (the Bishop) had lately appointed, was getting on. 'Oh, my lord,' said the man, ''is preaching is most successful. The hidiots henjoys it hin particular.' "

In the late published Proceedings of the Hamilton Scientific Association the figure No. 1 accidentally represented as "Dendrograptus" is one of the Lichenalias obtained in situ beyond the rock cutting on the Grand Trunk line close to the stream which crosses the road near the little Horseshoe Falls. I placed the original, which I am of opinion may be a new bryozoon, with some other fossils from our local chert beds of the Niagara series. In the plate the Lichenalia was displayed upside down.

It is unnecessary for me to explain my reasons for resigning the Curatorship of the Museum. The removal of all the flat cases by a few members of the Council while concealing their intention from the very person responsible for the proper arrangement of the Museum would alone be sufficient to justify me in the eyes of anyone acquainted with a Curator's office for the step I was forced to take. All members of the Hamilton Scientific Association were aware of the fact that the present quarters were inadequate as a museum and lecture-room, so when we failed recently to procure additional accommodation, the Council apparently concluded to fix up a few upright cases with shelves, cram the contents of all the flat cases into these, in accordance with peculiar ideas regarding "local museums" prevailing here, *viz.*: that such places are intended mainly for the display of "old curios" and minerals from places outside the city.

Mr. Neill, our Chairman, called attention a short time ago to the overcrowded state of the cases containing local specimens. The object our Section had in view was to collect as far as possible a complete series of the fossils of the district, and when proper accommodation was subsequently afforded us, we could re-arrange them in the usual way. The largest upright case, intended for organic remains, is insufficient to contain our Barton and Niagaras alone. The long case at the top of the room held what geologists from the States considered a very good collection of Clinton fossils, which are impossible now to obtain here. From want of the necessary accommodation we were obliged, as a temporary measure, to place in this case also a considerable number of Hudson River and Trenton organic remains, partitioned off from Utica shale specimens, Medinas, etc. The contents of this case I am unable to collect. Scattered specimens from the Devonian and Dominion palæontological cases, the latter received from Ottawa—where have these been put? Mr. A. Gaviller, a late Curator, at the request of the writer promised to write to relations in England for a small collection of *chalk* and *lias* fossils, in order that the Geological Section could present a few examples in an unbroken series from the Potsdam sandstones to tertiary times. That collection was given conditionally. It was not to be sent to Dundurn, nor, as I suggested, to Toronto either, in case the Association failed to keep open the City Museum. I am not aware if he imposed conditions on other things he presented to our Association.

It has been truly remarked by a well-known Smithsonian professor that a Museum which admits of no expansion and is unable to find a place for future contributions is to all intents *a dead one.* The new upright cases are insufficient. The upper shelve specimens cannot be well seen. Neither can the ones contained in the lower one to advantage. They take up less room, are less liable to injury, exclude dust better than the cases they supplanted, but for displaying the contents to advantage I must admit a preference for the old cases. "One has to stoop considerably to see the shells down there," remarked a lady visitor recently, pointing to a lower part of an upright, "and I think they were better arranged before."

The missing case, which held the Eocene and Miocene fossils from the United States, turned up empty—probably the contents were mistaken for modern sea-shells and may be found promiscuously mingled with specimens of land snails, fresh water ones, etc. They are all shell-fish. Why should not the same case hold all?

Everyone knows the place used as the city museum is unsuited for a lecture-room or the display of the annual camera exhibition in addition. Surely for the very slight space secured members of the Council must see it was scarcely worth the object gained to destroy in a great measure the work of the Geological Section. We were gradually replacing the collection of modern sea-shells and Indian relics Mrs. Carey removed to Dundurn. Further additions are rendered impossible. This may be said also of the entire collection. As far as the writer can see the Museum, as such, has passed out of existence. To all intents and purposes it is what a Smithsonian professor calls *a dead one*.

How can any additions be made in future to cases overcrowded already? And the Council blocks the way to any further contributions.

A departed Museum needs no Curator.

Notes Geological and Antiquarian

By Col. C. C. Grant.

MAY 8, 1906.

Mr. Schuler, late Curator of the city Museum, now residing at Rochester, has received information that the large collection of Hamilton-Niagara graptolites in possession of the Smithsonian Institute at Washington was about to be handed over to the New York State Survey for description. A few of the old members of the Association may recollect that this collection was about to be described many years ago by Dr. Gurley, whose sight unfortunately failed when a few only were figured. The writer thinks there are about 300 or more specimens in Washington.

No account has been kept of the number of graptolites subsequently forwarded to the British Museum. They represent a large number of new species no doubt, quite distinct from any previously found here. The City Museum (and the Redpath in Montreal, perhaps) has others as yet undescribed. "Hamilton fossils are everywhere in great demand," remarks Mr. Schuler. The ones he took from this country to the States will probably be described by Prof. R. Ruedmann, who has recently described a very large number of the family from the lower Silurian rocks in the States. The plates are not given in the copy of the Report which the Director-General of the New York State Survey kindly sent me. The new species (about from 16 to 20, perhaps) are named, but not described yet. The professor also in addition recognizes many already known to Hall, Nicholson, Lapworth, outside the States.

A parcel forwarded to the British Museum on the 3rd of April contained a very fan-like Lichenalia claimed as a new species, also a chert Stromatopora, which was pointed out as differing internally from any known to the writer in Clinton, Niagara or Guelph beds.

Another head-shield of *Acidaspes Halli* was also discovered and sent to London. This trilobite, now in the Redpath Museum, was described by Dr. Spencer, F.G.S. We believe these are the only ones found as yet here or elsewhere.

These "old stones from the mountain," so designated, are highly prized in Great Britain, Germany and the States, everywhere but in Hamilton itself.

PRIMITIVE MAN IN IRELAND.

A series of lectures on this subject was recently delivered at the Alexandra College, Dublin, by Prof. J. Cooke. There was a large attendance and the learned gentleman displayed by limelight views of flint and stone implements found in Ireland. Slides of similar things from Hamilton, Ontario, were also displayed when pointing out the undoubted superiority of the workmanship of the prehistoric Neolithic man there to the articles made by the red men in Canada. It is said that the Erie Indians possessed greater skill in manufacturing these things than any of the other tribes. The writer has never found any pirtrap in Canada yet. He has, however, seen mound-builders' relics from the United States, made by the red men's ancestors, which may compare favorably with the Irish implements. A few relics in better preservation were forwarded more recently to Dublin from Ontario. The writer was glad to see Prof. Cooke was of opinion that the early Neolithic civilization, such as it was in Europe, was derived from Kushite tribes from North Africa, the builders of monoliths, cromlechs, cairns, tumuli, etc. The famous Italian astronomer and antiquarian, Secchi, states that the early civilization of this ancient people in the Mediterranean was blotted out by invading hordes of savages called Aryans from Asia. It is claimed that these Kushites imparted to Egyptians, Indians, and Babylonians, the first rudiments of arts, burial rites, etc.

It is greatly to be regretted that so little interest is taken in the relics of primitive man by Canadians in Hamilton. I find almost the only collectors of such things here are lately arrived men from other countries. We are lagging sadly behind Toronto in this matter. A few more like Mrs. R. Holden are much to be desired.

Natural History Society, Montreal

**Extract from a Montreal Paper.*

The last regular meeting of the session was held last evening in the Society's hall. An interesting paper was read on "Recent Discoveries of Lt.-Col. Grant in the Fossils of Niagara Limestone." The fossils exhibited were from the collection of Lt.-Col. Grant. Hamilton, Ontario. He has long been known as a diligent and successful collector in the formation near that city. Many of the specimens passed through the hands of the late Mr. Billings, and a new species of sponge (*Aulocopina Granti*) was named by Mr. Billings in honor of its discoverer. Col. Grant has recently made many new acquisitions, some of which he has kindly presented to the Museum of the University.

Some of these specimens illustrate the graptolites (remarkable) of the genus Dietyonema and allied genera. Of these several new forms have been discovered by Col. Grant, which it is hoped will shortly be described. Another series of specimens represent the interesting sponges of the Hexactinellid type (found in the Niagara limestone). They are preserved in silicious nodules, in this resembling the more recent sponges of the chalk formation, many of which belong to the same group. When polished many of them show in a beautiful manner the star-like spicules of these sponges, arranged in the most beautiful and intricate patterns. A few also exhibit the internal forms. They belong to the genera *Astylospongia* or *Aulocopina* and some of them are probably new species. A selection has been placed in the hands of the German Palæontologist Zittel, who has promised to report on them. A very remarkable discovery recently made in the Niagara limestone is that of some fragments of a gigantic crustacean of the genus *Pterygotus*, comparable in size with the great *Pterygotus Anglicus* of the Devonian of Scotland. Though of much greater geological age, the present is so far as known the first example of a large and well-developed species of this genus from so old a formation. Col. Grant hopes to obtain additional remains. In the meantime the well-preserved maxilliped or ectognath before us, with rounded, scaly bosal part and narrow maxillary procep with about twelve denticles and three and a half inches in length, is sufficient to indicate a large and new species which may for the present be named *P. Canadensis*, which was the Canadian predecessor of *P. Anglicus*.

P.S.—In addition to about twenty-nine new graptolites described by Dr. Spencer, Col. Grant has obtained since some seventy more undescribed from the Niagara and Clinton beds, Hamilton. Dr. Head, Chicago, has named two new genera (sponges) from Hamilton, Ontario. His illness has unfortunately prevented their description yet, and later two additional ones, also unknown hitherto, one of which he also discovered in Tennessee, but the other—well marked and widely differing from this family group—must remain for further investigation until his arrival, which is expected soon.

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*Note—Extract mislaid some years ago.

ASTRONOMICAL SECTION

The Astronomical Section did not begin its regular meetings till December, although previously several lectures of an astronomical character were delivered by the returned members of the Eclipse Expedition to Labrador.

Below is a list of papers contributed :

1. Dec. 12, 1905—The Motions of the Earth, by Mr. J. J. Evel.
2. Jan. 8, 1906—The Sun, by Rev. Dr. Marsh, F.R.A.S.
3. Jan. 30, 1906—The End of the World from an Astronomical Standpoint, by G. Parry Jenkins, F.R.A.S.
4. Feb. 13, 1906—Recent Solar Eclipse Expeditions, by Rev. Father Brady.
5. March 13, 1906—Photography in Astronomy, by Rev. Dr. Marsh, F.R.A.S.
6. March 22, 1906—The Earth's Beginnings, by F. L. Blake, O.L.S., D.L.S., Toronto.
7. April 10, 1906—Motions of the Heavenly Bodies, by Alex. Laing, Detroit, Mich.
8. April 24, 1906—The Heavens Declare the Glory of God, by Rev. Dr. Marsh, F.R.A.S.
9. May 8, 1906—Vesuvius Eruptions and San Francisco Earthquakes. A general conference.
10. May 15, 1906—The Annual Meeting. At which reports were read and officers for the ensuing year were appointed.

The reports showed the Section to be on a sound financial basis, and in a flourishing condition otherwise.

Gratitude to the parent Association was expressed for their kind and attentive interest in all matters pertaining to the success of the Section.

For reasons of economy no work of a special nature was undertaken, and it is pleasing to note that without the attraction of special lectures the interest of the members has not diminished. In fact, the general interest has increased. Twelve new members have been added to the roll, making in all a total of eighty. It is noteworthy that all the papers but one (that of Mr. F. L. Blake) given during the year were by members of the society. The general public also have manifested a deep interest in astronomical subjects and look to the members of the Section for information re astronomical phenomena.

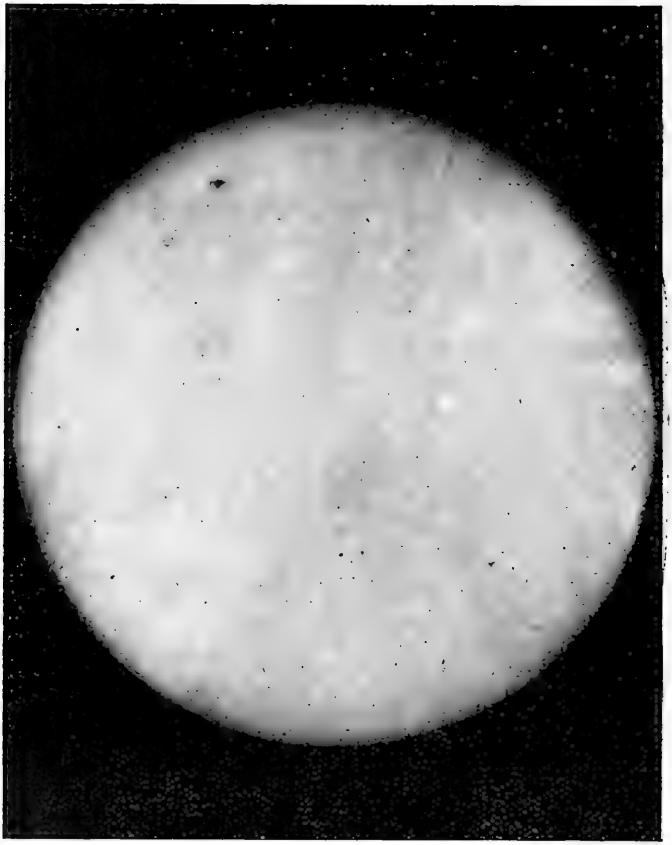
During the season now closing we have been honored along with the Scientific Association by having the following prominent gentlemen consent to become honorary members: Mr. E. W. Maunder, F.R.A.S., Royal Observatory, Greenwich, England, and Mrs. Maunder; W. F. King, M.A., LL.D., Government Astronomer, Ottawa; W. T. Grenfell, M.D., M.M., F.R.C.S., Labrador; John A. Brashear, F.R.A.S., Allegheny, Pa.

After the reports were received the following officers for the ensuing term were appointed:

Rev. D. B. Marsh, Sc.D., F.R.A.S., President.
G. Parry Jenkins, F.R.A.S, 1st Vice-President.
J. J. Evel, Esq., 2nd Vice-President.
E. A. Gaviller, M.D., 3rd Vice-President.
J. J. Greene, Esq., Treasurer.
E. H. Darling, Assoc. M. Can. Soc. C. E., Secretary.

Rev. J. J. Morton . . .
W. A. Robinson, Esq., } Councilors.
Wm. Murray, Esq. . .

Alex. Turner, Esq. } Auditors.
J. G. Cloke, Esq. .



SUN.

July 27th, 1906.

PHOTOGRAPHED BY REV. DR. MARSH, HAMILTON, ONTARIO, WITH A FIVE-INCH BRASHEAR REFRACTING TELESCOPE.
EXPOSURE, 1–1000TH OF A SECOND.

The Motions of the Earth

By Mr. J. J. Evel.

In dealing with this, the lecturer illustrated the subject with an elaborate mechanical device of his own construction, showing the sun and the orbits of the planets; and as this lecture was intended to reach the most untutored student of astronomy as well as to help those further advanced, the many confusing technical terms were explained, after which the following eleven motions of the earth were described and discussed :

1. Diurnal.
2. Orbital.
3. Precession of equinoxes.
4. Parallactic inequality.
5. Nutation.
6. Obliquity of the Ecliptic.
7. Variation of eccentricity.
8. Changes of major axis.
9. Perturbations.
10. Planet attraction.
11. The whole Solar system moving.

The Sun

By Rev. Dr. Marsh.

This paper was intended to instruct and encourage the amateur astronomer, and was profusely illustrated by lantern slides. Many of the photographs were taken with his own 5-inch Brashear telescope.

The End of the World—From an Astronomical Standpoint

By G. Parry Jenkins.

No doubt there are those who consider it presumptuous to discuss such a subject as "The End of the World." They argue that it is entirely beyond human understanding, and is far better left severely alone. To inquiring minds, however, the very fact that there is a mystery around it only spurs them on to endeavor to find a solution. If man had shrunk back from the apparently insurmountable difficulties that beset many a problem, some of the greatest discoveries and inventions would to-day never have been brought to light. The inborn spirit of research is fully emphasized in Milton's immortal words :

> "To ask, or search, I blame thee not, for heaven
> Is as the book of God before thee set,
> Wherein to read His wondrous works and learn."

It is only intended to deal with the subject here from an astronomical standpoint, without going into the theological aspect of the question. In passing, however, we would allude to St. Peter's prediction of the destruction of the world by fire, which is very graphically portrayed in Second Peter, iii., 10 : "But the day of the Lord will come as a thief in the night, in which the heavens shall pass away with a great noise, and the elements shall melt with fervent heat ; the earth also and the works that are therein shall be burnt up."

Although St. Peter uttered those memorable words nearly two thousand years ago, it is worthy of note that, long previous to his day, in the great Sanscrit poem, the Mahabharata, there is also a similar prediction, which says, "O King, towards the end of those thousands of years and when the lives of men become very short, a drought occurs, extending for many years. And then men and creatures, endued with small strength and vitality, becoming hungry, die by thousands. And then seven blazing suns, appearing in the firmament, drink up all the waters of the earth that are in the rivers or seas. And then everything of the nature of wood and grass, that is wet or dry, is consumed and reduced to ashes. And then the fire called Samvartaka, impelled by the winds, appeareth on the earth that hath already been dried to cinders by the seven suns. And then that fire, penetrating through the earth, consumeth the nether regions, as also everything upon this earth, and that fire destroyeth all things in a moment."

Accepting the truth of these remarkable predictions of scripture, and of some of the most ancient records of the East, let us endeavor to explain how, from an astronomical point of view, the catastrophe of the end of the world by fire might be brought about by the operation of natural causes.

Many consider that such a conflagration as we are considering might one day be brought about by a terrific outburst of the internal fires of the earth. We have in the existing volcanoes, of which there are 300 in activity, direct evidences of the pent-up fires that rage within the earth itself, but geology teaches us conclusively that the earth is cooling down and will doubtless continue to do so for many years to come. Indeed the granite and other igneous rocks are standing proofs of the time when even the crust of this old earth of ours was in a molten condition. Besides, St. Peter distinctly says that the fire will come from without. "The heavens," meaning the earth's atmosphere, not the earth, being on fire, is to be the immediate cause of destruction.

Others have sought for a possible cause of destruction of the earth by an outburst of the sun, and this is far more likely, although not at all probable when we examine existing conditions. Astronomers are quite familiar with the daily outbursts on the sun, as indicated by the huge red flames, prominences as they are called, which are revealed by the spectroscope. Some of these solar outbursts have been known in recent years to throw out tongues of living fire 300,000 miles in length—or nearly 40 times the diameter of the globe we inhabit, but fortunately we are 93,-000,000 miles away and escape their consuming breath.

Now all life that we are acquainted with depends upon the constancy of the heat we receive from the sun. Any great changes of temperature, which in this case would not be due to weather or climatic conditions, but to excess in radiation of the sun's heat, would mean certain death to all mankind on the face of the earth. Consequently, the end of the world, as far as we are concerned, would surely follow from an increase of solar radiation. Most astronomers, therefore, look to such a catastrophe as we are considering arising from this quarter.

Before we pursue the argument further, or adduce proofs in support of this theory, it is well for us to take the true bearings of the sun's position in the scheme of God's infinite creation. What is the sun, which is the source of all light, heat and life to the earth we dwell upon, as well as the planets that belong to the solar system? The sun is no more than an ordinary star, and, conversely, the stars are suns. It is most essential that this great truth should be fully grasped and its significance properly estimated. In his "Night Thoughts," the poet Young has beautifully and accurately described this conclusion:

> One sun by day,
> By night ten thousand shine,
> And light us deep into the Deity.

When the so-called fixed stars are critically examined by the spectroscope, we find they are composed of precisely the same elements that form our own sun, and that these very substances also enter into the constitution of both suns and stars alike. No fact has been more clearly demonstrated in recent years than this close relationship of sun and stars.

When one of our friends "shuffle off this mortal coil," we miss the accustomed form and familiar nod, but the old world goes on just the same. Precisely the same thing happens in the sky. When a star disappears, or in reality that particular world comes to an end, its bright face is missed, but the myriads of other companion stars shine on as if nothing has happened.

Let me say right here that if what we would call the end of the world were to come about this very night by the destruction of the earth and every planet belonging to the solar system, including our own sun itself, the only effect upon the face of the sky from the nearest fixed star would be that one star had ceased to shine, and that solitary star would be our sun. From Alpha Centauri, the nearest fixed star, our glorious sun appears only as an ordinary star. Not a single planet—no, not even Jupiter itself, although over 12,000 times larger than the earth—is visible there, because the earth and all the planets only shine by reflected sunlight. At the immense distance that separates one sun from another—say, our own sun and the sun Alpha Centauri—the earth being a dark body is quite invisible, like every other member of the solar system, with the single exception of the sun itself. If I have made this important fact quite clear it follows that the destruction of our world then, by whatever means brought about, would only be quite a local affair as far as the real universe is concerned.

We might reasonably compare the sun and the planets to a small group of islands in the great ocean of space. The nearest star-land we can expect to strike outside this island universe of ours is very remote—in fact, infinitely further off in proportion than the distance that separates the continent of America from Europe across the Atlantic Ocean, or even Asia by way of the Pacific Ocean.

Nevertheless, as it is an ascertained scientific fact that the sun is in reality moving through space, and dragging all the planets with it, at the rate of eleven miles a second, which is 660 miles a minute or close upon 40,000 miles an hour, what are the probabilities of our world coming to an end through the actual collision with one of the thousands of blazing stars that lie around the sun's path? Well, let me allay any fears that may arise in this direction by saying immediately that even travelling day and night at the prodigious velocity I have mentioned—40,000 miles an hour—it would take our swift sun no less than 80,000 years to pass over the distance that separates it from the nearest fixed star. There is, therefore, no danger signal ahead of us from one of the stars that shine above us for a good many years at least, and the chances are that if we do get near to one of them 80,000 years hence the mutual laws of attraction and repulsion will avert a celestial catastrophe.

Now we know the rate we are travelling at, it becomes an interesting question to find out where we are bound for. This point has also been settled by astronomers. The sun and all his family are travelling to a spot in the sky situated in the constellation of the Harp, and close to that first magnitude star named Vega. Unfortunately this line is not double-tracked, and it is along this very road that the real danger exists. Not indeed by coming in contact with any of the well-known fixed stars, as they are called, but by a hidden star, in fact a dead star, the very existence of which we cannot ascertain until it is too late to avert the awful calamity which is sure to befall this old world of ours sooner or later.

A noted astronomer, J. Ellard Gore, has calculated if this approaching dark body had the same mass as our sun, its first appearance would be heralded as a star of the ninth magnitude when at a distance of 15,000 millions of miles from the sun. If the dark body were moving towards us at the same rate the sun is moving in space, it would take just a trifle over 15 years from its appearance, before colliding with the sun. The effect of such a collision would reduce the two bodies into a gaseous state within an hour, and enough heat would be produced to burn up the earth and probably most of the planets of the solar system.

The great Bishop Butler, of "Butler's Analogy" fame, says that analogy is the law of life, and we might add with equal truth that it is also the law of death. Let me recall to your minds Tennyson's words in this connection, for altough he was only a poet, yet he was always scientific. He says:

"The old earth had a birth,
  As all men know, long ago.
And the old earth must die;
  For all things must die."

This universal law of life and death seems to pervade throughout the whole material universe, and we have in consequence stars, or worlds, in different stages of development.

Thanks to the invention of the telescope and spectroscope, we have ocular demonstration of the life history of many of these other worlds than ours.

The heavens abound with examples of infant worlds in their embryonic stage. These are the nebulæ of which thousands are accurately mapped and catalogued. Then we have stars in the prime of life and vigor like Sirius, Vega and Altair. This class, or type, is known as "Sirian Stars" and embraces more than half of all the other stars. Following in the order of development we have stars which have reached their full maturity, and are just turning the hill of life, as we familiarly say. Of these our own sun is an example, so is Capella and Arcturus, and stars of this class are generally known as "Solar Stars." The stars nearest to the solar system are mostly of this type. After these we have numerous examples of real old age, and even death itself in some of the great orbs around us.

The latter have, of course, lost all their former light and heat (like our own moon), and they may be regarded as a menace to the worlds of light and life.

After this short review of the condition of things above, I think we are in a better position to comprehend the awful doom that awaits the solar system when "the heavens shall pass away with a great noise, and the elements shall melt with fervent heat, the earth also, and the works that are therein, shall be burnt up." This is what will actually occur if the sun encounters one of those black bodies wandering in space, for the collision will have most disastrous effects. The sudden accumulation of heat in the sun will be so great that the earth's atmosphere will ignite and the whole crust will melt, while every vestige of life will be swept away.

The question arises whether, in the vast realms of nature, similar catastrophes as we are discussing have ever arisen in some other star system. If we could only find that such is the case, it would very materially strengthen the position we have taken up. I answer most emphatically that what are known as "temporary stars" are cases in point. The argument from an astronomical standpoint stands or falls upon this contention, and here again analogy is our chief guide.

Briefly, all stars are divided into three groups, called fixed, variable and temporary. The fixed stars, which are by far the most numerous, are those which shine with undiminished brightness. The variable stars are those which fluctuate in their light. The temporary stars, on the other hand, suddenly burst upon our sight, continue visible for a few days, weeks or months, and then they are gone forever. It is generally conceded by astronomers that the message conveyed to us when we witness such a sight as a "temporary star" is nothing more or less than a mighty world in space has been consumed by fire.

A few notable instances of such startling events may be recalled. The oldest record of such a strange phenomenon is that in the year 134 B. C. A new star suddenly appeared in the sky, and was bright enough to be seen in the day time. This led a famous astronomer of those days, named Hipparchus, to compile the first star catalogue ever made, with the object of detecting any other strangers that might enter into the starry skies.

The Chinese, who were great students of astronomy in olden days, also refer to a new star, which appeared in the constellation of Centaurus in the year A. D. 173.

During the reign of the Emperor Theodosius another "temporary star," equal in brightness to the planet Venus, made its appearance. This was in the year A. D. 389. We have also records of new stars which are said to have been observed in the years A. D. 945 and 1264. Then in the year 1572 a most remarkable temporary star appeared in the constellation of Cassiopea, and was observed by Tycho Brahe. When first discovered it was brighter than Sirius, and afterwards became visible in broad daylight. It, however, gradually faded away after remaining visible during a period of nearly sixteen months.

Kepler discovered a temporary star in 1604, and it was observed for over a year, after which it has never been seen.

Another astonishing instance of these new stars is the one which burst out in the constellation of Corona Borealis (the Northern Crown) in May, 1866.

In 1876 Schmidt, of Athens, detected a temporary star in Cygnus of the third magnitude. It ceased to be visible to the naked eye within a month after its discovery, and can now only be discerned with a most powerful telescope.

One of the most modern occurrences of these wonderful objects is the new star which was detected in Auriga by an amateur astronomer, Dr. Anderson, of Edinburgh, just 14 years ago. It only remained visible to the naked eye a few weeks, and I was fortunate enough to make several observations of it in February, 1892. With regard to this latter body Prof. Todd, of Amherst College, says: "The outburst which produced the sudden rise in its brightness must have taken place on a scale inconceivably grand. The complex character of its spectrum in February, 1892, indicates a probable collision, or at least a near approach of two vast gaseous bodies travelling through interstellar space with a relative motion exceeding 500 miles a second."

One of the greatest authorities on such matters, the late R. A. Proctor, concludes: "A change in our sun, such as affected the star in Cygnus, or that other star in the Northern Crown, would unquestionably destroy every living creature on the face of this earth; nor could any escape which may exist on the other planets of the solar system. The star in the Northern Crown shone out with more than 800 times its former lustre; the star in Cygnus with from 500 to many thousand times its former lustre. Now if our sun were to increase tenfold in brightness, all the higher forms of animal life, and nearly all vegetable life, would inevitably be destroyed on this earth. If the sun increased a hundredfold in lustre his heat would doubtless sterilize the whole earth."

Of course, the final word has not yet been spoken on this profound subject; and it is only by a closer study of the starry hosts, in general, that the astronomers of the future can hope to throw further light upon the operation of universal laws within the little globe upon which we "live, move and have our being," as well as the greater worlds beyond.

Solar Eclipse of 1905

By Rev. R. E. M. Brady.

FEBRUARY 15, 1906.

The lecture consisted in a short sketch from different reports given of the sun's eclipse Aug. 30th, 1905.

THE REPORT FROM THE BELGIAN EXPEDITION.

The eclipse was observed from an elevation at Lelaila near the city of Burgos, Spain, at an altitude of 2,000 feet. Here the Belgian, English, French, German and Holland Expeditions met.

They were given assistance by the Spanish officers and soldiers, who also furnished them with tents. Dust and excessive heat interfered with the atmosphere and with the instruments; but those great scientists met difficulties in a philosophical way and overcame them as best they could.

Photographs of the landscape were taken at three different stages of the eclipse, illustrating how the light receded, until Venus and a half dozen stars were clearly visible.

At Phillipsville darkness was even greater, owing to a different condition of the atmosphere. Dogs, sheep and other animals were noticeably affected by the phenomenon.

From 12.20 to 1.20 p.m. the temperature fell from 80° to 74°, and for a short time at broad noon day, those sweltering under the Spanish sun were allowed to sit in the shade of the moon, without moonlight, without sunlight, while they gazed upon the stars. The eclipse in its first contact was invisible; the other two contacts were seventeen seconds ahead of time. There were distinct red protuberances on the corona.

ECLIPSE.

The fleeting of the waves of light was photographed and measured and found to recede at 700 metres a second.

Among the many contrivances was a paper disc affixed to an alarm clock; it had an opening through which it received light as the minute hand revolved.

The King of Spain paid a visit to the observatories. A most interesting report came from Manager Spee who, with the skilled assistance of eight Jesuit priest artists, sketched the eclipse from the observatory of Merrid College.

HAMILTON EXPEDITION.

The closer a thing is brought home to us the more interesting it becomes. Up Hamilton Mountain at 5.30 a. m., August 30th, some 30 or 40 members of the Hamilton Astronomical Society and their friends ascended the mountain and took possession of the few telescopes and instruments erected the day previous. There was a tent to shelter them from a great rainstorm which preceded the eclipse. This eclipse has been described by a learned member. I will only mention the prelude. Shortly after the moon had started its course across the sun's disc, the heavy clouds, which till then reigned supreme, split asunder, and from 6.45 till 7.20 there was a good view of the eclipse. There was no corona as there was not a total eclipse.

Perhaps the moon projected 4° above the horizontal line drawn from east to west through the centre of the sun's disc.

It was quite visible to the naked eye, as the sun's rays at that early hour are not strong. A few photographs were taken, but the effects of the eclipse on this globe were not well marked at our point of observation owing to the terrible thunderstorm which had preceded the eclipse.

Bright and early that morning the elements of nature which envelop our own planet were early astir, as though jealous of the spectacular phenomenon which the other planetary bodies were about to give us.

And for one short half hour it seemed to outdo all that sun and moon in conjunction could possibly bring to scientific observers. The vast expanse of the heavens seemed too restrained to contain the mountains of clouds. Nimbus, Cumulus and Stratus rushed forth in their angry mood and seemed to link arms till the heavens fairly groaned beneath their weight. Then thunder and lightning, as though jealous, came to demand their supremacy in this great drama.

Suddenly, as a flash of lightning alone can do, the electric fluid passes from east to west, thundering its presence from cloud to cloud, and the great canopy of the heavens fairly trembles with its explosions. Never could the scene be more dramatic ; it was almost tragical.

The stage upon which this great drama was performed had the heavens for its dome and the earth for its footstool, while the actors, more skilled than human genius, were the elements of nature. So realistic were they that fire and brimstone fell within a few miles of us and burned before our eyes a large building across Hamilton Bay.

I shall never forget this great prelude to our eclipse, which in itself was one of a lifetime. Now deep darkness, then sudden flashlights, with peals of thunder, then a conflagration reflecting upon the placid waters of Canada's most beautiful bay ; all while you were waiting for the eclipse.

Uses of Photography in Astronomy

By Rev. D. B. Marsh, Sc.D., F.R.A.S.

Synopsis

The lecturer gave a brief outline of the history of photography in astronomy, tracing it to the present. Then he threw on the screen some recent work done by the various large observatories throughout the world.

The effort of the lecturer showed that by photography in astronomy

1. Comparisons could be made.
2. Transient conditions were rendered permanent.
3. Correct records of conditions were obtained.
4. Photography a great aid to new discovery.
5. Orbits were determined with more accuracy.
6. Spectroscopic study much extended.

The Earth's Beginnings

By F. L. Blake, O.L.S., D.L.S.

The supposition, first formed by Col. Clarke in 1878, that the earth is an ellipsoid with three unequal axes rather than a sphere has acquired new and unexpected importance on account of its relation to the hypothesis brought forward by Mr. Jeans of Cambridge University that immediately before consolidation the earth was pear-shaped in form. According to Mr. Jeans, after the moon was thrown off from the earth, our planet was preparing to eject a second satellite, but stopped short of this perhaps on account of complete solidification ; hence the pear-shaped appearance. The ultimate configuration of the earth after consolidation was reached only as the result of a long succession of ruptures. This places the question outside the range of exact mathematics, but we can fairly assume that the final shape of our planet would retain traces of its initial asymmetrical condition, and, therefore, would be not quite spherical.

These speculations are of considerable importance since they throw fresh light on the very difficult question of the origin of the ocean. When the final stage of configuration was reached, the surface of the globe would not be quite an equipotential, and, therefore, the centre of gravity would not quite coincide with the centre of the figure. Were water placed on the surface of such a planet, it would form a circular sea of which the centre would be on the axis of harmonics, while the dry land would form a spherical cap.

The atmosphere of our earth during consolidation (exerting as it did a pressure of 5,000 pounds to the square inch) must have played an important role in the evolution of our planet, and may have given rise in a later stage of cooling to vast floating islands of scoria, the possible foreshadowings of future continents. Our planet was profoundly disturbed by tides produced by the sun, for there was yet no moon; it has, indeed, been suggested that the moon was severed from the earth by a tidal wave of great height. Be this as it may, the event of the separation of the moon from the earth is to be regarded as marking the first critical period in the history of our planet.

According to Professor Wiechert, the outer envelope of the earth's interior nucleus consists of silicates possessing a density of 3.2. It was from this envelope, when molten, that the moon was removed, twenty-seven miles in depth going to its formation. The density of our satellite, allowing for differences in temperature, is the same as that of the material from which it originated. Under circumstances of diminution of atmospheric pressure, as the moon drew away from the earth our satellite would become as explosive as a charged bomb, and the resultant explosions may have caused the existing features on the moon's surface.

The solidification of the earth probably became completed soon after the birth of the moon and marks the second critical period in the world's history.

On the crust becoming solid, definite areas of high and low pressures might have been established, causing depressions and elevations on the surface. When the temperature of the globe's atmosphere in cooling had fallen to 370° C., that part of the atmosphere consisting of steam would begin to liquify and the huge dimples on the earth's surface would become filled with superheated water, deepening till they formed the oceans. This is the third critical period in the earth's history. The course of events now becomes somewhat obscure, but sooner or later the processes of denudation and deposition commenced and have been acting uninterruptedly ever since.

The nebular hypothesis states that our earth was once a glowing star which in process of time cooled down to a liquid form and assumed a spherical shape, its atmosphere charged with water and mineral matter vapourised into steam by the intense heat. As the process of cooling continued, a thin crust was formed, gradually extending over the whole surface and increasing in thickness in spite of the opposition of powerful hypogene forces. Also, as the cooling went on, the atmosphere became over saturated and rain fell under tremendous pressure in scalding showers, while the earth's surface was battered and buffeted by the powerful factors acting upon it as the iron under the blacksmith's sledge. Finally, a turbid, shallow sea surged 'round the earth from pole to pole; and here the earth entered upon a regular series of progressive revolutions which gradually fitted it for the introduction of life.

It is evident that, as the process of cooling goes on, the earth's crust is proportionally thickening. Our superficial examination would lead to the belief that the crust is not of very great thickness. This assumption is supported by facts of which the following are the most important: (1) The temperature increases as we descend; (2) artesian wells furnish warm water; (3) the evidence afforded by hot springs and geysers; (4) the elevation and depression of the earth's crust; (5) the phenomena of volcanoes and earthquakes—all of which point to the presence of magma or molten metal at no great depth (probably not more than 50 miles.)

Men of science in their study of natural phenomena base their researches upon the "Law of Uniformity of Nature"—that is to say, they accept as true the supposition that similar causes produce similar effects, and that a study of the laws governing our earth will lead to a knowledge of those governing the universe. In such wise, the geologist, by observation of prevailing phenomena, is taught that the great stratified system of rocks was and is being formed by the deposition of sediment beneath water and under great pressure. These sedimentary rocks are Nature's sepulchres, where plants and animals from the most antiquated past have been entombed and embalmed; by means of them we can read pages from the history of the globe. Again, from a consideration of the discharges of volcanoes, the geologist sees that the material ejected practically corresponds with huge masses of rock which have been forced up through the stratified layers, and, therefore, applies to them the term "igneous." (These rocks must have been formed by internal convulsions.)

The remains of plants and animals found buried in stratified rocks are called fossils. They were known to the ancients, who connected them with mythological and supernatural events. As a rule only the hard parts of the vegetable or animal skeleton are preserved, and, hence, we have no record of the very soft bodies which probably constituted the earliest forms of life. In the case of the skeletons of vertebrates, it is very seldom that we find the perfect skeleton; often a very small part rewards our labours in the palæontological field. Palæontology (as the study of fossils is called) shows us that the geographical distribution of the fauna and flora was different in past ages to what it now is. Palæontology, while it does not teach us the exact period of man's advent, at least affords ample proof that he was contemporary with the mammoth, the cave-bear and other relics of the Post Pliocene.

Among the principal factors which aid in changing the configuration of our earth may be mentioned glaciers, and, by a study of their present modes of action, we are led to attribute very important results to their influence in past ages. They were especially important as transporting agents, carrying along rocks and sediment for hundreds of miles.

The first land, swept by a boiling ocean, was lifeless, and the period of time during which all life was (so far as we know) absent is called the Azoic time. The successive periods following the Azoic to the advent of man upon our planet are called: first, the Palæozoic time (time of ancient life); second, the Mesozoic time (time of middle life); third, the cainozoic time (time of recent life), which for the convenience of the palæontologist are all subdivided into periods in relation to the succession of life upon the globe. The palæozoic period is usually subdivided into (1) the Silurian Age (age of molluscs), (2) the Devonian Age (age of fishes), (3) Carboniferous Age (age of coal plants and amphibians).

Of these periods, the Carboniferous is to us by far the most important, since it is principally from these rocks that we obtain our coal, which plays such a widespread and significant role in all phases of modern industry.

The Mesozoic period may be subdivided also into three periods: (1) the Triassic, (2) the Surassic, (3) the Cretaceous. This period was essentially the age of reptiles, which were then in a position to call themselves the "masters" of the earth.

The third period of the Mesozoic, *viz.*: the Cretaceous, is also of importance as a coal-producing period, though much less so than the Carboniferous.

The last period, the Cænozoic, may be divided into (1) the Tertiary, and (2) the Post Tertiary, each of which is conveniently again subdivided into—

(1) Tertiary
- (a) Eocene
- (b) Miocene
- (c) Pliocene

(2) The Post Tertiary
- (a) Glacial epoch
- (b) Champlain epoch
- (c) Terrace epoch

It is in the Tertiary period that mammals first appear. The advent of man may be considered to be shortly after the Glacial epoch in the Post Tertiary.

MOON AT FIRST QUARTER.

JUNE 29th, 1906.

PHOTOGRAPHED BY REV. DR. MARSH, HAMILTON, ONTARIO, WITH A FIVE-INCH BRASHEAR REFRACTING TELESCOPE.
EXPOSURE, 10 SECONDS.

FULL MOON.

JULY 5th, 1906.

PHOTOGRAPHED BY REV. DR. MARSH, HAMILTON, ONTARIO, WITH A FIVE-INCH BRASHEAR REFRACTING TELESCOPE.
EXPOSURE, 6 SECONDS.

Motions of the Heavenly Bodies

By Mr. Alex. Laing, Detroit, Mich.

APRIL 10, 1906.

Synopsis

This lecture was very interesting, being illustrated by Laing's Planetarium, an instrument of the lecturer's own invention and construction. Mr. Laing very clearly showed the motions of the planets, comets, asteroids, etc., around the sun, explaining to the uninitiated the relation of time and longitude, the ecliptic (equinoxes) and solstices, the various eclipses, nodes, tides, seasons, right ascension and declination.

The lecture was very heartily appreciated and a vote of thanks tendered the lecturer.

The Heavens Declare the Glory of God

By Rev. D. B. Marsh, Sc.D., F.R.A.S.

Synopsis

In this the lecturer dealt largely with the immensity, variety, and numbers of the heavenly bodies; with their marvellous velocity and accuracy of the laws governing them. From this he sought to show the greatness of Him who created and sustains them.

Vesuvius Eruptions and San Francisco Earthquakes

Synopsis

This meeting being an open one, the above subjects were discussed by the President and Vice-President, with Messrs. J. J. Evel, E. H. Darling, Rev. J. J. Morton, J. R. Heddle, W. A. Robinson and Rev. Canon Henderson.

The various views relative to seismic phenomena were discussed with much profit to the audience.

The Annual Meeting

MAY 15, 1906.

After the appointment of officers and general business the work for the next term was discussed.

The term closed with a hearty feeling among the members.

BIOLOGICAL NOTES

By William Yates, Hatchley.

OUR NATIVE TURTLES.

Probably one of the most ferocious of our native *Chelonidæ*, or turtles, is the *chelone serpentaria*, or snapping turtle. This common inhabitant of our rivulets and morasses is sometimes designated the *mossback*, from the fact that parasitic vegetable growths, resembling moss, frequently almost cover the upper part of the shell of this *chelone*. These growths seem to take root and vegetate, and to be nourished, by the circulating fluids of the turtle's body, during its amphibious life in the sphagnous bogs and stagnant lagoons where the quadruped or lizard finds its carnivorous food and congenial home.

This creature attains considerable size, being sometimes captured weighing from twelve to fifteen pounds or more.

Where geese or ducks are bred, this dreaded, hideous-looking *chelone* preys with savage avidity on the immature or half-grown goslings or ducklings, and is consequently much dreaded and hated by the breeders of that description of waterfowl. Catfish, frogs, toads and snakes also afford foodstuff for this sanguinary and aggressive gourmand.

Their combativeness may be seen whenever a stick or such like weapon is placed in contiguity to the turtle's head, for they will suddenly snap thereat, fastening to it with their bony merciless jaws, and bulldog-like, refusing to relax their hold until beheaded or otherwise put to death.

Fierce battles are known to occur among rival males of this genus, about breeding time in the spring months, and the combat is said almost invariably to terminate in the death of one or the other of the contestants, and the battle, after the brutal jaws have once clenched, is sometimes of several days' duration.

Leeches, too, are frequently found in some numbers firmly attached to the crevices or joinings of the compartments or plates of the turtle's composite shell. These leeches are sometimes found preying on the chelone to the number of eight, ten or twelve, and are generally in such situations of the host's body as are inaccessible to its claws or mouth.

The female *chelone serpentaria* comes forth from its native bog or shallow mud-pool to some neighboring sand-ridge or sunny bank to lay its twenty or more eggs, which are deposited in a shallow cavity, excavated by the parent in the loam, sand or gravel. These are slightly covered and are soon hatched by the warmth of the sun's midsummer rays.

The progeny only attain a size but little larger than the diameter of a silver dollar by the time the cold weather of late autumn sets in, yet they seem to be left to forage for themselves from the time they leave the egg. Their food consists chiefly of worms, aquatic larvæ and small fishes.

Like the common mud-turtle or terrapin they hybernate in the soft mud, at a depth of from one to two feet, in the bed or near to the shore of ditches, undrained morasses and stagnant ponds.

Several communities of these terrapin were disinterred by an acquaintance of mine on the 2nd of October, 1905. These were associated to the number of five to seven in each group, and were embedded in a stratum of rather tenacious mud in a small brook near here, the mud being covered by a depth of ten or twelve inches of water which had a slight current. This arrangement was evidently designed to be the winter abode of these amphibious lizards.

It is an interesting sight to watch a group of these terrapins, reposing side by side, on a floating log or other floating wreckage, motionless, patient and silent, in the warm sunny rays of an August noon—a scene of sociability and fraternity reminding one, as an acquaintance once remarked, of the unanimity and dreaminess of a Quaker meeting ceremonial, peaceful ecstacy as it were. If the shadow of a passer-by approaches, there is an immediate dive or drop into the watery depths. These groups are usually composed of individuals of various sizes—a mixed harmonious "social" of infantiles up to vigorous adults.

The snapping turtle has been known to excavate a hollow for its eggs in the middle of a hard clay sunbaked, but perhaps little frequented, road, and the creatures seem to have some means of moistening the hard dried clay, for nests of eggs have been found near sunset time, where not a vestige of such an enterprise existed in the morning of the same day.

We have known some of the pioneer bush settlers to capture and feed and fatten the big snapping turtle for culinary uses by keeping the reptilian immersed for several weeks in a barrel partly filled with sour milk or hog-swill, and they asserted that turtle soup, made from these "moss-backs," was equal in flavor to the "Astor House" comestible supposed to be concocted from the famed green turtle of the Cuban lagoons.

There is another not uncommon species of terrapin which inhabits dried morasses, or that seems only partly amphibious. It has a more globular or bulging shell than the commoner one which infests mill-ponds and stagnating streams. The upper half of its shell is ornamented with nearly a hundred bright yellow or gold colored spots about the size of a pea.

It is affirmed by boys who amuse themselves sometimes by capturing these animals, that wherever they are set at liberty they are sure to crawl off in the shortest and most direct course to the nearest pond or stream.

CORVINE OR CROW CONGRESSES.

These are convened every autumn in a well defined "sphere of influence" or district area. In time, near to the end of the month of October. On a day, when sombre skies prevail, and the withering leaves in the forests are being stripped from the tree branches, and whirl and eddy across the landscape. In these swarming dark hosts the crow "traditions" and "folk-lore" are lectured on with much emphasis by the dark-hued "sachems" of the fraternity for the instruction of the "parvenus" of the season's hatching. The conclave seems to the human spectator a Babel of irreconcilable argument or denunciation. The "wiseacres" of the clan seem to be enunciating the traditional polity with threatening gesticulations toward the stupid juveniles or "kickers"—the irreconcilables, while utterances among the "pros and cons" seem at times to be blasphemous in energy and tone, and a "reign of terror" seems imminent. But after an hour or two of these angry cawings the turmoil abates and a few take the initiative and depart as if the "Resolutions" were carried by a potential majority and the crowd disperses, screaming across the landscape until all are absorbed in the headlong current sweeping away from horizon to horizon in quest of "fresh fields and pastures new."

It is averred by persons who have had experience with *pet* crows that if individuals of the latter kind ever attempt to return to the wild freebooting corvine life, and seek to regain equal status, the aliens are treated with deadly hostility and ignominiously "drummed out" or killed by the legitimists, who abhor the ideas of members of their kind who may have become infected with what seem to be regarded as unorthodox practices. Similarly if one of a young brood of "porcines" becomes from any accidental cause separated from the rest of the brood or family circle, though only for 24 hours or so, its return to the teat is fiercely resisted by the mother and killed by her if the reinstating attempt is persisted in.

CAMERA SECTION

Secretary's Report

During the past year, the Camera Section has been a little quiet, though there have been some very interesting meetings.

The outing to Tansley on Victoria Day was an enjoyable one, though for once the Grand Trunk Railway was a little too punctual, for a few of the members, losing their train, went to Bronte. The two parties meeting at Bronte station in the evening, each claimed to have had the best scenery, and this point has not yet been decided from the after results.

A number of short outings were organized during the summer, one of the most enjoyable of which was a trip round the bay in a gasoline launch.

The Section has the honor of being the only Canadian club to enter the American Interchange of Lantern Slides this year, and our winter months have been made more interesting by some very good sets of these slides.

A number of good demonstrations on lantern slide making, trimming and mounting of prints for artistic results and other subjects were given, and it is safe to say that a large number of members are not aware of the good points they missed through not attending these meetings.

The competitions during the year consist of that for the best picture taken at the outing on Victoria Day, when Mr. Hunt was awarded the prize; and the lantern slide competition in November, when the prizes were awarded as follows :—

Best set of slides open to all members—1st, Mr. Hunt; 2nd, Mr. Herald.

Best set by lady members—Miss Dixon.

The Annual Exhibition, usually held in March, was postponed till next October, this being considered a much more suitable time for the majority of the members.

During the year twenty meetings of members, including five outings, were held, and though nothing very startling has taken place, many of them proved very interesting and instructive. One of the Association's regular meetings was filled by this Section, when our President gave an interesting illustrated lecture on the History of Photography.

The Officers elected at our Annual Meeting for the coming year are as follows :—

President—Wm. Acheson,
First Vice-President—Chas. A. Herald,
Second Vice-President—Mrs. R. Campbell,
Secretary—Sinclair G. Richardson,
Treasurer—George Lees,
} Members of Executive.

James Gadsby,
A. H. Baker,
Miss Dixon,
Walter E. Hill.
} Advisory Committee.

By holding our Print Exhibition in October, we look forward to a more enthusiastic session next year.

SINCLAIR G. RICHARDSON,
Secretary.

Traders Bank Building,
May 18, 1906.

Curator's Report

The Curator begs to report for the year 1905-6. The Museum has been of interest to visitors and has been visited as much as formerly and the work of rearranging has been gone on with and will be continued until thorough renovation is made.

There have been some donations during the year, a collection of copper and silver money being one. We are working out the plan for cataloguing the Museum and hope to report actual work on the specimens soon. We regret that Col. Grant has had to relinquish some of his attention to the work of caring for the specimens, but are glad to say that he will still continue to give us his opinion and any assistance we require that he can furnish.

J. M. WILLIAMS,
Curator Pro tem.

Hamilton Scientific Association.

Treasurer's Statement for Year 1905-06.

RECEIPTS

Balance from 1905	$ 39 43
Government Grant	400 00
Members' Fees (general)	42 00
Members' Fees (Astronomical Section)	58 00
Members' Fees (Photographic Section)	33 00
Horticultural Society (rent)	12 00
	$584 43

EXPENDITURE

Rent of Museum	$ 97 50
Rent of Dark Room	18 00
Caretaker	64 00
Printing Annual Report (balance)	90 10
Printing Annual Report (on acct.)	31 60
Printing and Engraving	34 00
Postage and Stationery	45 46
Lectures	8 50
Insurance	17 00
Three Show Cases	109 00
Gas Account	17 60
Sundry Accounts	21 78
	$554 54
Balance on hand	29 89
	$584 43

P. L. SCRIVEN, Treasurer.

We hereby certify that we have examined the vouchers and found them correct.

SINCLAIR G. RICHARDSON,
E. H. DARLING,
Auditors.

May 17, 1906.

LIST OF EXCHANGES

I.—AMERICA.

(1) Canada.

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

(2) United States.

Kansas Academy of Science	Topeka, Kan.
Kansas University Quarterly	Lawrence, Kan.
American Academy of Arts and Sciences	Boston, Mass.
Psyche	Cambridge, Mass.
Library of Oberlin College	Oberlin, Ohio
American Assoc. for the Advancement of Science	Salem, Mass.
Museum of Comparative Zoology	Cambridge, Mass.
American Dialect Society	Cambridge, Mass.
United States Department of Agriculture	Washington, D.C.
Biological Society of Washington	Washington, D.C.
Philosophical Society of Washington	Washington, D.C.
Smithsonian Institute	Washington D.C.
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JOURNAL AND PROCEEDINGS

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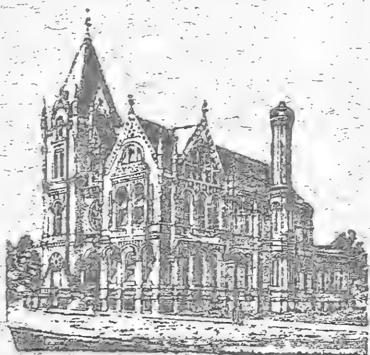

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1882—T. McIlwraith, H. B. Witton, A. T. Freed, A. F. Forbes, Rev. C. H. Mockridge, M.A., D.D.

1883—A. Alexander, A. Gaviller, A. F. Forbes, T. McIlwraith, R. Hinchcliffe.

1884—A. Gaviller, A. F. Forbes, T. McIlwraith, R. Hinchcliffe, W. A. Robinson.

1885—W. A. Robinson, S. Briggs, G. M. Barton, J. Alston Moffat, A. F. Forbes.

1886—J. Alston Moffat, Samuel Slater, Wm. Milne, James Leslie, M.D., C. S. Chittenden.

1887—J. Alston Moffat, James Leslie, M.D., P. L. Scriven, Wm. Milne, C. S. Chittenden.

1888—J. Alston Moffat, B. E. Charlton, T. W. Reynolds, M.D., S. J. Ireland, Wm. Kennedy.

1889—T. W. Reynolds, M.D., S. J. Ireland, Wm. Turnbull, A. W. Hanham, Lieut.-Col. Grant.

1890—Col. Grant, A. W. Hanham, W. A. Robinson, A. E. Walker, Thos. S. Morris.

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

1892—T. W. Reynolds, M.D., W. A. Robinson, P. L. Scriven, Wm. Turnbull, Wm. White.

1893—James Ferres, A. E. Walker, P. L. Scriven, Wm. White, W. H. Elliott, Ph.B.

1894—James Ferres, A. E. Walker, P. L. Scriven, J. H. Long, M.A., LL.B., W. H. Elliott, B.A., Ph.B.

1895—J. E. P. Aldous, B.A., Thos. S. Morris, W. H. Elliott, B.A., Ph.B., P. L. Scriven, Major McLaren.

1896—J. E. P. Aldous, B.A., Thos. S. Morris, W. H. Elliott, B.A., Ph.B., George Black, J. M. Burns.

1897—W. H. Elliott, B.A., Thos. S. Morris, Robt. Campbell, J. R. Moodie, Wm. White.

1898—W. H. Elliott, B.A., Robt. Campbell, W. A. Childs, M.A., Wm. C. Herriman, M.D., W. A. Robinson.

1899—W. H. Elliott, B.A., Robt. Campbell, W. A. Childs, M.A., Wm. C. Herriman, M.D., W. A. Robinson.

1900—Robt. Campbell, W. A. Childs, M.A., George Black, J. F. Ballard, J. H. Long, M.A., LL.B.

1901—W. A. Childs, M.A., George Black, J. F. Ballard, J. H. Long, M.A., LL.B., J. R. Heddle.

1902—George Black, J. F. Ballard, J. H. Long, M.A., LL.B., J. R. Heddle, J. M. Williams.

1903—J. M. Williams, George Black, James Gadsby, A. H. Baker, R. A. Ptolemy.

1904—Wm. Acheson, James Gadsby, J. M. Williams, Robt. Campbell, J. G. Cloke.

1905—Wm. Acheson, James Gadsby, J. M. Williams, Robt. Campbell, J. G. Cloke.

1906—Wm. Acheson, Robt. Campbell, A. H. Baker, Rev. Canon Henderson, Walter E. Hill.

ABSTRACT OF MINUTES

OF THE PROCEEDINGS OF THE

HAMILTON SCIENTIFIC ASSOCIATION

DURING THE

SESSION OF 1906-07.

THURSDAY, NOV. 8th, 1906

OPENING MEETING.

In the absence of His Worship the Mayor, Hon. Adam Brown, a charter member, occupied the chair in his usually efficient manner. In the course of his remarks he gave a very interesting account of the discovery of petroleum during the year of the organization of the Association.

President R. J. Hill gave a well prepared, thoughtful and timely paper on Ventilation, going thoroughly into particulars of the most advanced systems, and strongly urging the adoption of the best. He gave many valuable suggestions as to how to improve present conditions, showing wherein many buildings, in the construction of which ventilation was apparently unthought of, could be very much improved by the exercise of some thought and good judgment. The paper was well received and commented upon favorably by many, showing that it had deeply impressed the audience.

A very interesting feature of the evening was a remarkably fine exhibition of Sea Weeds of the Pacific Coast, by A. Alexander, F. Sc. S. Mr. Alexander's remarks and explanations were very instructive and highly appreciated.

The Camera Section work was a leading feature of the occasion, and being more elaborate than in former years and of a highly superior quality, it elicited praise from the many admirers of amateur art production.

Vice-president Rev. D. B. Marsh, Ph. D., F.R.A.S., bade farewell to our Association (having accepted a call to Springville). Several of his astronomical friends from the Toronto Association were present and gave short addresses.

A resolution was passed placing on record our appreciation of Dr. Marsh. On retiring, Dr. Marsh presented the Association with a well-executed photo of the moon of his own make.

THURSDAY, DEC. 20th, 1906

REGULAR MEETING.

President R. J. Hill in the chair. Herbert E. Murton, F. H. Wingham, B. G. Berg, Stanley Stewart Mills, Fred N. Harper, Ernest Hudson, H. H. Hines, W. W. Robinson, W. A. Jennings, B. A., H. Barnard and Walter Anderson became members of the Association.

Prof. A. P. Coleman, of Toronto University, gave a very interesting and instructive lecture entitled "Through South Africa to Victoria Falls," which was illustrated by numerous original slides.

THURSDAY, JAN. 10th, 1907

REGULAR MEETING.

President R. J. Hill in the Chair. Louis Whiting, Mrs. Catharine Hopkins, A. W. Morris, B.A., and W. Malcolm, B.A., became members.

W. A. Jennings, B.A., of Toronto, gave an exhaustive and thoughtful lecture on "The Ice Age and the History of the Great Lakes" to an appreciative audience, receiving a hearty vote of thanks.

THURSDAY, JAN. 24th, 1907

SPECIAL MEETING.

President R. J. Hill in the chair. E. G. Barrow, C.E., illustrated by many specimens of pipes and materials, as well as by valuable slides, the injurious effects of the electric current when not properly insulated and controlled.

A hearty vote of thanks was tendered the lecturer for his very valuable paper.

THURSDAY, FEB. 7th, 1907

REGULAR MEETING.

President R. J. Hill in the chair. John Allan and Wm. Hess became members.

Prof. W. A. Parks, M.A., gave an authoritative lecture on "The Cobalt Mining District, Past and Present."

After giving full details of the Government work and surveys, he expressed surprise that more had not been done sooner after discovery and that old prospectors had missed the prize over which they had gone and failed to find. He also spoke of the failure of the Indians to bring these treasures to the knowledge of the white man. The learned lecturer spoke discouragingly of the expectations of some that the gold mining of New Ontario would prove very profitable.

THURSDAY, FEB. 21st, 1907

SPECIAL MEETING.

President R. J. Hill in the chair. Hugh Allen and Dr. G. C. Buchanan became members.

S. B. Chadsey, B.A., Sc.B., gave a talk on Malleable Iron. By means of numernus specimens of metal, in succeeding stages of the processes employed, he illustrated the conditions from the very brittle product of the first casting to the astonishing strong, comparatively pliable product of the annealing ovens.

By means of a very complete set of slides the whole process was clearly shown, and the lecturer received the hearty thanks of the audience for his highly instructive presentation of a subject so little known to the general public.

THURSDAY, MARCH 7th, 1907

REGULAR MEETING.

President R. J. Hill in the chair.

Rev. S. Lyle, D.D., gave an elaborate exposition on "The Tripartate Nature of Man," which, in its concise definiteness, was really a psychological presentation of the teaching of the Bible in its three-fold bearings on the human race.

THURSDAY, MARCH 21st, 1907

SPECIAL MEETING.

President R. J. Hill in the chair.

"Notes on Plant Distribution," by A. Alexander, F. Sc. S., in which by references to geological formation, climatic conditions, animal migration and the peculiarities of vegetable productions and development, our high authority on local native botany showed that comprehensive mental grasp of the branch of science in which he has become so proficient.

A valuable discussion followed.

THURSDAY, APRIL 4th, 1907

REGULAR MEETING.

President R. J. Hill in the chair. Merton L. Raney elected a member of the Association.

Tuberculosis was fully illustrated and clearly elucidated by Dr. Jas. Roberts, of the Board of Health.

After explaining the nature, development and destructive growth of the various germs, the Doctor went on to show how by a sufficiently vigorous course of healthy treatment the human system may be brought to a state sufficiently strong to resist the action of all injurious microbes and maintain uninterrupted health.

THURSDAY, APRIL 25th, 1907

SPECIAL MEETING.

President R. J. Hill in the chair. H. B. Witton, ex-M.P., read a paper entitled "The English Bible." The lecturer gave an historical review of the various efforts through which the Bible was printed in a language understood by the people of Great Britain. A number of very rare old Bibles, the property of the lecturer, were on exhibition. A lengthy discussion followed the reading of the paper.

THURSDAY, MAY 9th, 1907

REGULAR MEETING.

Natural History notes by Wm. Yates, of Hatchley, were read by Mr. A. Alexander, F. Sc. S.

The pleasure of listening to the quaint and characteristic style of the writer was enhanced by the reader, whose familiar acquaintance with the sterling manhood of Mr. Yates, enabled him by explanatory remarks to add much to the enjoyment of the evening.

An acknowledgment of the delight afforded by the paper was considered due to Mr. Yates.

THURSDAY, MAY 30th, 1907

ANNUAL MEETING.

President R. J. Hill in the chair.

Mr. J. V. Elliott was elected a member of the Association.

The following reports were read and adopted :—

Report of the Council, by James Gadsby.

Report of the Curator, by J. M. Williams.

Report of the Treasurer, by P. L. Scriven.

Report of the Geological Section, by A. T. Neill.

Report of the Photographic Section, by Wm. Acheson.

Report of the Astronomical Section, by E. H. Darling.

Report of the Biological Section, by J. M. Dickson.

The following officers were elected for the ensuing year:

President—R. J. Hill.

First Vice-President—J. M. Williams.

Second Vice-President—Wm. Acheson.

Corresponding Secretary—S. A. Morgan, B.A., D. Pæd.

Recording Secretary—J. F. Ballard.

Treasurer—P. L. Scriven.

Curator—Col. C. C. Grant.

Assistant Curator—J. M. Williams.

Auditors—E. H. Darling, Sinclair G. Richardson.

Council—Robert Campbell, A. H. Baker, James Gadsby, Lyman Lee, B.A., C. G. Milne, B.Sc.

Report of Council.

Your Council take pleasure in submitting their report for the Session 1906–1907.

During this session there have been six meetings of the Council. Besides the annual meeting, eleven meetings of the General Association have been held, at which the following papers and addresses were given :

1906 INAUGURAL ADDRESS,
Nov. 8th. President R. J. Hill.

THROUGH SOUTH AFRICA TO VICTORIA FALLS,
Dec. 20th. Prof. A. P. Coleman, M.A.,

THE ICE AGE AND THE HISTORY OF THE GREAT LAKES,
Jan. 10th, 1907. W. A. Jennings, B.A.

ELECTROLYSIS (Illustrated),
Jan. 24th. E. G. Barrow, C.E.

THE COBALT MINING DISTRICT, PAST AND PRESENT,
Feb. 7th. Prof. W. A. Parks, M.A.

MALLEABLE IRON,
Feb. 21st. F. B. Chadsey, B.A., Sc.B.

THE TRIPARTATE NATURE OF MAN,
March 7th, Rev. S. Lyle, D.D.

March 21st. NOTES ON PLANT DISTRIBUTION,
A. Alexander, F.Sc.S.

April 4th. TUBERCULOSIS (Illustrated),
J. Roberts, M.D.

April 25th. THE ENGLISH BIBLE,
H. B. Witton.

May 9th. NATURAL HISTORY NOTES,
Wm. Yates.

Many new members were elected during the year.

We have this year honored ourselves by appointing Dr. Fletcher, of Ottawa, to represent this Association at the meeting of the Royal Society.

Your Council are pleased to acknowledge the financial assistance received during the year through the kind efforts of Mr. Adam Brown, which has enabled your Council to add a number of valuable cases to the museum without drawing on the regular funds of the Association.

All of which is respectfully submitted,

R. J. HILL,
President.

J. F. BALLARD,
Secretary.

Ventilation

Read before the Hamilton Scientific Association, November 8th, 1906.

BY PRESIDENT R. J. HILL.

Every person should be interested in three things—the food he eats, the water he drinks and the air he breathes. Each is of vital importance. One may say that good food is the most important, another that the water we drink is; a person may live several days without either. Shut off his supply of air and he will die in a few minutes.

I have no apology to offer for my choice of subject, and shall not deny the value of good food, pure water, and milk without *embalming fluid*, but shall confine my remarks to the necessity of breathing pure air. I have always considered ventilation one of the most essential things to be considered in the construction of any building, and that without pure air it is impossible to have good health.

Scientists have agreed to consider pure air as composed of a mixture of about 21 parts of oxygen to 79 parts of nitrogen, oxygen being the vital part, nitrogen serving only to dilute the oxygen. The air as we find it contains many other substances. A careful analysis of the air has shown it to be a mechanical mixture composed of Nitrogen, Oxygen, Aqueous Vapor, Carbon Dioxide, Ammonia, Chlorides, Dust, Carbon, Ozone, Argon, and various gases peculiar to the district where it is obtained. In occupied rooms we may add to these, excess of carbon dioxide, and waste animal matter given off from the lungs, and the surface of the body.

How to know where impurities exist, how to expel them as fast as formed, and how to supply a sufficient quantity of fresh air, are problems second to none. In most occupied rooms if the doors and windows were absolutely tight the occupants would die of suffocation in less than thirty minutes. How few people realize this, or that the prime cause of consumption is the breathing of impure and contaminated air. It seems strange yet it is true, that our prisons are much better ventilated than many of our churches and schools. Architects think more of the outward appearance of a building than of its ventilation. A building with nothing but ornament to recommend it is like a beautiful apple rotten at the core. One of the most pressing needs of the present age is a more general enlightenment on the subject of ventilation, and an improvement in the ventilation of schools, houses, public halls and churches. An epidemic comes and a few die from it, a cry goes up from one end of the country to the other, while hundreds die every year from the effects of breathing impure air, and no complaint is made. In the open air we have nothing to fear. Nature, by the principle of diffusion, provides that any excess of impurities will soon become diffused. It is in our houses, churches, public halls, schools and factories that we have most to dread. Air that has been breathed should not be breathed again, it becomes charged with carbon dioxide and waste material from the lungs to such a degree as to be very injurious, causing irritation to the mucous membrane, and the delicate air vessels of the lungs. The most common impurity of occupied rooms is carbon dioxide, and the degree of impurity of the air is generally judged by the percentage of this gas, because where it is found, you will also find other impurities. When the proportion of carbon dioxide reaches six parts in 10,000 it is positively injurious. It should not exceed four parts in 10,000. Carbon dioxide formed from combustion is not injurious except by excluding oxygen, but when the air is charged with waste animal matter from diseased lungs, unclean bodies, dirty clothes, and dust, it becomes positively injurious. An adult gives off from his lungs six-tenths of a cubic foot of carbon dioxide per hour, which will render 3000 cubic feet unfit for respiration from this cause alone. At the same time we are using up the oxygen and polluting the air with waste material from the lungs and body.

Each adult should have sufficient floor space to allow him 1000 cubic feet of air, and provision should be made to have this changed at least three times an hour to maintain a healthful condition.

How to keep the proportion of carbon dioxide as low as possible then, becomes the all important problem of ventilation; in other words to get rid of the foul air, and admit a sufficient supply of pure air at the proper temperature, and the percentage of moisture most suitable for breathing. We agree then that ventilation may be considered as the disposing of impure, and the admitting of pure air to take its place. It is of so much importance that stock raisers have been compelled to give much attention to it of late years. They have found that stock thrives much better in well ventilated stables than in foul ones. Manufacturers have turned their minds to it from a financial point of view also, for it has been found that men do more work when working in pure air, besides the factory inspector insists on certain conditions of ventilation. The worst ventilated buildings we have to-day are our houses, churches, schools and offices. In the summer these are easily ventilated by means of the windows, but this is impossible in winter in our cold and variable climate, and therefore becomes a serious question.

We have in the city a building inspector, whose duty it is to see that buildings are safe from fire and substantially built. But is there ever a thought given to ventilation? Perhaps ten die from the effects of bad ventilation to every one who dies from the cause of fire. I have been in a number of the hundreds of houses which have been built, or are under construction, and have not found any provision for ventilation, except that made by poor material or careless workmanship. In very few cases is even the bath-room ventilated. It may therefore be true that many people owe their lives to the carpenter more than to the doctor. Again, take the churches, except by the windows and doors, what provision is made? Worse even than the houses, the air becomes poluted on Sunday morning, is passed over the heated iron of the furnace, which burns the animal matter and particles of lint from the clothing and makes the air too dry for respiration. This causes irritation of the delicate air passages, and fits of coughing. Every window is shut to keep the place warm for evening service, and at the evening service the air becomes so bad that the lamps will almost go out. To make sure of keeping it bad every window and door is kept shut all the next week, when it is again warmed up for Sunday service. This goes on from year to year with little interruption except perhaps for a few weeks in the summer. Is it any wonder that people are overcome with stupor while the minister preaches? Some attempts have been made to improve the ventilation of our schools, and in the last school built in this city, "The King Edward," the best known system has been introduced; but there is much still to be done, and I do not hesitate to say that I believe the day is not far distant when much closer government inspection will be exercised over the sanitary conditions and ventilation of all public buildings.

A commission appointed by the City of New York to inquire into the cause of disease in that city, reported that forty per cent. of disease was caused by breathing impure air. We hear much about "fresh air treatment" for consumptives. I am in full sympathy with the improvements for dealing with this very numerous class of sufferers; but what are we doing to lessen the foundation of the evil? Why build one Sanatarium on the top of the mountain to cure the disease while we build places without number in the valley to propogate tubercolosis and kindred diseases? The Black Hole of Calcutta,

"Roused the vengeance, blood alone could quell,"

from one end of the British Empire to the other. There are hundreds of black holes in the country just as deadly, though somewhat slower in their action, causing catarrh, consumption, bronchitis, pneumonia and other kindred diseases. All physicians admit that consumption can only be cured by placing the patient in the open air. It follows that the only way to prevent the disease is to breathe absolutely pure air. It has been proved that a child requires from 2000 to 2500 cubic feet of fresh air per hour, and an adult 3000 or over. In many of our public halls, churches and schools not more than one-tenth of that is provided for. People are crowded together for hours, breathing the same air again and again, coming from diseased lungs and clothing, sometimes none too clean, and containing exhalations from the surface of bodies that seldom receive a bath. Is it any wonder that provision has to be made for them in a Sanatarium before they reach the age of twenty-five? I believe that three-fourths of the cases of tuberculosis could easily be traced to bad ventilation.

Ventilation is a difficult problem to deal with, because we are dealing with a substance we cannot see. The most perfect theory may be defeated by bad material, or an unskilled workman. The architect deals with the empty building, and seldom or never is in the building after it is occupied, when the conditions are entirely different. Changes of wind are so frequent and violent that no system or theory can be relied on at all times. What will suit one season, direction or velocity of the wind, will not suit another. The difference in weight of the air at the top and the bottom of a ventilating shaft may be only a few grains to cause the draught, which is very often reversed.

I shall refer specially to ventilation in cold weather, as the windows generally serve for ventila tion in the summer, though they were never intended for that purpose. Provision should be made to admit fresh air. The openings should not be too near the ground or the air will be impure. It has been proved that air brought from 135 feet from the ground contains only 20 per cent. of the dust and other impurities, which it contains when brought from 15 feet from the ground. The air should be warmed to the proper temperature before it enters. It should not pass over metal too highly heated, and should be diffused while entering. Several openings are much better than one, it should retain the proper amount of moisture. Air saturated at 20° raised to 40°, would require double the aqueous vapor and raised to 65° would take up double what it required to saturate it at 40°, and if this moisture is not supplied it becomes very dry and consequently irritating to the air passages. There should therefore be provision made to supply this aqueous vapor. Careful investigation has shown that the most healthful condition of the air is 73 per cent. of saturation. The amount of moisture is of vital importance. How frequently we see people leave church or public halls with a fit of coughing. This is caused by the dryness of the air, or by some animal matter which has become burnt in contact with highly heated iron.

The openings for admitting the air should be as low as possible if the openings for escape are high, otherwise the pure air will escape without being of much benefit to the occupants of the room. This is especially true when the air is warm when admitted. It is better to admit the warm air above the breathing line and draw it off from a lower level, or as near the floor as possible, this insures the passing of the pure air across the breathing line. We have two well-defined systems of ventilation, the *Plenum* system and the *Vacuum* system. In the former the air is forced into the room by artificial means, and is only lately coming into use. It should always be supplemented by the natural system when it will give much better results. A fan is placed in a flue which propels the air over heated steam coils, and then into the rooms. After becoming heated the air should pass over pans of warm water to supply the necessary moisture, the air then passes into the room at a medium height, while the foul air is drawn off from the room through openings near the floor connected with a ventilating shaft, kept warm to assist the motion of the air. This system could be used in the summer, for the air drawn from the higher level is cooler, or might be still more cooled by passing cold water through the pipes. This system will likely come into general use for all public buildings. The *Vacuum* system has a large ventilating shaft in which there is a fire, steam or hot water coils, or the pipe from the furnace may pass up through it. The air in the shaft becoming warm, ascends, and the cold air enters the room through openings to take its place. This causes a draft of cold air into the room which should never occur, besides it makes no provision for supplying the lack of moisture. It cannot be used without a constant heat in the flue, and is influenced very much by the wind. If windows are opened the reverse of the theory will often take place. In schools or where there are several rooms connected to one shaft, the foul air of one room will often pass through the ventilating flue to another room. The one in charge of ventilation requires to give constant and careful attention to the peculiarities of the building.

Many people think that the air expelled from the lungs is heavier than the surrounding air. Such is not the case. carbon dioxide forms such a small proportion of the expired air that its extra weight does not make a perceptible difference; besides the air from the lungs contains a large amount of moisture, is several degrees warmer than the surrounding air, and therefore is much lighter and ascends. This favors the openings for the escape of foul air being placed high up, for if they are at the floor the breathed air has to cross the breathing line.

Each person requires 30 cubic feet of pure air per minute, a school room for 50 pupils requires 1500 feet per minute. The ordinary class room for that number of pupils contains about 12,000 cubic feet, which, divided by 1500, gives eight minutes as the time during which a complete change should be made. You say this is a great waste of heat, true, but we cannot have health without it. The amount of pure air should be as definite as the amount of pure food, the air should be changed completely every seven or eight minutes. In many buildings it is not changed once in thirty minutes, and in some no provision is made for change.

It is much easier to warm pure, than impure air. The amount of heat required to raise one pound of water one degree will raise 48 cubic feet of air one degree, so that the heat required to raise one gallon of water one degree will raise 480 cubic feet of air one degree. The heat necessary to change a gallon of water from the freezing point to the boiling point would raise 86,400 cubic feet of air one degree, or 2000 cubic feet from the ordinary winter temperature of 20° to 65°, the temperature of occupied rooms. If the heat is properly managed it is not so expensive as some people imagine, and will be found much cheaper than medicine.

When heated, air expands 1-500 for every degree, and when heated from 20° to 70° expands 50 x 1-500 or 1-10, and heated still higher expands still more. This lessens the weight of equal volumes of air and is the cause of the drafts in the chimneys.

To test for carbon dioxide pass a quantity of air through lime-water, when it will turn milky if carbon dioxide is present; or shallow saucers containing lime-water may be exposed in the room, when a film will be formed on the surface.

To test for organic matter pass the air through sulphuric acid, when its presence will be shown by the acid turning a dark color.

The test for Ammonia is known as Nessler's test, and would require considerable quantities of air. Ammonia is the great supporter of microscopic organization, and is produced by the decay of animal and vegetable matter.

Through South Africa to Victoria Falls.

Illustrated Lecture before Hamilton Scientific Association, December 20th, 1906.

BY PROF. A. P. COLEMAN, M.A.

LADIES AND GENTLEMEN :

The summer before last I had occasion to visit South Africa. A number of scientific men from all over the world, very few indeed from Canada, I think only about two, including Professor McCallum of Toronto, were invited to join the British party in their excursion into South Africa. It is the longest expedition they have ever undertaken.

South Africa is not so very easily reached from Canada, in fact the shortest way is first to go to England, that is what we did. From England you can take steamers from Southampton, you can take steamers of different lines on the way and to Cape Town finally.

I have a set of lantern slides which presently will be in trim. I have quite a large number and shall make my talk on them. The map that is thrown on the board explains itself, and I suppose I need hardly say that these black lines that cross are indications of the direction in which we travelled. This is a little wrong here, because some of us went by the route marked – – – – instead of by the other; first to England, and then over the very long stretch of open sea, 6000 miles to Cape Town. Our excursion was completed by taking ship on the other side of South Africa and going up the coast to the Red Sea, and then through to the route – – – – and back. It is worth while perhaps to get a little idea of the geography of South Africa itself. Here is Cape Town, right on this peninsular strip. Then we go towards Johannesburg. Johannesburg is the biggest city in South Africa. We took connection to Portuguese East Africa. In the distance you can see it, and then we came down to the route – – – – and there took ship again.

Their railroads are different from ours in every respect; everything is on a different basis from ours. The conductor is not the man who conducts the train, but is the man who makes the beds. They have guiding cars attached to them in many cases, and you can get quite comfortable meals also. As the trains are very narrow, the sleeping accommodations have to be adapted to them. The cars are divided into compartments the same as ours. If three of you can get a four-berth compartment, it is all right, but with four in a four-berth compartment, you have to put everything on the floor, there is no other place, and there is hardly room to turn around. They arrange that there should be three in a compartment in most cases.

These are pictures of a number of points in regard to what we saw and what we did. Cape Town is, of course, the first point you reach in South Africa. Johannesburg is the larger city, but Cape Town has about ten thousand inhabitants, and there is no city in the world that has a finer background than Cape Town. Whatever little street you look down, it has for a background the Table Mountains. The name "Table Mountains" is very suggestive. The mountain is very difficult to ascend in most places, in fact there is only one place in the front side where you can ascend the mountain. The harbor is not a good one. In fact, I think there is only one real shelter in it. The Table Mountain is 3500 feet high. There are a number of these mountains which have been given various names, the Lion's Head, etc. You must remember that Cape Colony was a Boer Colony at one time, and on that account many names are connected with the old Boer inhabitants of the place. The Lion's Head, for instance, you can see the lion resting there. There were plenty of lions around Cape Town in early days. The lions used to come right up to the town, and were indeed a source of dread to the inhabitants.

There are a great many interesting bits of scenery in the neighborhood of Cape Town. This is near one of the suburbs, you can see some of the houses over there.

Another part of the Table Mountains is the Twelve Apostles. You can see several of the twelve. It should be thirteen Apostles, I think ; but I suppose there are not thirteen apostles.

One of the most magnificent sea views to be had in the world, one of the finest landscapes I ever saw, is to be had there. You can see the grand rocks there carved by the ocean, which is very interesting. One of the things that especially interest me is mountains ; one of the things we always undertake to do is to climb the mountain. I want that picture to be shown however, for this reason, that that was the way in which I climbed the mountain. I did not climb these walls here, but came through this ravine. There are only a verp few places where you can ascend the mountain. You can take an exceedingly steep path through this ravine, and then a very curious wind bears down upon you. At the time I was there, I was most desirous of seeing the wind blow from the east and dip down through the ravine. The mountain is 3500 feet high, and the wind has quite a fall over the edge of the cliff. Coming over the ravine with a heavy wind pushing one down, pressing down on your shoulders and driving you downwards, it is a constant struggle to climb upwards. It was misty at the edges. A view or two will give you a better idea of this. There is a more distant point of the Table Mountain. You see the table-cloth on it. When the wind is blowing in a certain direction, you see the wind is blowing up to a higher level and sometimes causes it to hang over a little, just as the table-cloth hangs over the table.

There you have the city looking very handsome below you, you see the splendid stretch of yellow beach where the sand has been tossed and the great rollers rush in upon the shore.

This is a picture from one of the supurbs of Cape Town, where the darkies live very largely, although there are people to be found of almost any color. You can get everything from the whitest of the white to the blackest of the black. There are no greens or blues of course, but practically every other possible color. Leaving Cape Town, you can not go in any direction into South Africa without climbing a mountain, because the whole of the interior of South Africa is really an elevated plain. The first thing to do is to climb upon that high tableland, and the scenery is then very striking. This picture is the Hex River. This is the pass by which the narrow gauge railroad goes through the mountain. My other pictures refer to the ground above, and will give you some idea of the general landscape in South Africa.

Now you have heard about the Veldt and Kopje. The Veldt is flat ground. The kopjes are made of very hard rock. That was the trouble in the Boer War. The soldiers must march along such a road as this or on the wide gently sloping plains, and anyone could easily fire down upon them. The kopjes then made one of the most serious troubles in the Boer War.

You must think of the region we visited up above the Table Lands as practically desert. The winds that come from the Indian Ocean all across South Africa have lost practically all their moisture before they reach the western side of the continent. You are three or four thousand feet above the sea and it is practically desert. Very little rains falls there. That region is called the Kara Desert, the northern part is called the Kalahari Desert. I suppose you think that South Africa ought to have a very fine set of trees of its own. In the Cape of Good Hope you find trees, but in the rest of Africa the majority of the trees have been imported. In fact the only native trees you can see are thorny bushes.

At one of the first stations we stopped, we got out to examine the country. This picture shows two of our party. There were two ladies in that party of which I was a member. One of the first things we saw was an old fortification, now falling into ruins. There are many of these scattered over the country, usually where the road forks, the idea being, of course, to keep watch of the roads. The roads are like our

Western prairie roads, just the tracks where the wheels have gone, except to choose a good place.

The next station we stopped at, we were to undertake a long drive of forty or fifty miles, so carts came to meet us. They are what they call Cape Carts, and are two-wheeled vehicles. We had a dozen of these carts to take our party of thirty or forty, and you see us negotiating there, each one trying to get a good driver. They were pretty good drivers on the whole. The houses are generally whitewashed, with iron on the roof instead of shingles. Wood is a very expensive thing in Africa, and you see steel and iron used instead.

On our drive from that town we came to some of the newer settlements, and it was interesting to compare them with our Canadian settlements. There you have the shanty put up by a Boer farmer. The house itself is built after the Indian style. In this case the roof was covered with earth, very much like our Western farm-houses and the higher regions of the West. The Boer farmer is a very ambitious man, and while a farmer in this country would think himself prosperous when he has a few hundred acres of land, the Boer farmer needs 10,000 acres to live upon, because the soil is barren. They have only a few inches of rainfall in the year, and so the number of animals that can be fed is small, and you cannot raise a crop anywhere unless you are able to irrigate. The irrigation will be dependent upon the streams that flow in the region. A great majority of his acres will not be cultivated at all. It takes the greater part of his land to feed his herds and flocks. They seem able to feed on almost anything or nothing. The vegetation is not of the most attractive sort, and when a man has 10,000 sheep you can see he needs a very large farm.

This picture is a very interesting one to me, because this was the first river that I had to do with in South Africa. This line indicates the river. There is no water in this river although it is an important river in South Africa. It has everything but the water. Here are the rocky shores, here are trees overhanging. It is quite a respectable river, and cuts a considerable figure on the map in spite of the fact that there is no water in it. While we were off doing geological work, our Boer drivers dug a hole of three or four feet in this river and succeeded in getting some muddy water, which they used for making a little coffee. As there was not enough for all, the rest of us sucked our oranges and went dry for that lunch. A very large part of South Africa, with us, would be counted unmitigated desert. They manage to inhabit it however, and although the population is sparse they raise their flocks and herds. One of the animals which they most frequently raise is the ostrich. They are rather peculiar animals, and have their own opinion of things. I am sorry I have not a picture to illustrate what one of them did. We were all getting out to look around, when an ostrich about eight feet high came along and put his head into the window of the train, absolutely at home, not afraid of the trains and not afraid of mankind. However, he was very prevaricated. Except in that one case, they were always trotting away as fast as they could. The growth of the ostrich is one of the great industries. The feathers are of great value and one of the important exports.

After passing through the Kara, we came to a range of mountains, the Black Mountains they were called. We drove through these mountains, and here you have our approach to them. We passed through some very interesting scenery there. The road wound around through the mountains. They removed all of the big stones from it. It looks as if it would stop there, but the road wound around and made its way. Here is another of those little fortifications. This is one of the points where supplies might come in, so here you have the railway. The goats are scrambling up the mountain, and fed while we were there.

The mode of travel in South Africa before the early days of the railroad was very primitive. I think I have a few pictures, about three, here to illustrate the mode of travelling in the out-of-the-way parts. You have a long team with

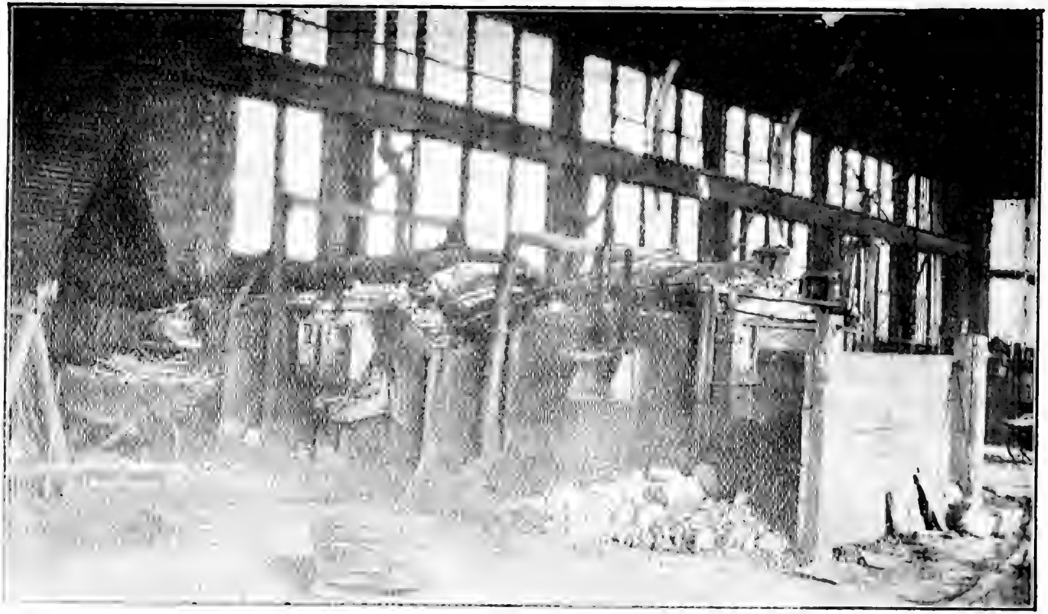


PLATE No. 1.

REVERBERATING MELTING FURNACE.

tremendous oxen. These have horns that are sometimes five feet from tip to tip. A team may have a dozen or may have twenty oxen in it. It is a strenuous affair to drive a team like that. The roads, as I said, are not made, they are found —discovered, and are not always of the very best.

Occasionally in South Africa the rivers do flow. I am afraid I gave you a rather bad impression of the rivers of the country from the one I showed before. It is not very difficult driving on the bare Veldt, but these ravines make tremendously hard travelling. The driver is generally a Kaffir. What bad words he uses I do not know, but he certainly has to use a large number of bad words. He has a whip made of rhinoceros hide, a short one, and then another like a fishing pole twenty or thirty feet long, and he can hit the ears of his oxen without any difficulty from his perch on the waggon. If that does not do the business sufficiently, the small boy runs ahead and whips the leaders. The boy that is running ahead is a sturdy, rosy-cheeked lad, bare-footed and usually bare-headed. They travel fifteen or twenty miles a day. That is the way South Africa was travelled in the olden times. That method of travel is still common in South Africa.

The Orange River is the largest river in South Africa. This river and its tributary, the Vaal River, are the two important rivers in that region, although not very deep. It was after night, and we had the mule team with four mules. They went rattling down the bank and into the water, and I found that it was only actually up to a foot or so. We have rivers that in their season may be flooded and may carry a large volume of water, but during the dry part of the year they carry comparatively little water.

South Africa is the land of gold. We went there to see geology and not mines, although we visited the mines. Johannesburg is the most populous city in South Africa. The buildings are of quite an American type. The American influence has been quite strong in Johannesburg. The street cars are the very weak side of Johannesburg, so that when you want to go from point to point you can take a cab, but if you do not feel capable of taking a cab you can take a ricksha, a glorified baby carriage on a large scale, and the animal that goes between the shafts is a boy. They admit that they are cattle and think they ought to have a pair of horns to put on their heads, as they have a sense of the artistic. They have paint on their legs to indicate a pair of stockings and other things. They are healthy looking fellows who are always prancing along, and inviting you to take a seat in their vehicle, at the rate of five miles an hour to any part of the town. Though right in the heart of South Africa it is not at all old fashioned. The capital, as you know, is Pretoria, a much smaller place than Johannesburg. It is so hot, I don't wonder the people are drowsy. I visited Kruger's house and saw the church where he preached, and then went to the cemetery. Do you see the word "Canada" back there; and here is a whole row of graves of soldiers and several of them boys of Canada. This young fellow was only twenty-two years old. This was one of the saddest cases I know of. There were some of our boys lying there in that far-off country. That was what impressed me most. There were hundreds and hundreds of graves there, the majority of them British, and a number of them Canadian.

We made a long excursion from Pretoria towards the East coast. This picture shows us calling on the ladies of the party, who come out much surprised to see us. These are some of the ladies and these are the houses that they inhabit. I always noticed a semi-circular fence in front of the houses, which are bee-hive shaped, a fence four or five feet from the house, and at last an explanation of the use of this was given me by a very genial Boer farmer. He said that the lions would come in at night and sometimes carry off one of the darkies. That throws a curious light on the history of the region. At one of the railway stations where we stopped, there was a great commotion, and when we inquired what was the matter, were told that the lions had been after their goats. There are lions in Africa yet, you see. We did not see any lions ourselves except in captivity.

The Kaffir is a handsome man. They use largely as a food a kind of corn. It is simply our Indian corn which was introduced there. This lady has boiled the corn, and now she is griding it in order to make cakes. I suppose you have wondered why it was that the Kaffir wants two wives. It keeps one of them nearly all day making the bread for the family, and it keeps her busy most of the time just to feed them. I suppose you sympathize with the poor Kaffir who doesn't happen to have a second wife. This represents the bee-hive shaped house. The door is three or four feet high and there is no chimney. Consequently there is a fine deposit of soot over everything, and the inhabitants have red eyes from the smoke. Here the lady is grinding corn once more, but the baby has to be attended to just the same.

One of the records of the way that rather impressed me was the house of General L———. We came to the place first at night, and it was so black we thought nothing of the two mile avenue we passed through before reaching the house. Coming back we saw it however. It is a most beautiful and interesting place, but the General was so disgusted at the burning of his house that he never want back. The two-mile avenue leads to a ruin.

In that region we have vegetation of a sort so different from the rest of Africa that I thought I would show you a picture of it. One of the trees that is very characteristic in that part of Africa is the Uforbia, something like our cactus. It is not a cactus however. It has no leaves but a green stock thirty or forty feet high. The bloom is very different from the cactus bloom. They have imitated the methods of the cactus but they have a different type of growth.

We passed Majuba Hill by a deal of climbing within the flanks of the mountain. It was on top of that hill that a small army of British soldiers was cut off by the Boers and a great number of them killed and the rest taken prisoners. They retreated to the hill and there they had no water. The Boers just had to wait. The ragged top of the hill which you can just see dimly here, gave them little protection from their enemies. It was probably that event that gave the Boers the courage to bring on the war which followed. Had the British been able to defeat the Boers at this time, I doubt if there would have been any war. It is too late to say anything about that now however. It is settled, and settled, let us hope, in the right way.

Returning we made our way towards Rhodesia, and on the way stopped at Kimberley, which is the capital of the Diamond fields. It has 35,000 or 40,000 inhabitants and is quite a lively little place, as you can see. The houses are two or three stories high. You can see the heaps of debris from the diamond mines. This is one of the biggest holes man has ever dug in the ground. It is 1000 or 2000 feet across the upper part. Here you come down to the solid rock, the blue part from which the diamonds are obtained. They are not using this open pit any longer. You come right upon it in the street and it is well that there is a good wire fence around the edge of it. The mines are in the town itself. Half a dozen of them are producing large amounts of diamonds, although there are ten or twelve in all. The price of diamonds has gone up at least double since the early days. They say, however, that Cecil Rhodes and his party had full control of the trade and that the rise in price was purely artificial.

As one goes north, one finds a different type of scenery again. The trees are immensely wide. Bulawayo is the largest city in Rhodesia. After another long excursion this was one of the sights that met us, the famous spot where Cecil Rhodes the empire builder, has his grave ; far away from the nearest town and hardly any inhabitants in the neighborhood. He wished that the railroad should not be carried to his grave. The station stops four or five miles from the grave and you must take a team. This is the vehicle that I was on. Five teams of mules in front of it. The roads were heavy and the loads were heavy too. The tomb of Rhodes is an absolutely simple one. The tomb of that great man is merely a cavity, and cut into the granite, "Here lies Cecil Rhodes." The simplest possible thing and yet most impressive. You see many more of these granite hills but you don't see anything more suggesting life. However, there is something suggestive and impressive in the fact of that great man lying there. He went out and made peace with the Kaffirs, took his life in his hands in order to bring the Kaffirs to peace. It is quite suitable that he should be entombed there in the far wilderness.

Leaving here, we went still further north on our way to Victoria Falls. This rather curious thing is an ant-hill, an ant-hill that is ten feet high. The white ants make these hills. A tree makes a very good start for the hill and generation after generation live there until it gets to be quite a little mound. In the flatter parts of the desert this is one of the places you can get a view. The natives do not build much more elaborate houses than the ants. The natives, as you go further north, are very scantily clad. Things grow more primitive as you go towards the great central forests of Africa.

This represents some of the best forest we saw on our way to Victoria Falls. When you cut one of these trees, you find that the wood is red. We were there in the summer and half the leaves were fallen. That was the dry part of the year, and most of the leaves are gone in the dry season. Autumn and spring come very close together there. A little later and there would have been the fresh green of spring. At that particular time of year you had almost the feeling of here in Canada except that the heat was great. The Baobabs, perhaps, are the biggest trees in Africa. They are bottle-shaped. They are thick and massive at the foot. No trees in the world surpass these in girth. There are trees in Canada taller, but I doubt whether they have a wider girth than one of these. You notice that it is leafless. That time of year was the time when they were taking their rest. A few weeks later everything was fresh and green.

The first day we were at Victoria Falls, we made an excursion around the river, and one of the things I did was to take a walk up along the river. There are all sorts of reed plants and dense forest trees, even much thicker forest than we had seen before, owing to the presence of the great Zambezi river. The Zambezi is like one of our own lakes. These fellows going along are hippopotami. The hippopotami are a great nuisance and very apt to rise right under your canoe and upset you. They are more than a match for a steam launch. The upper part of the river is broad and shallow and does not suggest anything tremendous in the way of a waterfall. Here is a map which will bring out the main points which I shall describe briefly. The broad part of the river turns up here and that is the view I showed you of the rank reeds, and here are islands covered mostly with trees. That is about one mile in length, perhaps a little over the mile; more than a mile in width, in most parts above that. Several islands break it. That large island there is called Livingstone Island. The Falls are divided into several separate sheets of water—the Leaping Water, the Main Fall and the Rainbow Fall there. Now you notice that the water falls into one long ravine, a long narrow ravine of four or five hundred feet wide. The pool is here. The water from that end must flow here, and, after a very narrow channel, you come to a most remarkable zigzag. It was dug by the river itself. The river has manufactured its own canyon about forty-five miles long. The river is slowly cutting its way back into the table-lands of Central Africa. There you have the great chasms with the islands breaking the water. Here you have the narrow pool that I pointed out, and two of the zigzags with the walls of the canyon.

Here is a picture of the Falls made by an artist in London. The gentleman who made the sketches made pencil sketches of the Falls, and made the pictures from these. He was about the third white man to visit that part of the country. Here is a Buffalo just ready to plunge into the abyss, and here you have a number of thick trees, palms and so on. The Falls are broken by several projecting black rocks. Here is one of the main figures of the west end of the Falls, called Leaping

Water. The rapids don't run very far, averaging about 350 feet at that point. You just see part of the Falls from that end. This is the Rainbow Falls, which you remember I showed you on the map. At the time we were there the water was very low, but still the Rainbow Fall had its rainbow, and there you have sunshine all day long. This is the great abyss into which the water plunges. The streams are coming from away down in the Basaltic rock. This is the Main Falls. It is not a continuous stretch of water. It is unlike Niagara in this respect. Here you have it broken, but this is the Main Fall. I estimated that the volume of water would be about one-fifth of that of Niagara, but there are times when there is much more water. You must think of this as being more than twice as high as Niagara and the mist keeps everything moist around it. There are hundreds of acres of forest kept fresh and green from the spray of the Falls. This was the one thing that really satisfied you in the way of a tropical forest.

Here you have that immense canyon, more than 400 feet deep. Here is the bridge across the river. We are proud of our steel arches. The steel bridges are certainly beautiful at Niagara, but here is a steel bridge that is very much longer and very much higher. You have a bridge more than 600 feet long in a single span, more than 400 feet above the water, one of the most impressive things that we encountered.

While completing this bridge, when they got to the middle strand, they had them brought out and placed, and were horror-struck to find that it did not fit. Then it occurred to someone that when the hot sun was gone, it would cool down. Then it just fitted and they put it into place. Their measurements were a little out. The cold night had contracted the steel enough so that it fitted into place perfectly. We were there just in time to open the bridge. At present the railroad is two or three hundred miles away from the bridge. We were there when the first passenger trains were beginning to cross.

Here is a view from the bridge down the stream, down that zigzag that I showed you. You are looking down four hundred feet now. You have rapids like the Niagara River below the Falls. In reality it is a great river. It is not so big as Niagara, but still a very beautiful and impressive river. There are very few places where you can get down to the edge of the river below the Falls. Hanging plants and ferns are above your head until you get down to a whirlpool. This is called the Boiling Pot because there is a big eddy that goes around and around. You are able to look down and see this whirlpool under you and the Falls beyond. From the east end of the Falls you can get very good glimpses of about half of it. The air is so dense with the spray from the water plunging down, that it seems to go up with a tremendous rush and you feel as if there was a whirlwind laden with spray which takes your breath away.

In order to visit the actual edge of the Falls from Livingstone Island, you must go up to it the usual way. Arrangements were made to be ferried across to Livingstone Island. When I came to get on my boat, I was astonished to find a Maple Leaf on the bow of it. This was a Peterborough canoe. These fellows who took us over were very interesting. They do not wear more clothes than is necessary. The climate is very hot, and somehow it always seemed to me that the black skin is a sort of clothing. Most of the way they bowled. The water is not very deep and they would bowl all in order, four on each side with their bowlers. Where the water was deep they would use paddles. Here is the gang after we had just got ashore. The forest is only some four hundred feet away. Some of our friends were on the other side, and now and then a mist would rise between us and hide them absolutely. The Niagara in certain places is much finer, but in other respects it won't compare at all with Victoria Falls. You have not the tremendous black rocks, you have not at Niagara that immense chasm into which the water plunges. The point is that you can see Niagara Falls. There is no one place where you can see Victoria Falls. You can see parts of it, but there is no one spot along the whole of that great chasm from which you can see the whole of the Falls.

I suppose I shonld say one word about Livingstone Island. There is a place, the finest thing on Livingstone Island, and if you approach it you are told not to go any further. I hope the boys won't take pattern in this respect after Livingstone. He had been travelling over all that country by cart, ten or fifteen miles a day, and at last when he reached one of the greatest waterfalls in the world, was so elated that he carved his name on a tree. It is really a bad practice, but this, I believe, is the only instance in which he carved on a tree. We stopped some time at Livingstone Island.

We had an old bridge engineer with us, a very doleful old gentleman, and I saw him take off his boots and socks and wade in the Zambezi River, and try to push shells out of the rocks and so on. I was quite amused with him. However, he was as innocent and as delighted as a boy could be. We had a very interesting party with us, which added very greatly to the pleasure of the excursion.

Victoria Falls was the close of our excursion. There was much more of it, but I will close with this view of the Falls.

The Cobalt Mining District—Past and Present.

Abstract of Paper Read before the Hamilton Scientific Association, February 7th, 1907.

BY PROF. W. A. PARKS, M.A.

We have at Cobalt one of the richest spots on the face of the earth, situated about three hundred and thirty miles north of Toronto, and about four and a half miles from Haileybury. Haileybury has been in existence quite a number of years, and about twelve years ago was quite a thriving little town. Lake Temiskaming was a highway of travel for the fur traders of the Hudson Bay Co. over two hundred years ago. It is a wonder that the Indians had not found native Cobalt and discovered mines in that district.

In the spring of 1903, prospectors first noticed a slight pink stain on the rocks, samples of which were brought down to Toronto and recognized as Cobalt. A little later various other deposits were opened up, and silver was discovered in the fall of 1903.

The original discovery of Cobalt was made at Lake Cobalt, a lake about three-quarters of a mile in length.

At the end of 1903 we had here all the claims that were located. Men did not think a great deal of them at that time. It is a little remarkable that there was not more excitement at the end of 1903; there would have been a boom the next spring. Although there was much about Cobalt in the Government reports, it caused no real excitement. In the spring of 1904 a few prospectors went up. They had to carry their packs on their backs, as the road was so bad that the horses were not able to carry them. They found the Lake absolutely deserted, not a sign of activity anywhere. During the summer of 1904 prospectors came in here, but were unable to discover anything and went home disgusted.

Before 1904 was over, prospectors found Native Silver, and Niccolite or Smaltite, which is reddish in color and very nice, resembling the German Kupfer Nickel or Copper Nickel. When Smaltite is subjected to the action of the weather it rusts to a pink rust called Cobalt Blue. The facility with which Smaltite decays is remarkable. The smallest quantity of Smaltite subjected to the action of the weather rapidly alters to a beautiful pink color. Cobalt, as a metal, is like iron, and has about the same hardness ; it is used in making steel, but not very largely. The main use is for staining windows, such as we see in churches, and for making water colors used in china painting.

Previous to the discovery of Cobalt in Canada, most of it was brought from a little island in the South Sea, called New Caledonia. In 1900, New Caledonia produced about 275,000 francs worth of ore, entirely different from that found at Cobalt. New Caledonia Cobalt was worth about sixty-five cents per lb. in the ore. It is now about one-half or less than a half the price it was before the Canadian mines were opened up.

The presence of Cobalt makes the country rather unique, but it is the silver that makes the country really valuable, and not the Cobalt. The greatest mass of solid Smaltite that has been known was discovered at Cobalt in 1904. In 1904 the Ross mine was found ; it is estimated to be worth more than a million dollars. It is a wonder that the Indians did not discover the presence of Smaltite. Mr. Trethewey came up one afternoon in the fall of 1904 and found his claim in little less than half an hour. There are remarkably fine veins of silver in the Trethewey mine, running right up the hillside.

Around Cobalt Lake, on the south side, the railway laid out a town, and the fall of 1904 saw the beginning of the town of Cobalt. The year of 1904 proved the value of the country, and by the spring of 1905 there was a real rush. Cobalt rushed up in 1905 where before it was virgin forest ; by the fall of 1905 there were big advances. In 1906 an even greater boom than ever began.

In the Cobalt district there are many veins where you can walk along without taking your feet off of solid silver. Silver is detected through these veins in threads, in streaks, scales and large masses, and in some cases almost filling up the vein itself with practically pure silver.

The Cobalt mining district is about three miles square, and mines are widely distributed. A piece of silver was taken up out of the Ross mine in the summer of 1906, weighing 610 lbs. and worth from $3,000.00 to $4,000.00 ; this piece was practically pure silver. Land that was previously worth nothing became very valuable at once. Various parts of the Cobalt are now worth many thousands of dollars per square inch. The ore, as it comes up from the shaft, contains considerable rock matter, silver and Smaltite. The ore is broken and sorted into two or three different grades, and the rest of it thrown up on the dump, but any of us would be glad if we had the dump; in some parts of the world it would be mined just for itself. One strange thing at Cobalt is that the actual production of material is in advance of concentrating machinery. Open dredging is a pernicious habit, because the water naturally gathers and prevents them from lowering the shafts into the mine. Mining is going on constantly, and $300,000.00 worth of silver has been taken out of a small mine.

The geological structure of the country is peculiar, after you get down to the rock the surface is more or less smooth ; the country has been claimed by glaciers. The Gneiss Granite of the Laurentian Age are a series of rocks known as Keewatin. These are probably the oldest that we know of. These rocks are more or less green or dark grey in color. A vast period of time must have elapsed before this rock was put down. Then came the period when the Cobalt silver rocks were laid down, the rocks of the Lower Huronian Age. There are indications of large masses of molten material on these rocks at some subsequent time, and I am inclined, very strongly, to think that these huge masses are more or less responsible for all the silver and Cobalt there is in the country, and that when these molten masses came into the country they had a certain amount of silver and Cobalt in them. One of the things necessary is that the rock should be fractured, and from the general appearance of the Huronian or silver-bearing rocks, these fractures have taken place.

So far away as the township of James, men state that they have seen native silver, and it is reasonably true. Cobalt and native silver have been found on the shores of Lake Huron, and in the northern part of the township of Wingham a considerable amount of Smaltite has been found.

Around Lake Cobalt some varieties of the southern type of trees have been found, but the vegetation is mostly of the northern varieties, such as spruce, pine, etc.

Manufacture and Properties of Malleable Iron.

Read before the Hamilton Scientific Association, February 21st, 1907.

BY S. B. CHADSEY, B.A., SC.

The material, regularly known in commercial circles as Malleable Iron, is more accurately, though less conveniently, described as Malleableized Cast Iron, and may be defined as a cast iron of a special composition which has been rendered soft and malleable by a more or less prolonged heat treatment or annealing. There are branches of engineering and manufacture in which it is rarely met with, while in other lines it constitutes one of the most important materials of construction, and is so largely used that upon its quality depend the usefulness and reliability of the structures of which it forms a part. One of the most interesting of metallurgcial products, both from the curious transformations which it undergoes during the processes of manufacture, and from its numerous applications to mechanical construction. It is strange that so little information concerning it exists in the technical literature of the day. This is largely due, however, to the great reluctance of the older foundries to the dissemination of information regarding it, and it is only during recent years that a change has taken place in this respect, and that it has come to be more generally recognized that greater publicity alone will bring about many desired improvements.

The foundations of the manufacture of malleable iron were laid by discoveries of Reamur, about 1720, who found that iron castings that were too hard to be worked could be greatly softened by packing them in iron ore or hammer slag and exposing them to high temperature for a number of days. The industry was not founded in America, however, until

1826, when Seth Boyden, of Newark, N.J., started a foundry for the production of harness hardware and other castings of small size. Since that time it has grown to very large proportions, and the uses of the material have greatly extended, until at the present time its foundries are engaged in turning out castings varying in weight from a few ounces to several hundred pounds, and adapted to as wide a variety of requirements. It would be impossible to enumerate a list of the uses to which it is put, but it may be stated, in a general way, that it enters very largely into the construction of many lines of machinery, of which agricultural implements may be taken as a type. It is also extensively used in the building of railway cars, and it is only recently that steel has been substituted for malleable iron in car couplings.

The value of malleable iron, as a material of construction, lies in certain special properties which are, in a sense, intermediate between those of ordinary gray cast iron on the one hand, and mild steel on the other. Its most valuable properties are the readiness with which it may be machined, a fairly high strength under tensile strain, a considerable degree of ductility, and a consequent ability to withstand impact strains under working conditions. It may be readily bent, and castings may, therefore, be adapted without difficulty to the positions in which they are to be used. In these respects malleable iron is undoubtedly inferior to mild steel, and steel castings are therefore in demand for uses in which the conditions are more severe, as for example, in the case of the car couplings already cited. But the difficulties attendant upon making them, and the consequent higher cost of their production limits their application to situations where higher strength is of the utmost importance. Ordinary gray cast iron, on the other hand, while it is cheaper than malleable iron, and while it is admirably adapted for use under compression, is incapable of withstanding severe shock, will not bend, and is unsuited to working under tensile strain.

For the purpose of illustration there is given in Table 1 a statement of the ductility and tensile strength per square inch of gray iron, malleable iron and mild steel castings, which serves to show the intermediate position of malleable iron.

Table No. 1.

Material.	Tensile Strength. Lbs. per Square Inch.	Ductility.
Gray Iron............	20,000 to 30,000	.25 to .75% in 4 inches
Maleable Iron.........	40,000 to 50,000	2.50 to 10.00% in 4 inches
Mild Steel Castings....	60,000 to 70,000	20.00 to 25.00% in 8 inches

In regular commercial work it is not usual to meet malleable iron that exceeds 50,000 pounds per square inch in tensile strength, but the writer has met specimens in the form of round test bars ½ inch diameter, having a strength of over 58,000 pounds and capable of 15 per cent. of elongation in a length of 4 inches. Such material may be very greatly deformed without being broken, as may be seen in Plate No. 1. In this are shown two round test bars of ½ inch section, which have been bent by hammering as much as they would stand without breaking. One of the specimens represents iron of unusual excellence, while the other, although well suited to all uses for which malleable is applied, is of a more ordinary quality. Before proceeding to a description of the method of manufacture it may be of interest to quote from the Standard American Specifications for Malleable Iron, which were adopted in 1904 by the American Society for Testing Materials, and which may be considered as representing good average practice.

Tensile Test—The tensile strength of a standard test bar, (1 inch square) for castings under specification, shall not be less than 40,000 pounds per square inch. The elongation measured in 2 inches shall not be less than 2½ per cent.

Transverse Test—The transverse test of a standard test bar on supports 12 inches apart, pressure being applied at the centre, shall not be less than 3,000 pounds, deflection being at least ½ inch.

These are requirements that can be readily met in any well regulated foundry, and it is probable that by far the largest part of the castings made at the present time are of a

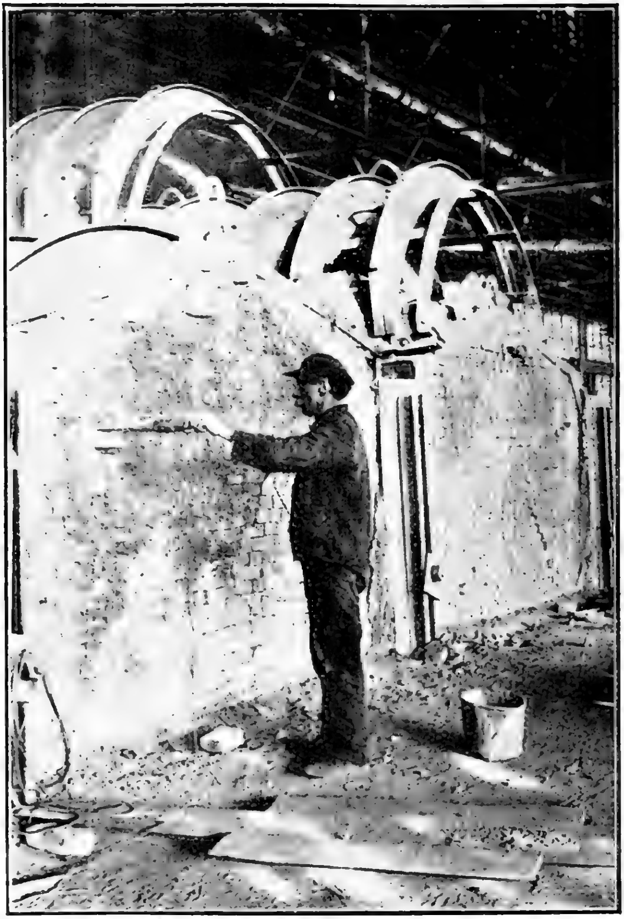


PLATE No. 2.

TAKING TEMPERATURE OF ANNEALING OVEN.

PLATE No. 3.

INTERIOR OF ANNEALING OVEN.

quality superior to that laid down in the foregoing requirements.

Turning now to the methods of production, we have the three main subdivisions of melting, casting and annealing, but as the second has the least effect upon the quality of the metal, we will omit it from consideration, and will deal only with the processes of melting and annealing.

Melting may be carried out in the Cupola, the Open Hearth Furnace or the Reverberatory Air Furnace, and each of these is in actual use in present day foundries. Owing, however, to the somewhat poorer quality of the material turned out by the Cupola, and the difficulty of economical manipulation of the Open Hearth Furnace in malleable work, by far the largest tonnage is melted in the Air Furnace, to which alone we will make reference.

The special form of the air furnace varies according to the conditions of the foundry, but there is a general agreement with regard to the main features of construction. The hearth of the furnace is separated from the fire box at one end and the entrance to the stack at the other by bridgewalls of suitable height. The roof of the furnace is usually made up of detachable bungs, which may be readily removed for repair, or to permit of charging the furnace from above. There is usually a forced draft below the grate of the firebox, and means for distributing a blast of air into the flame just as it enters the hearth over the front bridgewall. Long flame bituminous coal of low sulphur content is the fuel usually employed, and by suitable stoking and air regulation the furnace may be filled with flame of either an oxidizing or reducing nature. The regulation of the flame is one of the most important matters in connection with air furnace practice, since upon it depends both the economy of the melting and the quality of the metal produced.

The charge for each melt varies in amount within fairly wide limits, but 8 to 10 tons represents perhaps the average practice. The making up of the charge is a matter requiring experience and care, as disastrous results may attend the use of material of unsuitable quality. At the present time it is almost universally the custom to regulate the composition of the charge by means of chemical analysis, and the composition of the Pig Iron and Foundry Scrap are kept within fairly well defined limits. The elements that are present in commercial iron, and that are kept under special control are Silicon, Sulphur, Phosphorus, Manganese and Carbon, and although it is beyond the scope of this article to enter minutely into the question of the influence of these elements upon the quality of the metal, the general specifications for Pig Iron that are given in Table 2, indicate the customery limits that are set for this material.

Table No. 2.

Silicon	1.00 to 2.00%
Sulphur	Not above .05%
Phosphorus	Not above .20%
Manganese	.40 to .60%
Total Carbon	3.25 to 4.00%

The furnace charge is ordinarily made up of 50 to 60 per cent. of Pig Iron and 40 to 50 per cent. of foundry scrap, consisting of sprues, gates and defective castings. A small percentage of steel, also, is frequently used for the purpose of increasing the strength of the iron, or to bring the carbon of a tardy heat to the proper state of combination. The chemical composition of the various pig irons and of the foundry scrap being known, the composition of the charge is estimated upon the basis of the weights of each iron entering the charge. In Table 3 are given the weights of various materials making up a one ton charge, together with the calculated analysis of the mixture and the actual analysis of the product.

Table No. 3.

Iron.	Quantity Per Ton.	ANALYSIS. Silicon.	Sulphur.	Phosphorus.	Manganese
Pig Iron-Car $56,474	100 lbs.	1.56	.022	.26	.64
" " " 5,225	200 "	1.70	.035	.08	.42
" " " 9,378	200 "	1.86	.035	.16	.69
" " " 1,656	200 "	2.24	.032	.14	.72
" " " 17,530	350 "	1.05	.049	.16	.61
Sprue and Scrap	950 "	1.00	.066	.16	.25
	2,000 lbs.				

Calculated Analysis of Charge.		Actual Analysis of White Iron.	
Silicon	1.31	Silicon	.98
Sulphur	.048	Sulphur	.053
Phosphorus	.155	Phosphorus	.157
Manganese	.44	Manganese	.25
Total Carbon	3.20	Total Carbon	2.45

A comparison of the percentage of the various elements in the original charge with the percentage of those elements in the product of the melt will serve to illustrate the changes that take place in the composition of the metal during the course of the melt. Silicon, Manganese and Carbon are very considerably reduced. Sulphur is somewhat increased, while Phosphorus remains practically constant. The extent of the reduction of Silicon and Carbon is dependent upon the regulation of the flame and the duration of the melt, and it is most important that the reduction shall not proceed too far. If the proper precautions are not taken, the carbon, the percentage of which greatly influences the melting point of the metal, will be reduced to such an extent that the heat of the air furnaces will not be high enough to maintain it in a sufficiently fluid condition to pour into molds. Moreover, an iron with too low a carbon content cannot be successfully annealed, and will remain in too brittle a condition for satisfactory use. The lower limit of the carbon for successful results has been variously stated, an eminent American authority placing it as high as 2.75%, but it has been the experience of the writer that it may run as low as 2.10% without serious injury to the product.

At the termination of the melt, which ordinarily requires from three to four hours, the metal has been sufficiently refined by the action of the flame to have its carbon almost entirely in the combined condition after it has cooled in the mold. By this is meant that the carbon is united chemically with the iron and cannot be detected in the fracture as it may in the case of gray iron whose dark color is due to carbon separated from the iron and existing in the form of graphite. The fracture of the air furnace iron is markedly crystalline, and is technically known as "white" in distinction to the ordinary gray fracture of cast iron. In Plate 3 there is shown the crytalline fracture of a white iron test bar after it has been annealed. The chemical composition of the white iron varies somewhat in accordance with the class of castings that are being made, principally with respect to the Silicon content. This element may be as low as 0.45% in castings of heavy section, and as high as 1.00% in castings of lighter weight. Sulphur should be kept as low as possible, the usual limit set being 0.06%. Phosphorus may be allowed to run to 0.20%, but better results can be obtained if it does not rise above 0.16%. Very small percentages of Sulphur and Phosphorus profoundly influence the annealing qualities of the iron, and an excess of either may entirely prevent the anneal from being effective.

The Anneal—After the castings have been cleaned from adherent sand, they are placed in white iron saggers, or pots of convenient size, and the spaces between them filled in by a packing consisting of rolling mill scale, slag, iron turnings and other similar material. The purpose of the packing is merely to prevent the hot gases of the annealing ovens from playing directly upon the castings, and not, as was formerly supposed, to supply oxygen for the decarbonization of the iron. Any material may therefore be used which is sufficiently cheap, is economical to handle, and will readily conduct the heat to the castings. The pots having been filled are transferred to the annealing ovens, which are rectangular chambers equipped for continuous firing, and provided with draft flues necessary to the even distribution of the heat throughout the entire space. Various fuels are used—oils, gas, lump or powdered coal—and good results may be obtained with any of them if they are burned to advantage.

The duration of the annealing process depends upon the size of the casting and the degree of excellence required, but it may be considered as averaging one week from the closing of the ovens to the discharging of the iron. The actual period of firing is usually from 90 to 100 hours, and is required by standard specifications to continue fully 60 hours after the annealing temperature has been attained. During the early portion of the anneal the temperature is raised as rapidly as possible without overheating any part of the oven, and when the full annealing heat has been attained the fires are so regulated as to maintain that temperature as uniformly as possible until the end of the firing period. In the majority of foundries the temperature is estimated by observing the color of the ovens, but since the development of Pyrometers, suitable for high temperature measurements, there has been a growing tendency toward their adoption, and the consequent substitution of the more accurate method of regulation for one which depends for its success upon the individual judgement of the oven tender (see Plate 2). At the end of the firing period the dampers of the ovens, as well as all other opening, are closed in order to permit of a very gradual cooling of the iron. If this is not done and the castings are allowed to be cooled too rapidly, they are liable to be rendered hard and brittle with little indication of malleability. When the cooling has proceeded so far that the ovens are black hot, the doors are opened and the contents removed as required.

The actual temperature which has been found most suitable for the anneal is from 1,500° to 1,600° Fahrenheit, although the necessary changes in the white iron begin at about 1,250° Fahrenheit. The temperature conditions of the process may be represented by a curve showing the sharp rise at the beginning to about 1,500°, a fairly uniform portion between 1,500° and 1,600°, and a gradual decline to 500° or 600°.

Turning our attention to the condition of the metal after the anneal, we find that it has undergone a most remarkable transformation. The brittleness of the white iron has been exchanged for a remarkable softness and malleability, the fracture has become black and the crystalline appearance has been lost. These changes are due to, or all events are accompanied by a transformation in the condition of the carbon. In the white iron it has been pointed out that the carbon is almost entirely in chemical combination with the iron, much as it is in the case of steel. During the anneal, however, this state of combination is broken down and the carbon becomes separated, and appears in a very fine state of subdivision between the grains of the metal. It is this separated carbon which is the cause of the color of the fracture, and its appearance is a condition of a material of satisfactory character. It is therefore customary to judge malleable iron partly by the appearance of the fracture, and it serves, under experienced observation, as a reliable indication of quality.

This separation of the carbon and the physical transformations which accompany it are the essential features of the anneal, but under regular manufacturing conditions two other changes of a minor character also occur. These are the oxidation and consequent removal of the carbon from the surface of the casting inward, and a gradual absorption of sulphur from the material of the packing and the gases of combustion. The removal of the carbon is due to the nature of the packing, which is composed largely of oxides, and which gives up its oxygen to the carbon at the elevated temperature of the ovens, while the absorption of the sulphur arises from the affinity of the iron for that element under the same conditions. The Silicon, Phosphorus and Manganese remain practically unchanged in quantity whatever modifications may occur in their state of combination.

To illustrate the changes in composition which take place in the annealing oven, we give in Table 5 the composition of the white iron, and of samples taken from bars one inch square, at the close of the regular anneal. Four samples were taken from the test bar, the first representing the iron of the outer layer, one-sixteenth inch in depth, and the other samples successive layers, each being nearer the centre of the bar by one-sixteenth inch than the preceding :

Table No. 5.

	Sil.	Sul.	Phos.	Mang.	Total Carbon.	Graphitic Carbon.	Combined Carbon.
White Iron	.75	.045	.175	.144	2.35	0.055	2.295
Annealed Iron 1	.75	.070	.177	.145	0.203	0.210	....
" " 2	.74	.051	.176	.147	1.460	1.465	....
" " 3	.75	.049	.177	.146	2.170	2.165	....
" " 4	.76	.049	.175	.145	2.240	2.230	....

Changes In Composition Due To Annealing.

It has been found possible to repeatedly anneal malleable iron without injuring it, the only important change after the first anneal being the gradual reduction of the carbon. Unless an excessive temperature is reached the quality seems to undergo neither deterioration nor improvement by greatly extending the period of the anneal.

TUBERCULOSIS

How Our Present Day Knowledge of the Disease Has Developed.

Read Before the Hamilton Scientific Association, April 4th, 1907.

BY JAMES ROBERTS, M.D., M.H.O.

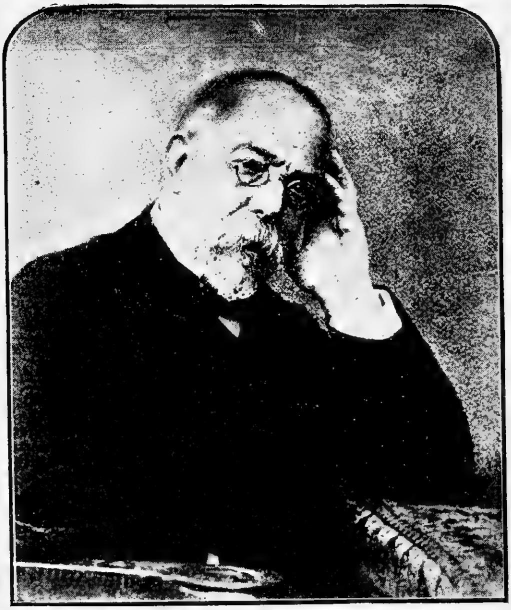
PART I.

Among the death-dealing agencies that have been instrumental in relegating mankind back to the traditional dust, ascribed as the basis of his origin, tuberculosis towers giantlike above all the others in potency.

No color, race or creed is immune to the inroads of this disease. Some of the gigantic intellects and geniuses of the world—and with a sense of sadness and despondency it is that one contemplates the fact—have succumbed untimely to it's attack.

If it be true, as has been said, "that death loves a shining mark," equally touching and pathetic is the fact that in such a large percentage of cases, the virus of this most loathesome malady should poison the shaft with which he singles out the elite among the world's nobility as the victims of his predilection. Schiller and Keats in poetry; Stephenson, Crane and Artemus Ward in prose; Chopin, Nevin and Von Weber in music; Rachel in the drama; Baruch Spinoza in philosophy; Rene Theodore Laennec in medicine—these are but a mentioned handful among the master spirits of the world, destined in the very zenith of their influence and their usefulness to be victims of the Great White Plague.

Phthisis, which is the technical term for pulmonary consumption and used synonomously for it, was a term used by the ancient writers of medicine to indicate what we of the



PROFESSOR COOKE

DISCOVERER OF THE TUBERCLE BACILLUS.

present day should call a wasting disease. Later on we find it associated with destructive lesions in the lung. No matter whether these destructive processes were suppurative, ulcerative or of the nature of abscesses, they were not regarded as differing essentially from the like lesions occurring in other parts of the body. "The most dangerous disease, and the one that proved fatal to the greatest number, was consumption," says Hippocrates, and he has left us an excellent clinical picture of the disease. What physician of the present day would care to attempt an improvement on the following description by Aritaeus of Cappadocia, written 50 B.C.? "Voice hoarse; neck slightly bent, tender, not flexible, somewhat extended fingers slender, but joints thick; of the bones alone the figure remains, for the fleshy parts are wasted; the nails of the fingers crooked, the pulps are shriveled and flat, for, owing to the loss of flesh, they neither retain their tension or rotundity, and, owing to the same cause, the nails are bent, namely, because it is the compact flesh at their points which is intended as a support to them; and the tension thereof is like that of solids. Nose sharp, slender; cheeks prominent and red; eyes hollow, brilliant and glittering; swollen, pale or livid is the countenance; the slender parts of the jaws rest on the teeth, as if smiling, otherwise a cadaverous aspect. So also, in all other respects slender, without flesh; the muscles of the arms imperceptible; not a vestige of the mammæ, the nipples only to be seen; one may not only count the ribs themselves, but easily trace them to their terminations, for even the articulations of the vertebræ are quite visible, and their connections with the sternum are also manifest; the intercostal spaces are hollow and rhomboidal, agreeably to the configuration of the bone; hypochondriac region lank and retracted; the abdomen and flanks contiguous to the spine; joints clearly developed, prominent, devoid of flesh; so also with the tibia, ischium and humerus; the spine of the vertebræ, formerly hollow, now protrudes, the muscles on either side being wasted; the whole shoulder blades apparent like the wings of birds. If in these cases disorder of the bowels supervenes, they are in a hopeless state, but if a favorable change takes place, symptoms the opposite of those fatal ones occur.''

And then, coming down to the seventeenth century, listen while we quote from quaint old Sir Thomas Browne, and I doubt not that some of you will be wondering what the clinician of the present day has to add to his observations.

The following extracts are taken from a desertation entitled "A Letter to a Friend upon occasion of the death of his intimate friend, written, so far as we can ascertain, about 1670:

"Upon my first visit I was bold to tell them who had not let fall all hopes of his recovery, that in my sad opinion he was not like to behold a grasshopper, much less to pluck another fig; and in no long time after, seemed to discover that odd mortal symptom in him not mentioned by Hypocrates, that is, to loose his own face, and look like some of his near relations; for he maintained not his proper countenance, but looked like his uncle, the lines of whose face lay deep and invisible in his healthful visage before; for as from our beginning we run through variety of looks before we come to consistent and settled faces, so before our end, by sick and languishing alterations, we put on new visages, and in our retreat to earth may fall upon such looks which, from community of seminal orignals, were before latent in us.

"He was fruitlessly put in hope of advantage by change of air, and imbibing the pure ærial nitre of these parts; and therefore being so far spent he quickly found Sardinia in Tivoli, and the most healthful air of little effect where death had set her broad arrow; for he lived on unto the middle of May, and confirmed the observation of Hippocrates of that moral time of the year when the leaves of the fig tree resemble a daw's claw.

"In this consumptive condition and remarkable extenuation he came to be almost half himself, and left a great part behind him which he carried not to the grave. And though that story of Duke John Ernestus Mansfield be not so easily swallowed, that at his death his heart was found not to be so big as a nut; yet if the bones of a good skeleton weigh a little more than twenty pounds, his inwards and flesh remaining could make no bouffage, but a light bit for the grave. I never more lively beheld the starved characters of Dante in any living face; an aruspex might have read a lecture upon him without exenteration, his flesh being so consumed that he might, in a manner, have discerned his bowels without opening of him, so that to be carried "sexta cervice" to the grave was but a civil unnecessity, and the compliments of the coffin might outweigh the subject of it."

The term tubercle was used as a descriptive anatomical term to designate any small morbid mass irrespective of its nature and was without special significance.

Wasting, no matter whether it was a symptom of disease of the lung or of any other part of the body, was designated phthisis, and from this confusion of nomenclature consequently originated the terms "phthisis pulmonum," "phthisis renum," phthisis intestinales," etc., which were in general and approved use until the end of the sixteenth century. *Galen* himself had no knowledge of phthisis as a distinct entity, and not until a somewhat later period do we find phthisis of the lung regarded as a special and distinct disease.

The peculiar little masses or tubercles then became recognized as standing in very close relation to the more destructive processes, and the term tubercle had a special and restrictive meaning attached to it.

Morton, in 1689, taught that the tubercle was the pathological evidence of phthisis of the lung, and from this as a foundation emanated all the subsequent theories of the disease. *Monget* described similar tubercles in other organs, but his observations were forgotten, and nothing resulted until at the end of 100 years *Baillie* revived interest in the subject once more, but fell also into erroneous conclusions by distinguishing nodular from diffuse lesions regarding the later as separate and distinct from tubercle and of a different nature. The cheesy and caseous matter, resulting from the breaking down of these, he called scrofulous material on account of its resemblance to enlarged lymphatic glands known as scrofulous.

Bayle, in 1810, was the first to recognize the connection between the disease known as "phthisis" in the lung and tubercular disease in other parts of the body, and to look upon the two as one and the same process.

He referred its origin to a peculiar diathesis, which he called the tubercular or scrofulous, and although regarding consumption of the lungs, as we understand it to be, as a specific affection, associated with catarrh, inflammation and hæmoptysis, did not look upon these as the cause of it.

The credit of further elaborating and establishing this view is due to *Rene Theodore Hyacinth Laennec*, a Frenchman. *Bayle* had grasped the fundamental idea, but his explanation of the different phases, by which tuberculosis manifested itself. was a trifle hazy in parts. His keen observations had shown him sometimes the hard, opaque, cartilaginous granulations, which showed no tendency to soften, sometimes the tiny, soft, numerous, seed-like bodies, for which he invented the term miliary, and which he noticed tended to break down. To distinguish the two, he named the first "granular phthisis," the second "tubercular phthisis." Here we see exemplified how the feeble flickerings and glimmerings of supposition brighten and burn steadily, until at last the benign rays of truth shine into the minds of men.

Laennec claimed a specific nature for phthisis and denied its inflammatory origin, claiming that all phthisis was tubercular, and that in Bayle's granular form the nodules were tubercles which had undergone fibroid change.

The large infiltrated masses, and also the nodules, he maintained began as a grey, transparent mass, which subsequently softened, became cheesy or caseous, broke down into pus, and was in coughing discharged, and led to the subsequent formation of cavities.

This simple view of phthisis was disputed by some of the greatest authorities, and at all points. That the grey and yellow tubercles believed by *Laennec* to be different stages in one and the same process, sometimes occurring in the nodular form and sometimes in the diffuse, were of the same nature. Whether caseation was pathognomonic of tubercle, and whether tubercle was allied to inflammation in any way, and what the relation was.

The great German anatomist and pathologist of the last century, *Virchow*, revived the discussion, and entirely changed the aspect of it by restricting the term tubercle to the small miliary form of the disease, and fell into the grievous error of regarding this as a lymphatic new growth, liable to break down and caseate. He looked upon the infiltrated areas of lung tissue which we now know to be tubercular, as something entirely apart from these and of a different pathological origin. Nevertheless, he accepted Buhl's views that caseous matter was infective and could produce tubercles, and that in this way the eruption of secondary tubercles around breaking down areas in the lung was to be produced.

Those of you who know anything of the life of this great man would perhaps marvel that he should thus get astray, and for those of you unacquainted with his work and his achievements during the major portion of a century of time I shall venture this epitome by his friend, the venerable *Jacobi*, still hale and hearty, with the weight of nearly 80 years :—

"The greatest, however, of all the gigantic intellects, and at the same time a humanitarian of a world-wide horizon, was Rudolf Virchow. We all have lost in him a friend, for he was a friend and benefactor of mankind. In the history of our profession, aye, in that of mankind, there is no man in whom a vast intellect was blended with a warm heart to the same degree. There never was so great a statesman in our ranks. At the age of 28 years the Prussian Government sent him to Upper Silesia to study the petechial typhus, which was devastating the country. In his report he pictured the nosology and pathological anatomy as it had never been done before, but also its etiology, viz.:—The governmental neglect of the inhabitants which extended over centuries; their poverty, ignorance, filth, the moral and intellectual tyranny of the hierarchy, the economic subjugation both of the Prussian bureaucracy and of the effete feudalism. He urged medication and sanitation, but more eagerly social reforms, culture, liberty and comfort, unlimited democracy, education in public schools, agricultural institutions, care and education of the numerous orphans, building of roads, and the general recognition of the fact that, as he expressed himself, 'our century is the beginning of a new social era.' What happened? Was he applauded? Decorated? Rewarded? In accordance with Prussian methods he was deprived of most of his public positions! Then in the first number of a new journal he said: 'The physicians are the natural attorneys of the poor, and the social problem should largely be solved by them; and in the last: The medical reform we contemplated was to be a reform of science and of society.' With this early programme he filled his rich life. He addressed hundreds of popular meetings, edited a thousand popular essays, looked after the sanitation of schools and civic and military hospitals, made Berlin a healthy city, and in parliament aided the liberal movement in Germany. There never was a man who more than he deserved the hatred of a few scoffers—amongst them of the coarse, brow-beating Bismark—and the admiration and gratitude of his native land and all mankind.

His like we shall not see again, perhaps need not see again, because men endowed with high talents will do enough when building on the foundations. If there be anything I am proudest of in my comparatively humble life it is the honor of his friendship which I enjoyed these last 20 years."

"Only a great master like Virchow," says Osler, "could have won the profession away from a belief in the *unity of phthisis*, which the genius of Lænnec had on anatomical ground announced. Here and there a teacher, as *Wilson Fox*, protested, but the heresy prevailed, and we repeated the striking aphorism of *Niemeyer*, 'The greatest evil which can happen to a consumptive is that he should become tuberculous.' "

Concerning the development of the idea that tuberculosis was a disease of infective nature, you will be surprised, perhaps, to learn that a Greek physician and a contemporary of Aristotle asked "Why are those taken by phthisis, who are brought into contact with the sufferers, and not taken by such diseases as dropsy, fever and apoplexy, however close the contact with sufferers from this disease may be?',

"Phthisis," he further adds, "is obviously infectious because it spoils the air and makes it heavy, and thus others become infected." *Galen* was fully cognizant of the fact that phthisis was an infective process, and that there was danger living with those affected with it.

"During the dark ages," says a gifted writer, "Mohammedanism exhibited a scientific enlightenment, the spirit of which is not excelled in modern civilization."

There was among them a wonderful development in nearly all the arts and sciences; and among the brightest gems in this intellectual crown was Saracenic medicine. Avicenna, the Arabian, 1037, who, like the best observers of antiquity, had definite ideas regarding the infectivity of consumption, referred to "many diseases which are taken from man to man like phthisis." In the seventeenth century "The Practice of Physic" by Lazerus Reverius, published in London, contains the following:

"Moreover there are external causes (of phthisis) as contagion, which is the chiefest; for this disease is so infectious that we may observe women to be infected by their husbands, and men by their wives, and all their children to die of the same, not only from the infection of their parent's seed, but from the company of him that was first affected, nd this contagion is more easily communicated to them that are of kin. Wherefore, it is not safe for a brother or sister to enter into the chamber for the miasmatic or vapors infective, which come from the lungs and infect the whole air of the chamber, and being drawn in by others (especially if they are in any way disposed to the same disease), beget the same disease in their lungs."

Villemin, in 1865, by the experiments of Buhl in 1857, and by other facts, among them the resemblance of tubercle to other diseases, was led to conclude it was infective and to perform similar experiments to that of Klenke in 1843, who had injected tubercular matter into the jugular vein of a rabbit, and six months later found tuberculosis in its liver and lungs.

He inoculated rabbits and other animals with caseous material, and in this way succeeded in transmitting the disease from animal to animal and from man to animal, and that not only with caseous material from the lung, but also with similar material derived from other sources e. g., broken down lymphatic glands, thus convincing himself that tuberculosis was an infectious disease, and that caseous material was tubercular in as much as it was the vehicle for carrying the infection. So numerous were the investigators and so uniform the results of their investigations along not identical, but similar lines, that *Toussaint* announced tuberculosis as one of the most communicable of diseases.

So complete and exhaustive were the series of experiments that when certain observers objected on the ground that other substances injected produced lesions simulating tuberculosis, it was shown that material from such lesions was incapable of exciting the disease again, or in other words, such tuberculosis was non-communicable. Also, it was proven that the caseous matter of supposed tubercle was infective by inhalation and feeding as well as by inoculation. In fact, the causative factor in the transmission of this widespread and fatal disease was believed to be a specific germ, whose early discovery was confidently predicted by *Cohnheim* in 1879.

The announcement of the discovery of the tubercle bacillus was made by Koch in March, 1882, and two years afterwards a full report of his researches appeared. His work on this subject stands to-day as probably the master-piece of bacteriological investigation. In the first place, because of the difficulties which had to be overcome in order to make the discovery of the specific germ, and secondly, because of the completeness with which he demonstrated the relation of this organism to the disease.

The tubercle bacillus cannot be demonstrated in the tissues, as is the case with a variety of other micro organisms, by means of a watery solution of a basic analine dye, and it was only by means of a variation of an ordinary method, worked out by himself and by prolonged staining of 24 hours, that he was able to reveal the germ.

All attempts to cultivate it on the ordinary media completely failed, but by bringing his able reasoning powers into play, it occurred to him that it might be induced to grow on the solidified serum of an animal's blood, the method of preparing which he devised himself. Further, no growth was perceptible on the surface of his media till the tenth day at the earliest, a circumstance which might easily have led a less patient and careful observer to the conclusion that no growth took place.

His genius and perseverance overcame successfully in the end every obstacle, and by a long series of inoculation experiments on various animals, he proved that bacilli from tubercular lesions produced like lesions and were the same bacilli.

His work on this subject Osler considers to be one of the most masterly demonstrations of modern medicine, and its thoroughness appears in the fact that, in the years which have elapsed since its appearance, the innumerable workers on the subject have not, so far as he knows, added a solitary essential fact to those presented by Koch.

How the Germ Accomplishes its Destructive Work.

PART II.

The tubercle bacillus of Koch may, without reasonable doubt, be now accepted as the causa causans of tuberculosis.

A mistake that must be guarded against, however, is that because a tubercle bacillus comes near or even in contact with the human body an attack of tuberculosis necessarily results. It is not enough that the bacillus find its way to a free surface, but must enter into the tissues of the body before it can do harm. Furthermore, it is very probable that in order to accomplish any dire results such tissues must be damaged or weakened in some way, and a special mode of entrance for the bacillus thus prepared. You know that numbers of medical men are at work every day in our large hospitals specially investigating the causes of death on the post mortem table, and making note of the after death appearances of those tissues which have been invaded by the tubercle bacillus during life. In the course of such investigation many of the bacilli must necessarily come into contact with the hands of the pathologist. Many are doubtless swallowed, and many inhaled, and make their way to the respiratory tact.

Nurses in attendance on those in the last stages of the disease must also come in contact with considerable numbers of these minute micro organisms, and yet in only an infinitesimally small number of cases do we find any untoward results, neither so long as these persons are careful to protect themselves—in the case of the pathologist from cuts on the hands, and in the case of both nurse and pathologist from being run down in any way or from congestions and catarrhs of the respiratory or alimentary tracts—need any be expected.

In other words, unless the soil is prepared, there can be no reaction between the tissues and the bacillus which can end in the latter getting a foothold in the former.

Now, the exciting and predisposing causes of the invasion of any tissue may be many, but in the lungs it appears most often to be a catarrh, that is, a congestion of the blood vessels accompanied by a pouring out of fluid and white blood corpuscles into the air vesicles, together with a proliferation of the delicate layer of cells, which forms the lining of these vesicles.

This accumalation of catarrhal products and subsequent entrance of bacilli into it usually takes place in those portions of the lung where there is deficient expansion and contraction, etc., the apex of the lung in adults, at the root of the lung in children, beneath any areas of the lung where there is adhesion between the parietal and visceral pleura; in fact in all situations where deficient movement allows the bacilli to remain, they multiply, produce their poisonous toxins which act on the tissues causing degenerative changes, which changes lay the foundation for the subsequent tuberculosis.

Now then, taking it for granted that the organism has found a suitable habitat for itself and has effected a permanent lodgement, it becomes clearly evident that, from this point of selection, unless something is undertaken by the system in order to accomplish their eviction, they are in a position to be distributed still by the respiratory passages to every portion of the lung, there to multiply, to produce similar results from their presence as in the first case, and to so overpower the patient that in the end we have set up a tuberculous catarrhal pneumonia, or in every day language a *galloping consumption.*

Not every case of infection by the air passages terminates in this manner. We have omitted to describe the results which were brought about in those cases where the natural resistance of the tissues to invasion by outside agencies inimical to its preservation are called into play. Every student of morbid anatomy, who has had any considerable experience in post mortem work, knows that in the lungs of old people, who have died from diseases, allied in origin in no way to tuberculosis, not seldom, and in fact, very, very frequently there is to be seen quite unmistakable evidence of lung trouble in early life, which has been successfully eradicated. Such evidences are to be seen in the form of local thickenings of the pleura, thickenings of the septa between the lobes, tiny gritty particles like grains of sand here and there, and in other cases pigmented scars showing at one time loss of tissue.

These evidences are found with variable frequency according to various observers, some pathologists finding them as often as in 1 in 3, others 1 in 5, others 1 in 7 of all deceased coming to the post mortem table.

Furthermore, there is abundant testimony in all these cases, even the ones which succumbed to tuberculosis, that the tissues waged a persistent warfare against their foes, and only failed in those instances where they became handicapped as a result of interference with their nutrition.

In fact the whole rationale of the once much vaunted Cod Liver Oil treatment, of the fresh air, sunlight, rest and good food treatment, lies in the belief that by means of them the resistance of the tissues is so heightened and reinforced that they are enabled to supply additional energy or combative force against the bacilli and their injurious toxins, so that they are either killed, rendered inert, or removed together with the tissues destroyed by them.

There are still two other methods by which the bacilli may be transported from the first point of entrance to other parts of the body, each of which is of considerable importance in every case of chronic or acute tuberculosis, namely, the lymphatic system and the vascular system.

Between the cells of the tissues, and especially around the blood vessels, more particularly the small capillaries, there is a network of spaces which have been likened to the pores of a sponge. These spaces interlace and communicate with one another in such a way that there is always a free circulation of lymph bathing every living tissue. Such spaces pour their contents into small definite tubes or canals, which in turn lead to vessels of some considerable size with definite walls, these again leading to the filters of the system, the lymphatic glands. A large portion of the fluid of the body, concerned with nutrition, passes from the blood vessels to these same lymphatic spaces, there to be taken up by the tissues. The effete matters of the tissues are cast off into the same spaces to be in part taken up by the blood vessels, in part passed on by the small lymphatic tubes to the lymphatic glands where the coarser particles are filtered out.

EXAMPLES: —

In the lungs we have precisely the same arrangement of lymph spaces, lymph channels and lymphatic glands, and in them we find that the poison of tuberculosis is carried from the vesicles where it is inhaled to the lymphatic glands at the root of the lung by the lymph channels.

Just as the tubercle bacillus causes in the air vesicles of the lung irritation of their delicate lining with multiplication of cells and formation of new tissue, so does it exert the same effect on the cells which line the lymph spaces causing, in some instances, softening and caseation, at other times, depending on other factors the formation of fibrous tissue.

The marked feature of tuberculosis, which has run a chronic course, is the more or less abundant formation of this same fibrous tissue.

No matter in what part of the lung the bacillus gains a foothold, there is probably at first a temporary harmful effect on the tissue with which it comes in contact, followed later on by degeneration, softening and symptoms of irritation of the surrounding healthy tissues.

This formation of fibrous tissue furnishes us with direct evidence as to the character of the struggle which the system has been able to put up against the invasion of the tubercle bacillus. In some very chronic cases the quantity to be found will be great indeed. Enormous thickening of the pleura above the lesion and of the septa between the lobules. Numerous areas, which in the early stages of the disease must have been soft and pultaceous, entirely surrounded by a firm wall of this protective material with the interior hard and stonelike. If, however, the attempt of nature to circumscribe and wall off such diseased areas be incomplete or imperfect, as often is the case, then the bacilli break through, travel along the lymphatics until they find a favorable site for localization, where a repetition of the process just described takes place, or, travelling on still further, become lodged in the lymphatic glands. Here they may become arrested, the proliferation of cells, accumulation of fluid, softening and enlargement of the glands, showing that the tissues have been making a vigorous effort to accomplish their destruction, or should the conditions be unfavorable or the reaction of the tissues not good, then the bacilli are carried from gland to gland each in succession one after the other, being unable to arrest their onward march until the virus ultimately lodges in other organs.

Here follows a short explanation of how the disease spreads by the blood vessels:

Having explained, then, the different methods by which this disease gains a foothold in the human system, it might perhaps be not out of place just here to refer to the different stages of its advancement, and to try to understand how it is that a patient who has had consumption for some considerable time either becomes to all intents and purposes cured, and is able to resume his accustomed occupation, or on the other hand suddenly begins to go rapidly down hill and dies within perhaps a few weeks.

We called attention previously to the accompanying symptoms of an incipient case of phthisis, the congestion of the blood vessels, the shedding of the epithelium from the walls of the tiny air vesicles, the accumulation of fluid, the gradual consolidation of the small masses making a suitable breeding ground for the reception of the bacillus. If at this stage our patient is placed under circumstances conducive to a proper reaction of the tissues, is given sufficient nourishment, rest, sunlight, fresh air, and if the waste products of the body are properly and regularly thrown off, then the chances are exceedingly good that such a nidus will be surrounded gradually with fibrous tissue, the bacilli will be rendered inert, the damaged tissues gradually absorbed and a "cure" will be the result.

Suppose, however, that such a patient feeling himself recovered, and therefore under no compulsion to persevere in that method of life which has brought about such marvellous results in his physical conditon, and in such comparatively short time, returns to his old life and his old habits, some of which are by no means commendable, he finds himself once more on the downward road, and often to his no small surprise.

Such a one perhaps has a focus of diseased tissue in his lung cut off for the time being from the bronchus or larger air tube with which the air vesicles now consolidated once communicated. As a result of some indiscretion, he becomes temporarily run down in health, the protective wall around the focus of diseased lung weakens, the focus expands and spreads until it comes in contact with the wall of another air tube. This it invades cutting off its blood supply, first of the outside layers, then of the inner layers until, by a process of ulceration, the tube becomes perforated, and a large quantity of soft, cheesy, tuberculous material, in which the bacilli are imbedded, becomes discharged into the main tubes of the respiratory tract. Some of the material becomes expectorated, the remainder being inhaled again more and more deeply until ever increasing areas of pulmonary tissue are invaded to become in turn foci for the repetition of the process.

In most cases, when this state of affairs intervenes, our patient has lost such a considerable area of lung tissue, either as a result of consolidation or of the formation of cavities, that nature is not in a position to respond to the demands made upon her. Even should such a patient recover for the time being, he cannot under any circumstances be regarded as cured. He may, however, with proper care, lead a useful if not an active life.

A patient who has once suffered from tuberculosis and in whom the disease, as far as our imperfect measures can teach us, is permanently arrested, does not enjoy immunity from future attacks of the disease.

The lungs of many a patient who has succumbed to an attack of acute tuberculosis exhibit evidences of old scars from which all evidences of active disease have disappeared, leaving nodules of fibrous tissue surrounding little grains of calcareous material. These patients have recovered years ago only to subsequently succumb to an attack of acute miliary tuberculosis, in all probability an entirely fresh infection, though of this we cannot be positive.

It is for cases such as these, cases which have under proper conditions every chance for the enjoyment of fairly useful lives, that the sanatorium regime has accomplished so much. I do not care whether the open air treatment is carried out in special institutions or not. It is not essential that such should be the case, and the fact is too often lost sight of that it can be as effectively carried out at home. The encouraging results obtained at Sanatoria should moreover induce patients after discharge from such institutions to continue the treatment, if even in modified form, throughout their own lives. It is impossible to state when a patient can go back to the old round of life, and, in fact, only by insisting on improved conditions of life in our centres of population shall we be able to diminish appreciably the mortality from Tuberculosis.

The English Bible.

A PAPER BY H. B. WITTON, SR.

Read before the Hamilton Scientific Association' April 25th, 1907.

Books that expound the faith, worship and ethical doctrine of non-Christian peoples are called sacred, in contradistinction to those which are secular. To that designation no exception can be taken, as for centuries the Christian world has appropriated the stronger and more expressive title, Holy Bible, as the most fitting name for distinguishing from all other books the Old and New Testament scriptures. At one time serious study of strange religions would have been tabooed, and occasionally it still fails to be reciprocated. In early times, the disdain of men for each other, because of diversity of speech, race and religion, vented itself in such words of reproach as barbarian, gentile and heathen; and enough prejudice remains in the world to prevent such words from becoming obsolete. They are, however, losing some of their old-time harshness; and it is well to bear in mind the sage advice of one whose wisdom was gained from experience: "Never may we fret over human frailties, or jeer at them, or despair of their betterment."

To what extent such asperities have become mollified is apparent from the fact that investigation of historical religions is now a favorite study. In every quarter of the world the past has been forced to yield up some of its long-buried secrets, and every civilized nation is aiding in the work of their disinterment. So widespread are these operations that any fitting individual appraisement of their importance is impossible. For such a task books of general information are now inadequate, and works for special reference have become a necessity. But as a few samples of ore sometimes may aid in estimating the wealth of a gold-field, so a glance at some achievements in one branch of the study of comparative religions may help to gauge the value of what is being done throughout the wide fields covered by that study. If we glimpse only at work being done by English speaking Indianists in their special studies, we shall find that the Oxford University Press alone has published in this generation fifty volumes of the "Sacred Books of the East." And within that time the late Max Muller, after working at his task more than twenty years, completed his great edition of the Rig-Veda, the oldest of the many old works Indian literature can claim, and the one most highly prized by learned Brahmins.

On this side of the Atlantic, a few months ago Prof. Lanman brought out the revised, completed translation by Whitney, of the Atharva-Veda. This work met with warm welcome by students of Indian religions, from the reputation of the translator, the time he was known to have given to his translations, and from the fact that, though the latest of the four Vedas, the Atharva-Veda sheds more light on Hindu life, and on the superstitious side of Hindu religion, than is given by the other Vedas. These are but two of an "Oriental Series" of works published under the auspices of Harvard University. The latest volume, just printed, of that series is a royal quarto of eleven hundred pages, on which Prof. Bloomfield worked for twelve years. Its publication has been eagerly looked for, as it is a concordance to every line of every hymn found in the whole body of published Vedic literature, and is also an index to every sacrificial and ritual formula referred to in that literature.

Thus in this year of grace 1907, scholarly men appreciated by pupils and patrons patiently decipher rare, time-stained manuscripts, bringing to the light of day authoritative expositions of systems of faith and morals in which millions outside the pale of Christianity still put their trust. And these strange volumes may be freely read by all who care to read them.

But as this present-day picture fades from view, another scene marked by darksome shadows looms up from the past, depicting the exile, deprivation and suffering of scholars who four centuries ago first gave to men of modern English speech a printed Bible in their mother tongue, albeit that gift for a time could be read only by those who ventured to face gruesome penalties. The descent of our English Bible can be directly traced back through the Latin, Greek and Hebrew languages. From well defined differences of structure, Latin and Greek rank with the Aryan group of languages, and Hebrew with the Semitic group. But it is interesting to know, despite these differences, that in their alphabets, the elements of written speech, traits of kinship have been traced. Indeed, one of the fairy tales told by linguists is their history of the Alphabet. After years of study, Rouge and Lenormant concluded that nineteen letters of our alphabet have come in direct descent from the alphabets of Rome, Greece and Phoenicia; and primarily from that system of hieroglyphics called by the Egyptians themselves "the writings of divine word." These conclusions are widely received as true. It by no means follows, however, because an alphabet may be traceable to a Semitic origin, that the language it gives expression to, or the people speaking it, are also Semitic.

The English Bible in general use contains sixty-six books. But the authorized version of James the First was printed with fourteen additional apocryphal books that were included in the canon adopted at the fourth session of the Council of Trent. By a large part of Christendom the Aprocrypha is still revered as a portion of the canonical scriptures. Almost all the Old Testament has been transmitted in Hebrew; the exceptions being some chapters in the books of Daniel, Ezra and Jeremiah. St. Jerome, fifteen hundred years ago, in his most interesting preface to the book of Daniel, pointed out that these special portions of the Bible, though written with the Hebrew alphabet, were in the Chaldaic and not in the Hebrew tongue. Of late

Chaldaic and Aramaic are used as synonymous words; or, more precisely, Aramaic is made to include Chaldaic and Syriac, the two leading languages of northern Semitic speech. The Aramaic language evidently possessed great vitality, as it became the mother tongue of the Jews for a thousand years, Hebrew being reserved for purposes of learning and religion. It was the common speech of the Jews in the time of our Saviour, and ceased to be so only when gradually superseded by Arabic, after the Mohammedan conquests in the East.

Veneration for their scriptures was always a marked trait in the character of the Jews. They are pre-eminently "the people of the book." For their "Book of the Law," used in the synagogue, the skin of no unclean animal could defile the parchment scroll on which the sacred text was written; and if by mischance the transcriber made four errors in any column, so soon as such defect was discovered, the copy, deemed unfit for use, was destroyed by burial in the earth, as destruction by fire might savor of irreverence. Such profound regard accounts for the numerous copies of the Hebrew scriptures found in all important collections of ancient manuscripts. But it is somewhat surprising that none of these manuscripts is remarkable for extreme age. In the British Museum there is a copy of the Pentateuch that dates from the ninth century A.D. That is claimed to be one of the oldest known fragments of a manuscript Hebrew Bible. Still inscriptions of far greater age, recording incidents of Jewish history, are sculptured in Phoenician, a language akin to Hebrew. Of these the "Moabite Stone" in the Louvre is one of the most famous. It is a Phoenician record of a victory by Mesha, King of Moab, over the Israelites in the days of Ahab, and its accredited date goes back to 890 B.C.

Tyndale perhaps excepted, the earliest translators of the English Bible were but indifferent Hebraists. Roger Bacon and one or two others who lived before the close of the sixteenth century, are the only Englishmen of that date recorded as being "tolerable Hebrew scholars." The Wycliffe translations are professedly from the Latin Vulgate. And of the King James' version of 1611, by which time England had taken a notable stride towards learning, the translators said: "We never thought from the beginning that we should need to make a new translation, but to make a good one better; that hath been our endeavor, that our mark." And again, as to qualifications for their task, they said: "We could modestly say, after Jerome, we have learned the Hebrew scriptures in part; and in the Latin tongue we have been exercised from our very cradle." Thus in England, prior to the close of the sixteenth century, the day-spring of such learning was only beginning to break; and for construing Hebrew texts aright, translators were fain to depend on what those had garnered who reaped earlier harvests. The supply on which they had to fall back was, however, rich and abundant; for in primitive times Jew, Christian and Gentile had devotedly studied the Hebrew scriptures. That devotion in past times may be realized by remembrance that the distractions of modern life have failed to rob such studies of their charm, inasmuch as during the last twelve years Prof. Haupt, of Baltimore, has been engaged in editing an elaborate critical text of the Hebrew Bible, and that in furtherance of Hebrew studies Harvard University has established a costly Semitic museum.

Of the numerous Old Testament versions, none better deserves mention than the Septuagint, a Jewish Greek tranlation made at Alexandria in the third century before Christ. When Alexander found that the capture of Tyre, the queen city of Phoenicia, cost him a nine-months' siege, he resolved to establish on the Mediterranean coast a city that for commerce and maritime strength should rival Tyre. The place he chose, then a fishing village, thenceforth in perpetuation of his fame was to be called Alexandria. This new city was soon renowned for commerce and for learning. In early manhood Alexander died; and when the countries of his conquest were divided among his generals, Alexandria and its tributaries passed under the rule of Ptolemy, one of his favorites. When this founder of the Ptolemaic dynasty died, the scepter passed to his son, Ptolemy the Second, at whose instance the Septuagint translation is said to have been made.

The legendary version of the Septuagint is: Seventy-two learned Jews of Alexandria, at command of King Ptolemy Philadelphus, each secluded from the rest, made seventy-two translations of the Hebrew Bible into Greek, and on comparing the seventy-two versions they were found to be miraculously alike. Critics have questioned this and other legendary accounts concerning the Septuagint. The result of such discussion is well summed up by Prof. Mahaffy in his contribution to Petrie's Egypt. In substance, he says: "After critics, as was their duty, applied to this subject their sharpest tests, the broad fact remains that seventy Alexandrine Jews, at the instance of Ptolemy Philadelphus, did translate the Hebrew Bible into Greek.

Thus with a rapidity suggesting modern enterprise, Alexandria, that great city, with institutions compelling the admiration of subsequent generations, was built up within a century; and the dream of Alexander had in part become a reality. And that achievement embraced more than mere material progress. For whatever were the defects of Ptolemy the Second, to followers of the three great cults—Egyptian, Grecian and Jewish—which for so long dominated the world, he gave equal protection. With his sanction, if not at his command, Manetho, high priest of Egypt, wrote a history of that country; and the "Book of the Kings," the only fragment of that history left, is still the corner-stone of Egyptian chronology. He was also the patron of Grecian teachers, who lived there and taught doctrines that afterwards developed into the school of philosophy known as Neo-Platonism. And the Greek version finished in his time, by the seventy, of the Old Testament was not only a welcome gift to the Jews, but was a boon destined to aid in the promotion of a religion greater than Judaism.

In the early part of the third century of the Christian era, vexatious disputation as to the correct rendering of passages cited from the Old Testament was common between Jew and Christian. To prevent such disputes, Origen devoted many years of his life, and to remove their cause he collected Bible manuscripts from all parts of the Christian world. Carefully educated as he had been at Alexandria, he was well equipped for his undertaking, and succeeded in producing that version of the Bible known as the Hexapla. As the name implies, the texts used by him were placed in six parallel columns. They were arranged in the following order: In the first column was a Hebrew text in Hebrew script; the second column contained a Hebrew text in Greek letters; of the Greek versions that of Aquila was in the third column; the version of Symmachus in the fourth; the Septuagint in the fifth; and in the sixth column was the text of Theodotion. In this way Origen adopted what is now recognized to be the true method of diplomatic criticism. The object of textual investigation is to find out what an author really wrote. And in the absence of authentication by the author himself, it is agreed that the most likely way to accomplish that object is to arrange the best available manuscripts in genealogical order, and to make inter-comparison of them, sentence by sentence and word by word. It is generally believed that the Hexapla was burnt in the Arab tumults of the seventh century, though hope is not altogether extinct that a copy may yet be found in some out-of-the-way monastery in the Levant. The work was well known to the early Christian fathers, and such fragments of it as have survived have been printed in both England and France. Because of its unique value as a link in the chain of scripture transmission, the University of Berlin recently appointed a commission to prepare a critical edition of all that could be found of the Hexapla.

The next Biblical service worthy to be compared with Origen's great work was done by Eusebius Hieronimus, a great man, wider, if not more appreciatively, known as St. Jerome. He was born near the middle of the fourth century in a small Dalmation city, now so utterly decayed that even its site is forgotten. In childhood, he tells us that he learned enough Latin to read his Horace, and in youth went to Rome, studying there under the best teachers. Among his other Roman masters, he mentions Donatus, the famous orator, whose Latin grammer was the favorite text-book for more than a thousand years. That clever little book was one of the few "block books" preserved from times before the invention of modern printing. Chaucer writes of it as well known in his day; and later than his time the old proverb lived on, that "Satan is still over his Donatus"—that is: "The evil one never tires in learning the rudiments of his craft." In early life, Jerome, like Saint Augustine, narrowly escaped ruin from evil allurements; but better influences prevailed, and he turned a deaf ear to the voice of the sirens. Travel and intercourse with learned fathers of the church developed his talents, and he became Latin secretary to Damasus, the thirty-sixth of the Roman pontiffs. In Jerome's preface to the Vulgate of St. Matthew's gospel, he says it was at the express wish of Damasus that he undertook to translate anew the scriptures into Latin.

In early manhood Jerome dedicated himself to the work of translating and elucidating the Bible, a sacred vocation, then, as now, bearing the strange-sounding name Hermeneutics, from the word Hermeneut, the name given to one who interpreted the service of the early church to worshippers who used another language. And devoutly and with lifelong industry did he keep his vow. Before the death of Pope Damasus, in 384, Jerome had revised the old Latin versions of the New Testament in common use, because from errors of copyists and other variations their differences called for amendment. He also translated some books of the Old Testament, but only part of his work of that period has been preserved. The grand aspiration of Jerome, the desire of his life, was to make a definitive traslation of the scriptures. To carry out that purpose he withdrew for twelve years to a monastery at Bethlehem, where with the aid of three learned rabbis he made, chiefly from the Hebrew and Chaldaic, his final translation of the Old Testament. Jerome's translations are the substance of the Latin Vulgate, the volume entitled first place in any collection of modern books. It may be traced with but little change through more than fifteen centuries. It is the authorized version of the Catholic church, and besides that, every Bible issued since its first engrossment has profited by its influence. And it is little short of a crime to forget that the one name indelibly stamped on this great book, to which we all are debtors, is the name of St. Jerome.

There are fragments of the gospels, translated in the fourth century by Bishop Ulfilas, from Greek into Gothic. Although of but secondary aid in tracing transmission of the scriptures, they are perhaps more highly prized than any other manuscripts preserved in Europe. Apart from them, little or no other written record is left of the Goths, whose prowess contributed so much to the overthrow of the Roman empire; for soon after this translation was made the Gothic language became virtually extinct. In his youth Ulfilas was held as a hostage at Constantinople. There he learned Latin and Greek, and formed plans for giving to his countrymen a version of the gospel in their own tongue. The Codex Argenteus, preserved at Upsala, in Sweden, contains most of the gospels; and but little more of the translation by Ulfilas has been preserved. That manuscript is within a hundred or a hundred and fifty years as old as the original translation. Its linguistic value can hardly be overrated. Without it, Grimm's comparative grammar in its present complete form would have been impossible. And it moreover furnishes in a Low German tongue nearest akin to our own, a version of the gospels more than five hundred years older than any we have left us written in early English speech.

Only a few scripture translations into what an old writer quaintly calls "The birth-speech of the English people," are found in the Anglo-Saxon period of the English language. In Latin psalters, in fragments and paraphrases of the gospels, and in various Latin service-books of the early church, occasional interlinear Saxon glosses are found; and these, with a few of the first entries in the Saxon Chronicle, comprise nearly all the written Englsh, from the first ten centuries, that time has spared. Early Latin manuscripts, the work of that time, there are, which are highly prized. Some of them, of exquisite penmanship, are by Irish copyists. For one or two of these, claim is made that they were written by St. Columba, the great missionary to Iona; and two preserved respectively at Oxford and Cambridge, have been venerated as the very presents sent back by Gregory the Great from Rome by Augustine's messengers who took the news to Rome that King Ethelbert had accepted the Christian faith, and had been baptized on Whit-Sunday of the year of our Lord 597. Archbishop Parker took care to preserve these documents from destruction when spoliation of the monasteries was made.

Modern experts take from these early documents a hundred or two of the years assigned to them by legend, but leave them still priceless mementoes of national adolescence. Still, though Augustine and Bede, with their thousands of converts and with their cloisters at Weymouth, Jarrow and Canterbury, show us the beginning of a new England, their inferiors in zeal and learning were soon to follow them; for King Alfred, at the close of the ninth century, makes sad complaint that already the golden age was in the past. He regretfully looks back to the time when men came to England for instruction, and says: "Now, very few this side the Humber could render their services in English, or translate a Latin letter." And, north of the Humber, he says: "I ween not many could do so." And he further adds: "South of the Thames, when I took the realm, I cannot think of so much as a single one."

By the middle of the twelfth century, however, most of the scriptures had been translated into Early English. But the full story of who the translators were, and when their translations were made, has never yet been told, and likely never will be. The wholesale destruction of original records of that period has made that task impossible. Dr. Bosworth, after his life-long study of Anglo-Saxon, wrote in 1865: "We are not certain as to the names of those patriotic Anglo-Saxons who translated the scriptures into Anglo-Saxon; and we have no more knowledge of the exact date when the gospels were first translated than we have of their translators." And his words then call for no modification now. Several editions of the gospels in Anglo-Saxon have been printed. The 1888 reprint of Bosworth, and Waring's edition of 1865, which has in parallel columns the Gothic, Anglo-Saxon and two later English versions, is still easy to obtain at a nominal price.

In his preface to what is called the "Great Bible," Archbishop Cranmer wrote: "Many hundred years ago the Bible was translated and read in the Saxon's tongue, which at that time was our mother tongue, whereof there remain divers copies found lately in old abbeys, of such antique manner of writing and speaking that few men have been able to read and understand them. And when this language waned old and out of common usage, because folk should not lack the want of reading, it was again translated into the newer language whereof yet also many copies remain and be daily found." On this subject none of his day, nor since his day, could speak with more knowledge. To the truth of that the ancient books of his library, still to be seen, annotated in his own handwriting, bear witness. The Bibles Cranmer refers to were doubtless in greater numbers when he wrote than now. For besides versions by Rolles and others of the Psalms, there are left but few scripture translations made from the time of the Conquest to the days of Wycliffe.

One exception, an oasis in the desert of Middle English, is the Ormulum, a gospel paraphrase in metre. Orm, or Ormin, who wrote this book, was an Augustinian monk. A single copy, believed to have been the author's own, is preserved in the Bodleian Library. It is the only copy come down from his day. Guest esteems the Ormulum as "by far the most valuable specimen of our Old English dialect that time has left us." His introductory verse fairly indicates the quality of the poem :

"Nu brotherr Wallterr brotherr min : affterr the fleshess kinde,
And brotherr min i crisstenndom : thurrh fullught und thurrh trowwthe,
Icc have wennd inntill Englissh : godd spelles halghe lare
Affter that little witt tatt me ; min drihhtin haveth lenedd."

(Now brother Walter brother mine : after nature of the flesh,
And brother mine in Christendom : by baptism and by faith,
I have turn'd into English ; the gospel's holy lore,
After the little knowledge that : to me my Lord hath lent.)

The name of Wycliffe is associated with two translations of the Bible. And he was likely the originator of both, although his actual share of work as translator remains uncertain. Of the first version, the translation from Genesis to the middle of the Apocrypha, was by Nicolas of Hereford. His manuscript, with his notes and emendations, still exists. The rest of the Old Testament was by an unknown hand ; and the gospels, and likely much of the New Testament, are mainly by Wycliffe. But few copies of this first version are left in manuscript. Nicolas of Hereford, its chief translator, was student and fellow of Queen's College, Oxford, was a warm supporter and friend of Wycliffe, was imprisoned for aiding the Lollard cause, and after Wycliffe's death was chief leader of the Lollards, as the Wycliffites were called. But, according to the National Dictionary of Biography, Nicolas recanted in 1391, became chancellor of Hereford Cathedral, and ended his days as a Carthusian monk at St. Anne's, Coventry.

For the second Wycliffe Bible, the work of John Purvey was most important. While Wycliffe was rector at Lutterworth, Purvey was closely associated with him, and there he commenced rendering into idiomatic English Wycliff's literal translation of the Vulgate. His work was finished at Bristol about four years after Wycliffe's death. Purvey has left interesting particulars as to how that work was done.

Ancient Bibles and glosses were collated to ensure a correct text; all aids were consulted to obtain the exact sense of that text; then came the task of translating that sense into English, and finally, to use his own words, the translator sought "to have many good fellows and cunning at the correcting of the translation." About one hundred and fifty manuscript copies of the Purvey version of the Wycliffe Bible, it is said, are still known to exist, some of them written and illuminated in the most beautiful style in vogue in the fourteenth century, when calligraphy was at its best.

Volumes for and against Wycliffe have been written. But as we eschew controversy, only a few incidents of his life to illustrate his Bible translations are relevant to our purpose. Early manhood found Wycliffe master of Balliol College, and professor of divinity at Oxford; a popular preacher at London; the personal friend of John of Gaunt, Duke of Lancaster, and a favorite with the English court party. He was a good scholar, and in scholastic fashion wrote in Latin, volumes and tracts concerning logic, metaphysics and philosophy, numerous enough to fill a good-sized book shelf. In 1374, when he was about fifty years old, he was presented with what one of his friends calls "the valuable living of Lutterworth in the county of Leicester." Of that he was never deprived, and his final stroke of paralysis came when he was hearing mass in his own church. Following the example of Dante in Italy, Wycliffe and Langland in England attacked the arrogance, riches and faults of the higher clergy. That brought him reproof, and at length Urban VI sent out five bulls against him, authorizing his imprisonment. Gaunt and his friends shielded him from prison, though he was deposed from the University of Oxford. He then attacked some of the doctrines of the church with much vehemence, and organized a band of "poor priests," who, on a scanty subsistence, preached his doctrines with such zeal that an old chronicler says: "At one time it seemed as if every other man to be met with was a Lollard." Wycliffe and his followers were what Bishop Pecock, who knew them well, called "Bible-men"—that is, they taught that every humble-minded Christian man or woman is able, without "fail or default," to find out the true sense of scripture, Wycliffe died at Lutterworth on the last day of December, 1384.

As Charles the Fifth, after the battle of Muhlberg, pensively stood at Luther's grave, and one of his staff asked if the grave should be rifled, the emperor curtly answered: "I war with the living, not with the dead." But the corpse of the great "Bibleman" did not escape the barbarous usage of that age, for forty-four years after its burial, Richard Fleming, bishop of Lincoln, who had himself been once condemned for Wycliffe tendencies, armed with authority of the Council of Constance, had the body of John Wycliffe dug up and burnt and its ashes flung into the river Swift. And then, as Wordsworth tells, that ancient voice which streams can hear thus spake:

> "As thou these ashes, little brook, wilt bear
> Into the Avon, Avon to the tide
> Of Severn, Severn to the narrow seas,
> Into main ocean they, this deed accurst
> An emblem yields to friends and enemies,
> How the bold teacher's doctrine, sanctified
> By truth, shall spread throughout the world dispersed."

Wycliffe's translations are virtually the last of the written Bibles. One other is said to have been made by John de Trevisa, chaplain and vicar of Berkeley, in Gloucestershire, who was contemporary with Wycliffe. He was a voluminous writer, and was translator of the Polychronicon, written in Latin by Ralph Higden, a Benedictine monk of the abbey of St. Werburgh, Chester, at the close of the thirteenth century, a work that in England for two centuries or more was the standard history of the world. Caxton, having "a little embellished," as he said, Trevisa's version of this old chronicle, printed it, and in his preface said that Trevisa had also translated the Bible into English. The translators of the King James' version, in their preface, also make direct reference to such a work in the following words: "In our King Richard the Second's days John Trevisa translated the Bible into English." His translation of the apocryphal gospel of Nicodemus is known; but, that apart, other biblical translations by him are now unknown, although some think a copy may yet be found lurking in one of the great manuscript collections, or that unrecorded his work was incorporated in one of the Wycliffe Bibles.

A little more than a century from the death of Wycliffe brings us to the days of William Tyndale, whose name is known and honored by all who are conversant with the history of the English Bible. His translation of the New Testament is memorable from its merit, because it was the first portion of the Scriptures to be printed in English with movable types, and from the translator's tragic death. From the records we learn that Tyndale when about forty years of age was a priest without benefice, being tutor in a country family in Gloucestershire and sometimes preaching in that neighborhood. He espoused the cause of the new learning, translated the Enchiridion of Erasmus, disputed with the clergy, and was so outspoken in his censure of idle monks, ignorant churchmen, and overbearing prelates, that he was called to book and censured before William of Malvern, abbot of St. Peter's, Gloucester. Tyndale had studied both at Oxford and at Cambridge, and the influence of Erasmus at the latter place had not then died out, for the great Hollander did tarry awhile at both these universities, though Gibbon's epigram, that Erasmus learned Greek at Oxford and taught it at Cambridge, is too sharp an antithesis to be exactly true. Like Erasmus, he too had faith that a vernacular Bible must give strength to a nation and contentment to its people. Erasmus in the preface to his Greek New Testament wrote: "I long for the time when, in his own tongue, the husbandman shall say over to himself verses from the Bible while he follows the plough, when the weaver shall hum them to the tune of his shuttle, and when the traveller shall beguile with them the weariness of his journey." And words could not better than these do express the desire of Tyndale's heart. Such an order of things had been the dream of his youth, and unselfish toil to make that dream a reality was to be the passion of his life and glory of his death.

Tyndale went to London in 1523, hoping that in furtherance of his translation he might be appointed chaplain to the bishop of London. His own words are: "In this bishop of London's house I hoped to have done it." But he was doomed to disappointment. The bishop's house was full; and Tyndale concluded that in praising Bishop Tunstall Erasmus had been beguiled into "making of little gnats great elephants." After half a year's residence in London with a friendly cloth merchant, Tyndale made up his mind that his plans could succeed only by going to Germany, as there alone he was likely to find printers, help from friendly scholars, and patrons. He was confirmed in his determination by knowledge of the fact that up to the year of grace 1522, when England had not a single printed Bible, no less than sixteen German Bibles, from the Latin, had been printed by various German printers. (Of these John Mentelin printed the first at Strasburg in 1466.) And he also knew that, greater than all the rest, Luther's New Testament had been brought out at Wittenberg in September, 1522. Possibly Tyndale at that time did not know that from the "queasy" times, Melchior Lotter, Luther's printer, though in the safe latitude of Wittenberg, did not venture to put his name to Luther's epoch-making book.

Tyndale arrived at Hamburg in May, 1524, and was there again in April of the next year. In the eleven intervening months he is said to have spent some time with Luther. John Dobneck, whose Latinized name was Cochlaeus, wrote the King of the Scots that Tyndale and a companion were at that time at Wittenberg learning the German language so that they could turn Luther's New Testament to account in an English translation they would print. Cochlaeus watched every step taken against the church, and was so fiery a zealot that he once challenged

Luther to public discussion of the doctrines at issue betwixt them, on condition that the disputant worsted in the controversy should be burnt. Arber says that during these eleven months some unknown printer printed for Tyndale an English version of the gospels of Matthew and Mark. If that conclusion be true, these were the first portions of an English Bible ever printed. But though the evidence that these gospels existed at one time is strong, no copies of them are now extant.

In the summer of 1525 Tyndale was at Cologne, where Peter Quentel began to print for him an edition of three thousand copies of his English New Testament. The edition was in quarto format, and had here and there short marginal glosses, nearly half of which were literally translated from those by Martin Luther in his German Testament. When Tyndale's edition had gone through the press to the signature K, about forty folios, the work came to a sudden stop. For one night, over their wine cups, some of Quentel's men boasted that England would soon be Lutheran, as the New Testament they were printing was being paid for by English merchants, who would scatter it throughout England before king or cardinal could stop them. Cochlaeus, as soon as he knew this, procured from the senate an interdict against all concerned, and Tyndale and his companion, seizing what printed sheets they could lay hands on, hurriedly fled up the Rhine to Worms for safety.

Tyndale next printed an English translation of all the New Testament. It is of octavo size, and without prefaces, notes or comment. The translator's name is omitted, conformably with the command that men should do their good deeds secretly. It bears no date nor printer's name, nor place where it was printed, though beyond reasonable doubt it was printed at Worms by Peter Schoeffer, near the close of the year 1525. The printer was the second son of that earlier Peter Schoeffer, who, with Guttenberg and Fust, share between them the honor of being the inventors of modern printing, and of being the three men who worked the first printing establishment in the world. Peter the Second, whom the inquisition ranked with heretical printers, followed his art at Worms for seventeen years, and scrutiny of the watermarks of the paper, type, and other characteristics by which experts judge as to where, when and by whom a book was printed, point to these conclusions as to the origin of Tyndale's first complete New Testament as being essentially true.

How many copies of Tyndale's version Schoeffer printed is not certain. Possibly the quarto edition Quentel commenced at Cologne was completed at Worms or near Worms; or a new quarto version was simultaneously printed with the smaller format. Copies of both sizes were sold in England in 1526, the next year. Herman Busch informed the Elector of Saxony that six thousand copies were printed at Worms, and that the translator, who had two assistants, was a learned man. On these points Busch was sure to be well informed, for he was a professor in Luther's university at Marburg, had written some of the best of the "Epistolae Obscurorum Virorum"—that piece of sixteenth century controversy still noted for its irony and coarse wit—and he was already the missionary of humanism.

During the next ten years of Tyndale's life he translated the Pentateuch and the book of Jonah, and issued a revised edition of his New Testament. In a part of the Pentateuch translation, Coverdale, his friend, assisted him. The rest of Tyndale's life was full of adventurous escapes from the wiles of his enemies, till at length, early in 1535, he fell a victim to the plot of one Phillips. He was arrested at Antwerp for heresy, and after eighteen months' imprisonment in the castle of Vilvorde, near Brussels, was tried and condemned as a heretic. At Vilvorde sentence was carried into execution, for there, on October the sixth, 1536, William Tyndale was strangled and burnt at the stake. An official paper bearing number 191,622 is filed at Brussels in the Belgian archives, which gives the names of the commissioners who tried him and the sums paid for their services. The same document also gives the names of, and payments made to, the executioners and messengers who, as it records, "were engaged in prosecution of the process against William Tyndale, a priest, a Lutheran prisoner, and executed by fire at Vilvorde for entertaining certain wicked opinions touching the Holy Catholic faith."

English history records how Henry the Eighth and his counsellors strove to destroy the influence of Tyndale's New Testament. The king writes early in 1527 that of his tender zeal for his subjects, and with advice of the Archbishop of York, he has determined these translations shall be burnt, and that keepers and readers of them shall suffer sharp correction and punishment. Tunstall, bishop of London, declared in a sermon at St. Paul's Cross, that the book contained three thousand errors, and after his sermon the New Testament was first publicly burnt. That no copies might escape destruction, the Archbishop of Canterbury had agents in Germany buying up these English New Testaments for the fire; and bishops contributed funds to carry out that purpose. The bishop of London licensed Sir Thomas More to read heretical books that he might confute them, because "You, dearly beloved brother, can play the Demosthenes both in this our English tongue, and also in Latin." More wrote at least four volumes against Tyndale. His New Testament was declared to be as full of errors as the sea is of water, though when forced to name these errors More contented himself by saying Tyndale translates priests, "seniors"; church, "congregation"; and "charity he calleth always love"—no more diversity of meaning, said Coverdale, than that between fourpence and a groat. Not one who entered the lists against Tyndale was more truculent than Sir Thomas, the liberal author of Utopia, the man of whom Gairdner, who so well knew the troubled waters of these days, only a couple of years ago wrote: "He loved men, he loved animals, he loved every influence that tended to humanize or advance society." Yet such was the rancour of these evil days, that Sir Thomas More could write of

William Tyndale: "It is enough for good Christian men that know these things for heresies, to abhor and burn up his books, and the likers of them with them." Still, in his quiet moments More too had misgivings, for in a letter to his son he wrote: "I beseech our Lord that some of us, as high as we seem to sit upon the mountains treading heretics under our feet like ants, live not the day to be at league and composition with them."

Destruction of the two early versions of Tyndale's translation was almost complete, for of the quarto edition Quentel began to print at Cologne, all that remains is the unique fragment of thirty-one folios in the Grenville collection, British Museum. That was photo-lithographed under supervision of Mr. E. Arber, in 1871, and an admirable preface was supplied by him. Of the octavo edition printed by Schoeffer at Worms, there is one perfect specimen extant, the copy in the Baptist College, Bristol. It is well preserved, and has initials and cuts illuminated as if for presentation to some person of distinction. The paragraphs are also marked by the illuminator after the manner of books printed in the fifteenth and sixteenth centuries. In the library of St. Paul's, London, there is an imperfect copy, forty-eight leaves having been supplied from a modern reprint. No other copy or fragment of a copy of the Schoeffer edition is known to be extant.

The ownership of the Bristol copy is interesting to follow. It was bought by John Murray for Harley, Earl of Oxford, who thought so much of the book that he rewarded Murray for buying it with an annuity of forty pounds for life. After Harley's death his manuscript collection was bought by the nation for $50,000, as a nucleus for the British Museum, and after some delay his printed books, part of which had cost for binding $50,000, were sold to Thomas Osborne, the bookseller, for $65,000. Osborne privately sold the Tyndale Testament to Ames, the book collector, for fifteen shillings; at whose death in 1760 it was bought for fourteen guineas and a half by John Whyte, who kept it sixteen years, and then sold it to Dr. Gifford, librarian at the British Museum, for twenty guineas; and from him in 1784 it went, with many rare Bibles, as a legacy to the Bristol College. The strange part of the story is that a bookseller should have sold such a treasure for fifteen shillings. The explanation is that Thomas Osborne, the greatest bookseller of his day, was proverbially an ignorant man. He once offered a library as "the most pompous collection of the classics known," and many such malaprops by him were the gossip of the day. He was the bookseller Dr. Johnson was said to have knocked down with a book, in his shop, and when Boswell asked if the story were true, the doctor answered: "Sir, he was impertinent to me and I beat him, but in my own room, not in his shop." Yet, if Osborne knew little about books, he shrewdly fell back on such as had knowledge. For after his sale of the Tyndale book he had Dr. Johnson himself write the preface and compile two of the four volumes forming the catalogue in which he offered for sale the Harley library, which was perhaps the finest private collection of books ever gathered together.

Few men have done as much to make known the history of the English Bible as the late Francis Fry, of Bristol. His collection of various editions of the scriptures numbered twelve hundred; and at his cost fac-similes of three or four editions of special historical value were printed. Among his chief books should be reckoned his fac-simile edition of Tyndale's first octavo New Testament; and his admirable work describing bibliographically forty subsequent editions of Tyndale's book printed between 1526 and 1566. His minute account contains fac-similes of title pages, colophons, initial letters and specimen pages of each edition; and all but two of the forty different specimens had been subject to his personal examination. One of these copies, of about 1535, by some unknown printer, is noted for its peculiar orthography. Tyndale often promised that plowmen should read his Testament, and for years it was thought this special copy must be in English dialect. Examination by Ellis, the authority on English sounds, showed that it was not in dialect, and represented Flemish equivalents to the English vowels. The best clue to the puzzle may be Madden's discovery that in the first printing offices a reader dictated from copy word by word to the compositor, and that for this version of Tyndale's book the copy was English, and both reader and compositor were Flemish, the latter setting up his types by sound only, and not by sight.

In the British Museum, side by side are two proclamations by Henry the Eighth. The first, dated 1530, prohibits all translations of the Bible into English; the second, dated 1541, enjoins that an English Bible shall be placed in every church throughout the kingdom. From such a volt-face came the sarcastic line:

"Gospel light first came from Boleyn's eyes."

In 1530 the Royal Commission reported against a vernacular Bible, for the reason that religious opinion was then too unsettled, and further added that the only translation the king could sanction must be made by "great learned Catholic persons." Yet such was the irony of fate that of the four English Bibles sold in Henry's reign all of them were either supervised by Tyndale's friends or embodied Tyndale's translations. The first of these, which was also the first printed English Bible in its entirety, was brought out by Miles Coverdale in October, 1535. It was likely printed at Zurich, and its production was secretly approved and supported by Thomas Cromwell, who was a friend of Coverdale. It was in reality an English translation from the Vulgate, checked and corrected by Luther's version, as its title said: "Faithfullly and truly translated out of Douche and Latyn in to English." It was dedicated to the king, but was not sent out by authority. This, first of all printed English Bibles, is a small book, measuring 11¾ inches by 8 inches. The first edition is exceedingly rare, and but one perfect copy is known. In a bookseller's catalogue before me as I write, an imperfect copy is listed at the price of one thousand and fifty pounds sterling. In the thirteenth line of the title reference is made to Anne Boleyn in these words: "Your dearest, just wyfe and most vertuous Pryncesse Quene Anne, Amen." Other later copies bore in lieu of Anne's name that of Queen Jane (Seymour).

The Matthew's Bible was published in 1537. Of its eleven hundred pages six hundred are credited to Tyndale, who left his unpublished papers with his friend John Rogers, and five hundred are assigned to Coverdale's credit. Thomas Matthew is a pseudonym for Rogers, who revised and edited this Bible. The fictitious name prevented hostility from the bishops. Cranmer wrote Secretary Thomas Cromwell that interim permission to sell and read this Bible without risk might be granted till such time as the bishops shall provide a better translation, and the Archbishop petulantly adds: "That, I think, will not be till a day after doomsday." The Taverner Bible is dated London, 1539. It is essentially a reissue of the Rogers Bible, with some amendments and notes.

These first English Bibles were the work of private scholars and printers, and Cromwell and Cranmer at length obtained consent of the King to prepare an authoritative version, that should be of larger size and better printed than those of earlier issue. It was decided that Francis Regnault, the French printer, who for many years had a shop in London, and who printed most of the service books used in England for fifteen years, should print this new Bible. Terms were settled with the French King, and Coverdale as editor and Grafton as printer went to Paris to oversee the work. Hans Holbein devised an artistic title-page in black and red, set within an ornamental border, showing the King, Cranmer and Cromwell distributing Bibles to the people, and its ample page, beauty of type and fineness of paper taxed to the utmost the printing art of that day.

As for the translation itself, the title-page declared it to be the work of divers learned men skilled in Hebrew and Greek. Whether the bishops contributed much of the translation is not known, though it is certain Coverdale had much to do with it. The Inquisition interrupted the work at Paris, and the type and as many of the printed sheets as possible were taken to England, where the printing was completed. At the foot of the title is this notice "Printed by Richard Grafton and Edward Whitechurch. Cum privilegio ad imprimendum solum, 1539." The ordinary price of this Bible was equivalent to six pounds sterling of the present day. The library of St. John's College, Cambridge, contains the unique vellum copy printed for Thomas Cromwell, All its initial letters, headlines and titles are artistically illuminated. From 1539 to 1541, two years, seven editions of this "Great Bible," as it is called, were printed. The second edition, 1540, had Cranmer's prologue, and carried on its title: "This is the Bible appointed to the use of the churches." The fourth edition, also in 1540, carried this imprint: "The Bible in English of the largest and greatest volume, authorized and appointed by the commandment of King Henry the VIII, supreme head of this his church and Realm of England; to be frequented and used in every church within this his said realm." Six of these Bibles were placed in St. Paul's Cathedral for use of the people. With the printing of the "Great Bible" the fierce battle opened years before by Tyndale culminated in victory for freedom's cause, and in the religious and national life of the English people the authorized English Bible became a new factor of great and far-reaching influence.

In the interim between the "Great Bible" and King James' version, seventy-two years, there were more than as many editions and reprints of the English Bible. Three of these call for mention in order of time when they were printed. In 1560 was printed the Geneva version, prepared by scholars who fled from England to Switzerland during the Marian troubles. It was the first complete Bible to be printed in Roman type; it omitted the Apocrypha; it recognized a verse division; it was often reprinted; and it was the first English Bible printed in Scotland. In 1568, during the reign of Elizabeth, came the "Bishops' Bible." It was the "Great

Bible" revised by ten bishops of that day, under the superintendence of Archbishop Parker. And in 1609-10 was printed the first edition of the Douay Bible. Its title-page reads thus: "The Holy Bible faithfully translated into English out of the authentical Latin. Dilligently conferred with the Hebrew, Greek and other editions in divers languages. With arguments of the books and chapters: Tables: and other helps for discovery of corruptions in some late translations, and for clearing controversies in religion. By the English College of Doway." This first Douay edition was of the Old Testament only. The New Testament was separately published at Rheims in 1582. Both the Old and New Testaments were not printed together until 1763-64.

The Bible we all have read, the King James' or authorized edition, was first printed by Robert Barker, London, 1611. The original title states that in its production the translations of Tyndale, Matthew, Coverdale, Cranmer, Parker, and the Geneva Bible, were diligently compared and revised. The names of the forty-seven translators are given, with the portion of the Bible each respectively translated. It further states that the whole was finally edited by Miles Smith and Thomas Bilson, Bishop of Winchester; and that the translators' preface to the reader was also written by Miles Smith. It is a pity that preface has not been printed in all the King James' Bibles, as it is an instructive account of that version and is clearly and vigorously written. In the following year Smith was made Bishop of Gloucester. It is scarcely three hundred years since that translation was made, but it has had a diffusion throughout the world with which that of no other book is comparable. The numbers sent out are so great they can hardly be realized. The aggregate number of Bibles printed in Great Britain and the United States is estimated at three hundred million. That sum included translations in many languages; yet the great bulk comprised only English Bibles in the authorized version. The King James' version, like its predecessors, had to stand much criticism, though for lucidity and charm of style it won general favor. Throughout, it indeed abounds in passages of exquisite beauty. Each reader of his Bible dwells on some favorite text. Prof. Saintsbury thought the following one from Solomon's song, almost, if not quite, unrivalled in the English language: "Set me as a seal upon thine heart, as a seal upon thine arm; for love is strong as death, jealousy is cruel as the grave; the coals thereof are coals of fire which have a most vehement flame." Who too but has felt the majesty of that verse in Isaiah where the Almighty is characterized as "the high and lofty One that inhabiteth eternity." In this magnificent passage Wycliffe used the word "everlastingte," which after a short life became obsolete.

In 1869 Constantine Tischendorf, in the authorized version of the New Testament published by Tauchnitz as his thousandth volume of "British Authors," gave marginal variations from the Vatican, Siniatic, and Alexandrine Greek manuscripts, which date from the fourth and fifth centuries. His introduction first made known to many lovers of the Bible that these New Testament documents were centuries older than those used in translating any Bible in general use. Moreover, many deemed it desirable that archaic words and obsolete expressions of the King James' Bible should be brought into conformity with changes in the English language incident to three centuries of growth. These and other reasons led to the Canterbury resolutions 1870, and to the Revised Version of 1881-85. As was to be expected, the Revised Version has both merits and defects. Of its improvements the putting of all scriptural quotations from the ancient poets into rhythmical form, and a closer rendering of delicate shades of meaning characteristic of the Greek verbs, have found general favor. But trivial changes of well-known verses and words, and these not always for the better, but sometimes for the worse, ran counter to the national taste, and the King James' Version is still in popular favor.

The scope of this paper has been confined to consideration of the outward form of the Bible; but I venture on a couple of reflections as to its spirit. Not long before the Christian era the poet Lucretius wrote as follows: "The nature of the gods must ever of itself enjoy repose supreme through endless time, far withdrawn from all concern of ours; free from all our pains, free from all our perils, strong in resources of its own, needing nought from us, no favors win it, by no anger is it moved." That is an eloquent, awe-inspiring presentment of the relationship betwixt man and the limitless forces controlling all things, by the greatest philosophic poet of the Roman world. But with the advent of the New Testament came another doctrine, foreshadowed indeed by all the old religions, though never before finding utterance with such directness and such power. Its cardinal teaching, embodied in the Lord's prayer and in the discourse of the Apostle at Athens, is in substance this: The Ruler of the universe is the Almighty Father. And from that axiom comes this corollary: All men are brothers; and every man born into this world, be he rich or poor, wise or simple, if with lowly, contrite heart he strives to do so, may enter into direct, spiritual, filial relationship with our Father which is in heaven.

Notes on Plant Distribution.

*Read before the Hamilton Scientific Association'
March 21st, 1907.*

BY A. ALEXANDER.

This subject of Plant Distribution, or Geographical botany, as it is sometimes called, is but in its infancy, for the testimony of the rocks is very imperfect, as allowed by the most advanced adherents of the so-called Development theory themselves, and the full value of the Glacial Epoch, which figures so largely in the new view of the history of plant dispersion is full of difficulties, while the plant material, tho' consisting of tons of catalogues of the Flora of nearly every section of the earth's surface, is still in course of arrangement. Nevertheless a very feasible hypothesis has been launched, and many able men have devoted long lives to the study of the subject. Among these I may mention Bentham, Hooker, Darwin, Asa Gray and many others.

The earliest scientists who studied the vegetable covering of this globe of ours, took it for granted that the various species of plants were created where they found them, and that they were placed there because the environment was what they needed. They did not take into account the effect of long ago geological upheavals and changes of temperature. The only treatise published before Darwin's researches was that of De Candolle, who mapped out the surface of the earth into about twenty stations characterized by plants indigenous to these stations. Of course in each of these there are many species common to many or all of the others.

The distribution of plants is, generally speaking, more independent of other classes than that of animals. It has been well stated that the supply of food is one of the great causes regulating the diffusion of a race. Animals feed almost exclusively upon living animals or vegetable matter not yet disorganized. Plants, on the other hand, feed upon inorganic or disorganized substances, or if they generally, or perhaps always require more or less of organic matter, it is that from which life has departed and which is more or less in a state of decomposition, and may have lain dormant for ages. The habitation of plants is therefore more immediately and often more exclusively dependent on circumstances of soil, climate and geological conditions than that of any other class of organized beings. The distribution of plants is the most complicated. Fixed and immovable as is the individual plant, there is no class in which the *race* is endowed with greater facilities for the widest dispersion. Birds with their enormous powers of rapid locomotion, who will at certain seasons traverse thousands of miles in search of food return to their native haunts to rear their progeny. During the last few days we have had the proof of this by the return in considerable numbers of our old familiar friends the Robins. Plants on the other hand cast away their offspring in a dormant state ready to be carried to any distance by these external agencies to which I will refer later on in these notes, which we may deem fortuitous, but without which many a race might perish from the exhaustion of the limited spot of soil in which it is rooted. Modern, or comparatively modern invasions from distant regions to the more or less complete extinction or contraction of the original are much more frequent in the case of plants than of animals.

Until the advent of what is now known as the Evolution theory or doctrine of gradual development of organic forms by descent and variation, which is now almost universally accepted in some form by men of science. The place a plant or animal occupied on the earth's surface, or the time when it first appeared did not signify much. Each species was supposed to have had an independent origin. It was perceived that the organization and constitution of each plant must be adapted to the physical conditions in which it was placed, but this consideration only accounted for a few of the general features of distribution, while the great body of facts, anomalies and curious detalls remained unexplained.

These have now to a large extent been used by such men as Darwin, Bentham, Gray and others who have devoted their lives to this subject to invest the facts of distribution with special importance. The time when a group or a species first appeared, the place of its origin and the area it now occupies upon the earth, become essential portions of the history of the Universe. These men I have referred to have shown us the marvellous interdependence of every part of nature.

If there be anything in the theory of life now held by most men of science, and by those who have devoted their lives to the subject of plant distribution, we must come to the conclusion that not only is each organism related to, and effected by, all things living and dead that surround it, but every detail of form and structure, of color, food and habits, must have been developed as a result of its organic or inorganic surroundings. If that be so, then plant distribution must be as essential a part of the science of life as anatomy or physiology, for it shows as it were, the form and structure of the plant life of the world, considered as one vast organism and it should enable us to understand, however imperfectly, the processes of development and variation, during past ages which have resulted in the actual state of things. It must therefore afford a fair test of the truth of the development theory, or at least, must never contradict it, for the countless facts presented by the distribution of living things in present and past time, must be explainable by some *true* theory.

But my purpose is not to discuss the *theory* but rather to present a few interesting facts concerning plant distribution as it has been, and is found to-day.

The first attempt to review the whole subject of Plant Distribution from the modern point of view afforded by evolution is due to Bentham, who was for a long time President of the Linnean Society. His conclusions are based upon the experience of a long life devoted to systematic botany.

The general aspect of vegetation is largely affected by purely physical causes. In the Polar regions for instance, trees and shrubs become incapable of existence and only small perennials which are safely covered up by snow during the long winter are able in the brief summer to expand their flowers and ripen their seeds.

In looking at the vegetable covering of the earth it is easy to see that it must have always been separable into three great latitudinal zones—two belonging to the north and south hemispheres respectively, and one dividing them lying between the tropics.

Of course it must be borne in mind that these zones of plant life are hypothetical, and that the precise northern and southern limitations must have varied with changes in the earth's climate. The intermixture of diverse flora must now have become very complicated, but evidently ancient.

The northern flora is characterized by its needle-leaved Conifera, its catkin-bearing trees and shrubs, and other forest trees, deciduous in winter, and its vast assemblage of herbaceous types such as the Ranunculacæ, Cruciferæ, etc.; these spread over a great part of North America, Northern and Central Asia and Europe. This has been divided into that of the Old and New World by the severance of North America from North Asia, and by the barrier to an interchange of vegetation in the upheaval of the Rocky Mountain Range. Nevertheless its marked continuity requires it to be treated as a whole.

According to one authority the essential types of the present tree flora, of North America are indicated in the Cretaceous rocks of this country, and becomes more distinct and more numerous in the Tertiary, and because of this, it is maintained that the origin of the North American flora is American.

The analogy between the Miocene flora of Central Europe and the present North American flora is unquestioned, and is greater than between the same fossil flora and that now existing in Europe.

Those who hold this view believe that the American element in the vegetation of Europe at this period was deriv–

ative, and if so, it is another of the many illustrations of the curious observation of Asa Gray, the author of the Manual of Botany, when he said, that plants have in general a greater tendency to migrate from east to west, than from west to east.

This flora, according to Bentham and others, was gradually driven back again, and it is only as we travel from Europe to the East that we gradually find its traces getting stronger. It has been pointed out, for instance, that in passing from the Mediterranean to the Levant, the Caucusus and Persia, that living representatives of the Miocene genera are met with. I will only name two, viz., *Plantanus* and *Juglans.* Along the Himalays and through China we trace many other genera now growing in the woods around the City of Hamilton, such as *Aralia-quinquefolia* (Ginseng) *Trillium Erectum* (wake-robin), and many others. Japan forms part of the same botanical region as Eastern Asia. In fact, from the great latitudinal extent of Japan and its very varied conformation, more of this North American flora has been preserved there than anywhere else in Asia.

I will just name one other interesting fact which has but recently come to light. I refer to the occurrence of the Tulip Tree in Central China which, though a member of the European fossil flora to which I have already referred, has been hitherto regarded as exclusively characteristic of America Until quite recently many specimens were growing in this neighborhood.

It has been remarked by Bentham, who devoted a long life to this study, "that while some genera like *Astragulus* have multiplied largely in both continents, others, like *Eupatorium*, *Aster*, *Phlox* and others very numerously represented in America, have transmitted or produced a smaller number in Eastern Asia, gradually diminishing westward till they disappear altogether, or attain Western Europe in single species but little altered from American ones."

This great northern Flora has been subject also to change by the influence of variations of climate. The nature of these changes cannot be better described than by a quotation from the same authority. "Where the chief portion of this great northern flora originated, and whether it may be best termed Scandinavian, or North Asiatic or Caucasian, is a question for the determining of which we have little or no data. It is however one of the most ancient and widest spread, having at different times travelled over a great part of the Globe.

Recent researches have shown that the plants belonging to this flora extended far north during the warmer pre-glacial times, and that it must have been slowly driven southward as the glacial Epoch came on, and either then, or at some one or other periods, have been for a time continuous in two lines, at least, into the Southern hemisphere, for it has left traces easily discernable, especially in its herbaceous and mountain forms in the mountains of tropical Asia and to the Abyssinian mountains of Africa, and down the Andes to the extreme south of America where it is still luxuriant. In all these migrations, while retaining a general identy, the flora must have undergone continuous changes, losing species as their habitations became unfit for them, and gradually forming new ones when favored by long continued isolation or other requisite conditions."

The only other remark I would make about this division of our subject is that this flora has undergone a sort of specialization into three secondary floras, but I shall only speak of one of these, the most interesting of the three—It is usually termed the *Arctic Alpine* flora, consisting chiefly of plants of small stature, slow growth and limited means of dispersion, but compensated by long lines and great powers of endurance. It is interesting because it reduces the divergence of the Old and New World division to a minimum, and more especially on account of the great interest which attaches to the problem of its scattered Alpine outliers.

With regard to the first point Hooker has found that estimating the whole Arctic flora at 762 species, Arctic East America, possessed 379, of which 269 were common to Scandinavia. Of the whole flora 616 species are found in

Arctic Europe, and of these 586 are Scandinavian, and this eminent botanist says in his paper on "The Distribution of Arctic Plants" that the Scandinavian flora is present in every latitude of the globe, and is the only one that is so. This would seem, at first sight, to point to Scandinavia as the Centre of Creation for the Arctic lands; and it may now be termed the chief centre of preservation within the Arctic Circle, owing perhaps partly to its more broken conformation and partly to that warmer climate which, while it now admits species which some might object to being placed among Arctic plants, was during the glacial period a means of preservation of some colder species which were everywhere else expelled or destroyed.

I must now, however, say something about the various agencies existing for the dispersion of the seeds of plants. Many of those seeds are supplied with the means of wide disemination. To begin with the Winds; a great number of seeds are furnished with downy and feathery appendages, enabling them when ripe to float in the air and to be wafted easily to great distances by the most gentle breeze, Dandelion, Thistle and Goatsbeard. Other plants are fitted for dispersion by means of an attached wing, as in the case of the fir tree, the maple, the lime and others, so that they are caught up by the wind as they fall from the tree and are carried to a distance. As winds often prevail for days and weeks together in the same direction, these means of transportation may sometimes be without limits.

It has been found that a great numerical proportion of the exceptions to the limitation of species to certain quarters of the globe occur in the various tribes of cryptogamic plants. As the germs of plants of this class, such as ferns, mosses, fungi and lichens, consist of an impalpable powder, the particles of which are scarcely visible to the naked eye, there is no difficulty in accounting for their being dispersed throughout the atmosphere and carried to every point of the globe where there is a station for them.

Almost every lichen brought home by one of the first Antarctic expeditions, amounting to over 200 species, was ascertained to be also an inhabitant of the *Northern* Hemisphere, and almost all of them European. Sir John Hooker, who was the botanist in connection with another Antarctic expedition some sixty years ago, tells in his report that one-fifth of all sea weeds found were of species common to the British Seas. He has suggested that cold currents which prevail from Cape Horn to the Equator and are there met by other cold waters, and by their direct influence, as well as by their temperature, facilitate the passage of Antarctic species to the Arctic Ocean. This consideration, however, has nothing to do with the winds, but rather with the agency due to rivers and currents which, however, I cannot do more than name. There is no doubt that the mountain stream or torrent washes down to the valley the seeds which may accidentally fall into it, or which it may happen to sweep from its banks when it suddenly overflows them.

The majestic river, winding along the extensive plain and traversing the continents of the world, conveys to the distance of many hundred miles the seeds that may have vegetated at its source. The absence of liquid matter in the composition of seeds renders them comparatively insensible to heat and cold, so that they may be carried without detriment through climates where the plants themselves would instantly perish.

Dr. J. Hooker is authority for the statement that no one of the large nutural orders of plants is so rich in species common to other countries as the Leguminosæ (plants with pea-shaped flowers). The seeds in this order, which comprises the largest proportion of widely diffused species, are better adapted than those of any other plants for water carriage.

Currents and winds in the Arctic regions drift along icebergs covered with an alluvial soil on which plants and pine saplings are seen growing, which may often continue to vegetate on some distant shore where the ice island is stranded.

AGENCY OF MAN.

But in addition to all the agents I have already enumerated as instrumental in diffusing plants over the globe, we have still to consider man—one of the most important of all. He transports with him, into every region, the vegetables which he cultivates for his wants, and is the involuntary means of spreading a still greater number which are useless to him or even noxious.

Plants have been naturalized in seaports by the ballast of ships, and several examples of others which have spread through Europe from botanical gardens, so as to become more common than many indigenous species.

Little more than a century ago a plant of the common flea-bane of this country, *Erigeron Canadense*, was introduced into the botanical garden at Paris, and years ago the seeds had been carried by the winds so that it was diffused over France, the British Isles, Italy, Sicily, Holland and Germany.

The common thorn-apple, Datura Stramonium, now grows as a noxious weed throughout all Europe with the exception of Sweden and Lapland. It came from the East Indies and Abyssinia to Britain, and was thus universally spread by certain quacks who used its seed as an emetic. The same plant is now abundant throughout the greater part of the United States and Canada, along waysides and farm yards. I had occasion to visit Toledo, O., a few years ago, and outside that large town some vacant lots were literally covered with it.

The yellow monkey flower, *Messiulus Luteus*, a plant from the Canadian North-West, has now established itself in various parts of England. A specimen of this plant was sent me a few years ago by a beginner in botany with whom I was exchanging specimens. It was collected in Dorsetshire.

Some years ago I found a patch of the beautiful plant *Lithospermum angustifolia* growing on the Beach north of the Canal. I submitted the plant to an eminent botanist who was on the expedition which fixed the 49th Parallel of Latitude many years ago. He suggested that this plant was characteristic of a part of the continent more than a thousand miles from where I found it, and the conclusion was that the seeds had been carried down from the upper lakes and thrown on to the shore during a storm, for I found a small group of the same plant at about the same distance from the lake level near the filtering basin a few years after.

I will bring these too lengthy notes to a close with a very brief reference to some striking instances of plant distribution which I have noticed around Hamilton during the last thirty-six years.

The first instance I would refer to is a case where the wind was the agent. In a garden in the east end of the city, some plants of Salsify (vegetable oyster) Tragopagon was allowed to run to seed. These seeds are supplied with a wonderful appendage enabling them to rise in the air like a balloon when the least wind is blowing, and are easily carried to great distances. Some of these seeds alighted on the sides of the Port Dover Branch of the Grand Trunk Railway and grew, and in their turn produced seed which travelled on until in five years after I noticed the first specimens it had established itself in the vicinity of Albion Ravine in one direction.

Twenty-five years ago in botanizing along the railway to the east of the city I never found a specimen of *Melilotus Alba* (sweet clover), but about that time the white clover, so sought after by the honey bee, had failed for a year or two, and a well-known bee.keeper bought some seed of the Melilotus and sowed it near the railway embankment as a substitute for the ordinary white clover. The result is that this plant is found for miles along the track, and the bare portions along the mountain side are covered year after year with a luxuriant crop of it, as well as the surrounding fields.

The late Mr. Wilkins, Principal of the Beamsville High School, told me that between Hamilton and Beamsville on the Grand Trunk Railway track he had observed and collected eleven species of plants not found growing in this neighborhood. He added that they had no doubt been dropped from freight trains conveying cars of grain from the North-West. Many plants have seeds provided with hooks which enable them to attach themselves to animals, and they are thus carried to considerable distances, while birds devour many seeds and thus drop them sometimes in distant places.

Cotton-wool, brought from the south to the mills at Dundas, was responsible for the introduction of *Xanthium Spinosum* into that town. Years ago it was running up both sides of the main street between the curb stones and was travelling out the Governor's Road.

There are many other agencies at work distributing the flora of the earth's surface and changing the character of its productions, and in many cases the new-comers driving out the natives.

I cannot do better in closing these rather scattered notes than to quote the words of an eminent scientist when closing a discourse on kindred subjects to those engaging our attention this evening, he says :

"We aspire in vain to assign limits to the works of Creation in space, whether we examine the starry heavens or that world of minute animalculæ which is revealed to us by the microscope We are prepared, therefore, to find that in *time* also the confines of the universe lie beyond the reach of mortal ken. But in whatever direction we pursue our researches, whether in time or space, we discover everywhere the clear proofs of a Creative intelligence and of His forsight, wisdom and power.

As men of science, we learn that it is not only the present condition of the globe which has been suited to the accommodation of myriads of living creatures, but that many former states also have been adapted to the organization and habits of prior races of being. The disposition of the seas, continents and islands, and the climates have varied ; the species likewise have been changed, and yet they have all been so modelled on types analogous to those of existing plants and animals, as to indicate throughout a perfect harmony of design and unity of purpose. To assume that the evidence of the beginning or end of so vast a scheme lies within the reach of our philosophical inquiries, or even of our speculations, appears to be inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an Infinite and Eternal Being."

Natural History Notes

Read Before the Hamilton Scientific Association, May 9th, 1907.

BY WM. YATES, HATCHLEY

SOME PECULIAR TRAITS IN BIRD MIGRATIONS.

Near the time of the autumnal migration, almost all of our common species of birds appear to be taken possession of by the socialistic idea, and are impelled to associate in larger or in smaller flocks or companies. But what seems remarkable is the fact that often a few individual laggards or negligent ones are apt to get "left." Even the platoons of the small birds, such as Wrens, Finches and Robins, often leave lonely, odd members of their kith and kin that would appear not sufficiently on the alert in observing the social resolve to remove "to new fields and pastures new."

These dilatory individuals are reduced to the expediency of accompanying later groups of "Emigrees" of a different species or bird clan, that have the habit of flitting southward later in the season, or else of braving the risks of the non-migratory species.

When the weather conditions give the hint to the feathered kinds to make a move toward a presumably better "environment," an impulse like the swarming of bees is manifested. In the falcon tribe, this mode of journeying is frequently observable on a gigantic scale. The migrations of the various species of the larger hawks is often a magnificent and interesting spectacle.

The time of this phenomenal occurrence is usually near the tenth of September, and usually a calm cloudy day is selected for the journey, which begins in the early part of the day. The flight is in the form of a deliberate whirl or animate vortice, somewhat in imitation of the law of fluids through a resisting medium. In these flights across a district or province, the ornithic stream is always at an altitude above ordinary rifle range, and all, or nearly all, of the hawk inhabitants (of the district passed over) seem to be attracted "to çatch on" and join the procession. The number is almost incalculable, for the multitude stretches across the sky and usually (or invariably rather) is in motion from east to west, as seen from this township of Burford, and frequently occupies from one to three hours in the serene unhasting movement over a given point. In fact there is always a degree of grandeur attendant on a view of this phenomenon, as being suggestive of military generalship and obedience to discipline. It is probable that the great altitude at which the "hegira" is conducted is one reason that it eludes notice of all but watchful sky gazers.

The writer of this paper has been, two, three or four times an eye witness of these impressive "exoduses" in the course of forty years, which take place so high up in the heavens that only very attentive observers are apt to enjoy the privilege.

What seems singular, a few hawks in a locality, perhaps owing to lack of vigilance (or else mere apathetic ones) fail to be "sucked in" by the circling column of waving wings overhead, or else fail to hear and to respond to the "roll call" or "rallying cry," which leaders of all feathered armies or detachments utter when on their lines of travel, by way of pilotage to their uninitiated congeners.

Among the instances of such bird "left behinds" we call to memory one when, 7 or 8 years ago in the Township of Norwich, 4 or 5 miles from here, a "red-wing Grackle" straggled from among "the moving away" mass of its congeners, and comforted its feeling of bereavement by associating, on mutually amicable terms, with a big party of Town Sparrows, and lived in town stables and carriage houses in seeming contentment during several winter months, and was at length caught by an acquaintance of the writer and domesticated as a cage bird. It evinced some limited capabilities of melodious song, different, but sweeter than the normal red wing voicings. The owner of the bird seemed proud of the acquisition, and was accustomed to tell his neighbors, who came to the house in some numbers to listen to the dusky-feathered stranger's musical performances, that he believed the acquisition was a genuine American "Mocking Bird."

Odd individuals of the Virginia Rail or Sora Rail we have heard of being left forlorn by the main body of that species. These lingerers sometimes seek shelter and associates among the domestic poultry of the barn-yard, especially if an October snow squall should occur.

A few stragglers from the groups of migrating Meadow Lark occasionally make the attempt to winter in this latitude, and these "reluctants" usually resort to the shelter of hay stacks, or even big straw stacks, which are sometimes left standing for the wintry months in outlying parts or in the least frequented parts of a farm.

The curious trait of the snow buntings being semi-nocturnal seems a suggestion of the habit being acquired by these birds during their sojourn in Arctic Latitudes, for the traveller Nansen narrates that birds of this species occasionally visited his "bivouac" place when not many degrees from the North Pole.

February 27th, 1907. The winter season now drawing toward its end gives one an opportunity to speak of its type or character.

The normal degree of cold set in and put a peremptory stop to fall plowing on the first day of December, 1906, yet very little snow fell in this district, and we have had no sleighing so far on the highways.

The degree of cold has been about normal during a number of nights. During January the thermometers indicated ten below zero, although there has been brief alternate mild spells so far in February. On the 15th and 16th there was a few hours of rapid thaw with a rise of the mercury to 50 above zero, and the cold wave suddenly returned, and on the 18th night until the 21st several degrees below zero were indicated each night. The ice harvesters reported on the 13th instant ice thirteen inches thick on the creeks and ponds at the same time that correspondents in Dakota described the ice on the lakelets and streams, in that state, as being three feet in thickness in mid February.

As to wild animal or bird life, one has not heard of or noticed anything extraordinary. The usual numbers of snow buntings frequented our fields almost daily after about the 20th of November, and have been, except with very brief intervals, in daily evidence during the whole winter (to date). The Pine Grosbeaks have been frequent visitors hereabout during the past two months, and a flock of ten or twelve have been seen in our garden since the present letter was begun.

These birds came and examined the dried stems and seed capsules remaining on the flower beds, and also evinced fond partiality for the leaf buds of Spirea Sorbifolia as well as for the buds of the Sugar Maple. This penchant for bud-eating resembles that of their congener, the European Bullfinch. During the present month numerous instances of the wintering of the large Meadow Lark hereabouts have been noticed by some of our neighbor farmers. Their plaintive notes have occasionally been heard in the brief sunshine, periods of calm days, and also the smaller horned Larks have been almost daily seen about our pastures and highways since their advent in this country, about the 17th of January. These, as usual, are frequently to be observed in small numbers hovering in rear or near the flanks of the multitudinous flocks of Snow Buntings. Although the two species do not mix or associate closely, they seem on amicable terms, although seemingly regarded as a sort of Ishmaelite—gypsy bird—by the real boreal winter invaders of the white plumage.

Big flocks of the diminutive Pine Siskins have, from time to time (even on the most inclement windy days), been seen seeking their food in the pine groves around one's dwellings. This latter species examines carefully the pine cones, and with their pointed beak nip out the seeds from between the scales remaining on the branches of the varieties of evergreen trees, such as Pine, Cedar, Spruce and Hemlock.

During the dreariest portion of the winter-time, family parties of the Chicadee and Nut Hatches visited our gardens and door yards where food crumbs and kitchen floor sweepings happened to be placed as inducements, and in the shacks and rude huts of shelter where woodcutters in the bush dined or lunched, and where kitchen refuse, such as potato or apple rinds, or similar etceteras. In these precincts the diminutive winged fraternity readily perceive it to be to their advantage to congregate, and where usually there are no domestic feline enemies to keep the feathered tribes in awe.

It is asserted that Foxes are now nearly exterminated from this and several adjoining counties, and also that there has been a great diminution in the number of Racoon and Mephitis (skunk) pelts brought to the notice of the local fur merchants during the present winter.

With the disappearance of large areas of forest in this district, the sparseness of feral life excites no surprise. The enhanced price of building materials and lumber, suitable for farm and other implements and household furniture manufacturing, are causing the forests to disappear in this part of the province more speedily than there was any conception of one or two decades ago.

A few rodents of the Canadian hare species yet find congenial shelter and food in the remnants of the big cedar swamps, and the prolific gray rabbits are kept somewhat in check by the raptorial birds—Eagle, Owls, Marsh and other large Hawks. Woodcutters aver that the brightly ornamented Blue Jay, *Perisoreus Canadensis*, Canadian Jay, is far from extinct, but clings more and more to unfrequented forest solitudes. A pair of Whiskey Jacks were seen near here two years ago, and one of the two was shot and its plumage and skin well preserved by a taxidermist. This is a very rare species so far south as Brant County.

January, February and March, 1907, here in Southern Ontario, were notable in their meteorological conditions, such as unusually light snowfall, a winter without sledding facilities, yet with temperature as low as the average, twelve to fifteen below zero being registered here during several nights both in January and February. Also periods of strong winds from west and north-west, with clouded skies, and occasional sleet-rains which encased out-door objects in icy armor, were not infrequent occurrences.

The usual winter visits of big flocks of snow buntings were noted in this district by their arrival at an earlier date than usual. As early as 20th November, 1906, great numbers of the white plumed twitterers visited our stubble fields day after day and week after week, with only slight intervals of absenteeism, until the first week in March, 1907, since which period none of these northern adventurers from the land of "the Eskimo" have been reported in these parts, although other winged visitants from boreal latitudes stayed hereabout for weeks later. Flocks of ten or twelve individuals of the Pine Grosbeaks came to our groves and gardens daily, until the milder temperature set in about March 13th. These birds were by no means shy, and came near to our dwelling house and nibbled at the dried seed capsules remaining on the plants of the summer floral parterre, and eating the now swelling buds of the Spireas and other shrubs, such as gooseberry and currants. But just before the arrival of the Robins and Blue Birds (14th and 15th of March this year), the Pine Grosbeaks ceased to be in evidence in these their winter haunts. Some mild sunny days, March 15th to 18th, caused the gladsome notes of the Plover's "kill deer" to be heard over our fields and groves, and aroused the vocal efforts of the Song-sparrow and Meadow Lark, (*Sturnella Magna*) after their four or five month's silence. Many of our acquaintances here expressed surprise at the promptness with which numbers of the feathered tribes responded to the genial changes in the atmosphere. The notes of the interesting *Red-Winged Grackle*, and also the circling sky high flight of the broad-winged Hawk, were in prominent notice to the busy workers engaged in the maple sugar groves, so general in these districts. On Saturday last, March 16th, very promising beginnings in boiling the pure maple sap were made on the 16th, and again on the 18th of March.

Although the rather abrupt change from the severe frosts (occurring in the first week of March) to the temperatures of 45 to 55 degrees, just antecedent to the spring equinox, may be followed by a temporary reaction to a cold dip, and perhaps a brief white reclothing of mother earth, there is confidence that the reign of gloomy skies and ice-covered streams has been abrogated, and a more inspiring program of experiences is now ruling the hour.

The hardihood and heroic habits of the Snow Bunting do not seem to be expressed by that bird's physiognomy. One has thought, on looking at a living specimen when held in the hand, that a *plaintive* and appealing plea for sympathy—a sort of infantile and immature helplessness—rays forth from the bird's rather large eyes ; not quite so consistent with the ornithic jollity noticeable when say 500 or more of the species are revelling in hillarious flight, as is their habit, around our clearings during a tempestuous snow-laden gale, just at gloaming hour, on a zero January eve.

A phenomenon, just as above attempted to be described, convinces one that they maintain a mysterious, ethical relationship to the darksome, sombre inclemency ; and that in most depressing and shuddering hyperborean terror-phantasms, the fountains of hope and of courage, and confident optimism, are only temporarily eclipsed. As a winter negation, time is perhaps a necessary counterfoil and recoil to the ecstacys of the Roseate June "Calends."

The stormy Petrels of the North Atlantic Ocean, in their seemingly "devil may care" flights and careerings around the stern of a storm-stressed sailing ship as "the shades of night are gathering round," present a similar "phantasm" to the gleesome whirlings and swoopings of a white host of Snow Buntings in their pantomime round a dishevelled Canadian strawstack, just previous to the bird's roosting time.

Professor Nansen, in his Farthest North, mentions, I think, the Snow Bunting as an occasional solitary visitant (as well as similar hardy birds) to the dreadful seclusion of his "shack" *in the* "*desolation of desolations*," in the January Arctic Circle.

Tuesday evening, March 19th, 1907. A slight snow fall this morning, about two inches, caused two workers in the maple syrup business to leave their shanties and go into the boggy parts of the bush to investigate for foot-prints of birds or quadrupeds. My son accompanied the hunters, and has just returned home. He relates that two Mink tracks were found, indicating the movements of full-grown minks. These were followed by two good hunting dogs for the distance of nearly a mile, but the Minks had taken to cover under the matted roots of massive trees, and, for the present, the chase had to be given up.

The men also noticed the tracks (very recent of course) of a full grown Racoon. Four specimens of "*Procyon Lotor*" were captured in the same locality, two on last Friday, and two on Saturday 16th, all full grown. These Procyons were found prowling in the ditches and rivulets for Batrachian or Piscivorous quarry. The hunters also aver that they observed very distinct tracks on the snow indicating the flitting of a family of Flying Squirrels, from one hollow tree to another, many paces distant. The tracks of this species of rodent are not difficult to distinguish, on a snow-surface, from the tracks of their congener, the common Red Squirrel. "Turdus Migratorious, the common Robin, was very evident, and chirruped most vigorously its demurrence to the evil-disposed canine invaders of the solitudes. The hunters told that the Song-sparrow also occasionally uttered his cheerful refrain in evident faith that spring sunshine would speedily banish the white carpeting. On the return, just as about to emerge from the bush, about a hundred Carrion Crows moved off in hasty and noisy flight from the carcass of an equine, which seemed to have been hauled out of the range of odorous annoyance by the erstwhile human proprietor.

We hear frequent accounts of bevys of quail being noticed both in barn and stackyards during winter, just near its terminus. The almost snowless winter has been propitious to the survival of these game birds of the cultivated zones, and probably the pleasant voicings of "bob white" will be a more frequent occurrence than has been the case for four or five years past ; quail having been almost an unknown quantity in these townships for some years.

The welcome and solitude-loving Herons do not appear here until the opening of navigation, and when the piping of frogs in the waterways becomes audible.

The Herons are being reduced to the "minimum" in point of numbers, and seemed doomed, as far as these districts are concerned, to the fate of the Wild Pigeon, once so vastly multitudinous from time immemorial in these regions. The last struggles were noticed by the present writer about the year 1880. The conditions are so changed since the fourties, by the removal of the Beechen Forests principally, that the repatriation of the columbines seems out of probability's range.

Like the Wild Pigeons, the Herons of our species are so-called *socialistic* birds (as also the Rooks of Europe) We can visit, in the midst of a swamp solitude 2½ miles from here, a precinct where an almost inappreciable remnant of the Heron clans of former days lived and multiplied. A few tattered remains of the Crane or nocturnal Heron's *bushel basket-like nests* yet hang in ruins high up on the big forking sprays of the Swamp Ash and Elm trees, as vestiges or archeological relics of a by-gone time. Human residents near the border of the yet swampy solitudes, express the belief that the Cranes in two or three years from date may be only a reminiscence in these localities.

The Herons being long-legged waders, (as are the Flamingoes) here find their security in nesting in lofty trees, and they will also perch as sentinels, in the topmost branch of lofty pines, to give a commanding outlook in wariness of possible danger. The Bitterns, a seeming relative of the

Herron, is becoming of less frequent notice, as also are the Rails and Snipes, as the inevitable consequence of irrigation and cultivation of bogs.

The Plovers, on the contrary, seem to be holding their Numbers well, seeming like the European Pewit or Gray Plover, to find congenial habitat, or at least th epossibilities of existence in drier conditions amid grain and clover fields, as well as in moist soils where summer showers wash out the castings and larvæ of earth-worms and jelly-like insect organisms. The Kill Deers are harmless and interesting, and like some of the Sandpipers are rarely wantonly molested by the farmer boy gunner; and their nests are most frequently on bare ground, a mere slight depression on a smooth knoll in a turnip, mangel or cornfield, trusting seemingly to the earth-like coloration of the bird's dun plumage, and also of the eggs, to the survival and increase of the genus.

Electrolysis of Water and Gas Pipes, and Iron Structures.

Read Before the Hamilton Scientific Association, January 24th, 1907.

BY E. G. BARROW, C.E.

The destruction to water and gas mains, and particularly to lead service pipes, by electrolysis, which has been so frequently brought to notice of late years, principally on pipes adjacent to the single trolley system of electric propulsion, has at length aroused those in authority in cities and municipalities to take action for the prevention of the evil which might entail millions of dollars of loss if not checked. The distribution system of both water and gas pipes have been and are being gradually eaten away, and it is impossible to say to what extent, but it is certain that damage of a most serious nature is silently proceeding.

On account of the pipes being buried in the ground, it is of course impossible to estimate the full amount of damage.

The object of this paper is not to discuss in detail the theory of electrolysis, but to describe and try to bring to your notice, by description and illustration, the injury which has and is going on by electrolytic action; the means taken for its prevention, and to try and interest your association so that the members may be induced to use their influence in the very laudable endeavor to arrest what may perhaps develop into a very serious loss of property and perhaps life.

Electrolysis is defined as the resolution of a fluid into its proximate constituents by the direct chemical action of the electrical current. Another definition, and the one which I think is most applicable for the purpose of this paper, is the chemical dissociation which is brought about by the passing of a current of electricity from one electrode to another through a solution containing an electrolyte.

It would be foreign to the purpose of this paper to enter into a scientific description of the electrolyte cell, suffice it to say that the passage of the electric current through an electrolyte produces certain chemical effects, and in case this current is between the pipes and the rails the result is that the metal of the pipe is gradually carried away. Damage is also done to the rails. Although this paper deals with the injurious effect of electrolysis, it would be well to remind you that electrolytic action has been made of great service in the arts and manufacturies, and is a most important factor in electro plating.

The amount of damage done by electrolysis depends on the amount or volume of the electric current, the length of its duration and the constituents of the soil.

In all systems of electric propulsion where the return current is by the rails, it is found that at certain points there is an escape of electrical current from the rails to the adjacent metallic conduits, whether gas or water pipes, and from them back again to the rails and power house. It is where the current leaves the pipes to return to the rails that damage is chiefly done by electrolysis, the metal of the pipes being carried away leaving pits in the surface of the pipes, which in time pass through the entire thickness of the pipes and thus cause leaks. Should the leak be in a gas main, gas would of course escape and an explosion might occur. Breaks in water pipes of a serious nature have occurred in several cities; Providence and Toronto being two examples.

It will readily be understood that the pipes and rails are the electrode and the soil and its alkali salts the electrolyte. It is said, and has been proved, that the passage of a continuous current of one ampere per second into the earth involves a loss of 20 lbs. of iron from an iron pipe per annum, and a loss of 70 lbs. from a lead pipe. Cast iron pipes contain a large amount of graphite carbon, which is not attacked by the nascent chlorine or oxygen of the electrolyte, and a pipe of this metal often remains for some time strong enough to resist the bursting pressure of the water in the pipe, although electrolytic action had set in. The tar coating appears of little use to protect the iron. Serious damage, no doubt, to the water pipes is silently going on, as, of course, being buried in the ground, they are hidden from observation.

In the City of Richmond, the amount of damage done to the water pipes was estimated at $17,000 per annum. At St. Louis it was estimated that 122,980 lbs. of iron was being removed from the pipes by electrolysis. In Pittsburg, Mr. Brownell, an electrical engineer, thus reports:—

"In the City of Pittsburg there are 62.7 miles of parallel lineal streets jointly occupied by the tracks of railway companies and water pipes. Gas leakage from the mains to the earth decreases the electrical earth resistance and increases the electrolytic disintegration of the subsurface metallic structures."

He says that electrolysis is eating away the iron beams in the cellars of every fire-proof building in Pittsburg. Reports have been made by expert electrical engineers of the condition and direction of the electric currents in the City of Toronto, London, Ottawa and several other cities of the Dominion, and in all cases severe damage was found to have occurred and was, without doubt, still at work insiduously destroying the iron of the pipes.

The method usually employed to ascertain the position, strength and volume of the electric currents traversing the city in the neighborhood of the trolley lines, is to make what might be termed an electrical survey. A plan of the city is procured on which the street railway and interurban electric railways are laid down. The volt meter and ammeter readings are taken throughout the city and are plotted on the map. The city is then divided into two areas, one called the positive, where the current leaves the pipes and returns to the rails or power house, and the other is called the negative, and is where the reverse takes place, the current leaving the rails to the pipe. It is in the positive area, especially near the power house, where damage to pipes is most to be apprehended. A plan of the above nature reveals at a glance to the experienced engineer the whole electric (if it may be so termed) situation, and points out the places where he may expect electrolysis to be proceeding. Investigations are made at the points so indicated and openings are made to the pipes. It is surprising to find how truly the information obtained from the plan or map is verified, as in almost all cases where electrolysis is expected to be found, on digging up the ground these predictions are found to be correct. Having from these maps and from excavations obtained the requisite knowledge of the places where electrolysis is proceeding, the next thing is to suggest a remedy.

There is, I believe, some difference of opinion as to this. Some authorities holding that any system of electric propulsion necessitating a return of current through the rails is unsafe, and insisting that the double trolley system or some analagous system is the only way to entirely be rid of damage to the water and gas mains.

Others hold that by the proper bonding of the rails and by metallic connections in the positive area near the power house, or the places where the difference of potential is greatest, the current flowing from the pipes to the rails will be reduced to a negligable quantity. Again it has been said that if the alternating current could be employed instead of the direct current, as is usually done now in electric railways, the evil complained of would be done away with.

The ordinances for the prevention of electrolysis to metallic structures, which have been introduced into cities, have some of the following provisions inserted. These are taken from Atlantic City ordanances :—

"No bonding will be allowed to be made to the water or gas mains in order to equalize the potential between the conductors and rail, but means must be taken by furnishing an insulating or complete metallic circuit to effectually prevent current from the wires or rails of the railway.

"The company or individual operating the street railway may select the particular method of securing this protection, and will be held responsible only for the result.

"It shall so confine its current to the metallic return circuit so as to comply with the following conditions:

"The maximum difference is potential between any part of the metallic return circuit and any water or service pipe or other metal conductor not intended as a part of such return circuit, shall not at any time exceed ¼ volt.

"The difference in potential between any two points upon said metallic return circuit within a distance of 200 feet from each other, shall not, at any time, exceed ¼ volt.

"The current passing along any water or service pipe or other metallic conductor not intended as a part of said return circuit, shall not at any given time and point exceed one ampere.

"Tests shall be made during two months of the year, February and August, for the purpose of detecting stray currents, by the city electrician or other competent person. If any such damage is found to be done to the water pipes or gas pipes, then the company is held responsible and has to pay the cost both of discovery and repairing.

"Penalty $50.00 to $100.00 a day."

In conclusion I have to state that owing to my having been so very much occupied of late, I have hardly been able to do justice to this subject, but I trust that sufficient has been said to demonstrate the importance of it, and I do hope that the brief account has not been entirely unacceptable to the members of your association.

GEOLOGICAL SECTION

Report of the Section for the Year Ending May, 1907.

The Chairman and members of the Geological Section herewith beg to submit their annual report ending May 1907.

The Section, in submitting this report, has much pleasure in stating that the storm cloud (*Nimbus*) which at one time last fall appeared to be about to annihilate the section has passed over and serenity now prevails, and that the most active members again resumed the work during the winter months of comparing specimens and relegating them to their respective classes and families. Much useful work has been accomplished during this inclement season from a collector's view-point.

During the collecting season, which invariably begins in the spring of the year and ends when the snow is beginning to cover the ground, there has been a large number of fossils collected, many of which have been sent abroad to the different museums where these gifts are appreciated, and not a few have been added to our own museum. Colonel C. C. Grant has been devoting much of his time in search of rare graptolites and fossil sponges, and his endeavors in that direction have been abundantly rewarded. He has discovered what appears to be the root-like attachment of that species of sponge which has always heretofore been regarded as a free, or of the floating variety. He also found some beautiful specimens of graptolites which are new to science. There appears to be a peculiar circumstance connected with this form of pastcoulor palæozoic life which has not, so far as I am aware, been alluded to by any collector, that is that these graptolites appear to have been gregarious, and had existed in colonies of a very limited extent, because, when examining the rock beds of the same horizon in which these specimens are usually found in considerable numbers, and although not far removed from that spot where they are quite numerous, probably a hundred feet or so, they appear to be almost entirely absent, thus demonstrating that there was not a uniform distribution of this variety of sea life on the bed of the ocean even where the depth of water was favorable to their existence. The Hamilton collector has been distinctly favored because of this escarpment showing the depth of three distinct formations and the quarrying process of the different strata which has been going on for many years, but more extensively in the Niagara formation, revealing the peculiar forms of life which have been entombed therein during the process of deposition. The collector has had the privilege of examining and comparing the various forms of fossils as to their variety, their fuller development, and the effect which conditions of deposit during flood or ebb tide would have upon the distribution of these fossils throughout the strata marking the several epochs in the geological, as well as the palaeontological, life in the different beds which compose the separate formations.

Letters have been received from the directors of different museums expressing their appreciation and thanks of the governing Councils for the specimens sent to them by our most active and energetic member Colonel C. C. Grant. Professor W. D. Lang, of the British museum, acknowledges the receipt of 129 specimens of fossils from the Niagara formation and Hudson River group obtained at Hamilton and on the lake shore at Grimsby, among which were specimens of Cladopora and Lichenalia new to science. Professor J. F. Whiteaves, acting director of the Geological Survey of Canada, also acknowledges the receipt of fossils from the same localities. Professor Clark, state Geologist of the State of New York, also acknowledges the receipt of fossils. Information has been received from Ottawa that the collection of bryozoons from Hamilton and Grimsby have been forwarded to Dr. Brostter, of the Smithsonian Institute, in

Washington, D.C., a scientist of eminence who has made a study of these early and obscure silurian fossil remains. The result of his labors has not yet been made public.

The Museum has been kept open on Saturday afternoons during the year, and no doubt much information has been carried away by every student who has studied intelectually the rich collection of fossils which now fill our cases, and also those that lie upon our shelves, an opportunity which every earnest seeker after knowledge will fully appreciate.

There have been three meetings held, at which papers of more than ordinary geological interest were read by Col. C. C. Grant.

Following are the dates upon which the different papers were read and the subjects discussed :--

November 28th, 1906—Notes on the Late Collecting Season, by Col. C. C. Grant.

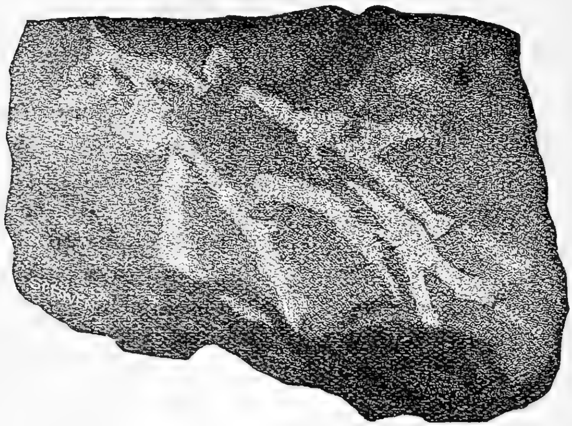
December 28th, 1906—Notes on the Late Collecting Season, continued, by Col. C. C. Grant.

March 22nd, 1907—Remonstrance respectfully submitted to the Council re the Preparation of a Catalogue, by Col. C. C. Grant.

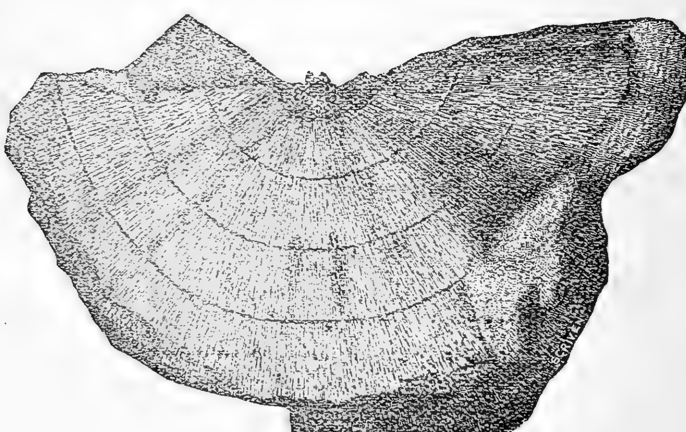
When Col. C. C. Grant read his first paper of the session, he produced some specimens of archæan and other rocks from the glacial Erie drift at Winona, and he said then that they belonged to a valuable deposit of feldspar and granite which must exist somewhere north of this district. Some time after a Mr. George Hawkesworth Armstrong writes that a valuable deposit of feldspar had been found about 100 miles north of Cobalt, from which a very hard cement can be produced, called Krenite, much used in Russia.

Respectfully submitted,

A. T. NEILL,
Chairman.



No. 1.—Represents a specimen of Ptilodictya of our local Chert. The outer marking of these Bryozoons is rarely preserved, as in the case of the fossils from the Niagara Shale at Grimsby.



No. 2.—This Chert Coral may be a new species—belongs to the Genera Calopora probably. Although in form resembling Cyathophyllum (Cup Coral), in structure it widely differs.

No. 3.—This fine, well-marked specimen from the City Quarry, belongs to the Genera Callyptgraptus of Dr. Spencer, F.G.S. The name was suggested by the overlying branches of the Graptolites. It differs from all I have seen in the Chert beds, and I believe it will prove to be a new species.

Notes On The Late Collecting Season.

Read before the Hamilton Scientific Association, November 30th, 1906.

BY COL. C. C. GRANT.

In a recent paper the writer referred to the discovery, by the late Mr. A. E. Walker, of the tail shield of a lower Silurian Trilobite "*Asaphus platycephalus*" obtained from a piece of shingle embedded in "Erie (glacial) clay," below the Ancient Lake Iroquois Beach, of Dr. Spencer, which is known to us now as the Burlington Heights.

My old friend and fellow-worker, for many years an ex-president of the Geological Section of the Hamilton Scientific Association, unquestionably was opposed to some of the views put forth in our early publications by members who took considerable interest in the Field Geology of the District. He was unable to see how Trenton fossils, not common to the Hudson River series also, could ever have been derived from the bed of the lake, the land adjacent, or the Great River which, Dr. Spencer asserts, carried the surplus waters of Lake Erie through the Dundas Valley. No doubt many of our Hudson River fossils obtained from the modern mis-called Beach, its more ancient predecessor and the lake shore, originated in the exposure of rock surfaces laid bare by river streams, or the washing of the lake against its land barriers.

The writer noticed, during the past few summers, the extraordinary number of mottled red and white Clinton slabs (sandstones) scattered along the lake shore between Winona and Grimsby. They are from the same horizon as the Hamilton *Iron-band*, greatly as they differ in appearance. The Grimsby rivulet probably transported them to the lake, No doubt, when the writer felt his sight so impaired as to recognize with considerable difficulty even a well-marked Niagara Chert Sponge from many of the non-fossiliferous fragments about it, he may have arrived at the conclusion that the result could only be disappointment. But where organic remains could be closely handled, as along the lake shore, or the rich fossiliferous Niagara shales of Grimsby, Ont., something may be found to attract a little more attention to our Silurian deposits than any Dominion Government is likely to bestow. "In advancing scientific interests, your Dominion, sir," remarked recently a visitor from the States, "wisely considers, I think, that the chief object of a Geological Survey of a little known county, such as this, is to point out to men where minerals are likely to be found which would attract capital from the States, and add to the wealth of the country." Doubtlessly the visitor was misinformed; but I am satisfied many people in this locality ignorantly consider the chief object of the officers of the Dominion Geological Survey is to disclose to land speculators where mineral lands are likely to be obtainable. Such individuals care little for the advancement of science, and only look to forward their own selfish interests.

The lake shore, between Winona Park and Grimsby, presented, during the past collecting season, an unusually favorable appearance for obtaining Cambro-Silurian Drift fossils. The extent of shingle exposed along the Beach was far beyond anything noticed previously, but the quantity of material proved bewildering. Independent of this, I was obliged to devote not a little time to securing additional evidence in support of the assertion already made, viz: That from the true glacial clay and the polished and scratched limestones and shingle embedded in it, displayed along the banks, we could trace the derivation of the majority of the organic remains found on the lake shore. The writer was quite aware few were likely to share, and some would probably oppose, a view contrary to what was generally entertained. On this account, during the past three summers, while we were staying at the camp, lake shore, considerable attention was given to the lower portion of the glacial drift subjected to tidal or stormy influence of the water, and also to a small ravine some few hundred yards to the west of the camp, where an exposure occurs below the little that remains of the primeval forest. The waters of Lake Ontario in the wildest storm penetrates only a few yards at the mouth of this creek, and when you find fossiliferous shingle embedded in the glacial clay there, it can readily be seen that *land ice* can alone account for the glacial deposit. The writer believes if his old friend and master in Geological matters, the late Sir W. Dawson, had studied the interior of this continent as carefully as its western extremity, he might have modified views not generally accepted either in Canada or the States.

As I stated in our last year's proceedings, the first discovery of a true Trenton fossil in the glacial drift here was made by our former president, the late A. E. Walker, below the Ancient Lake Iroquois Beach near the canal. It proved to be the tail shield of Asaphus Platycephalus. Our friend also extracted, on a different occasion at the same place, a small slab of Utica shale, containing a fragment of Professor E. Chapman's Trilobite, Asaphus Canadensis.

The writer noticed, on his arrival at Winona Camp some years ago, there was a considerable amount of shingle embedded in the lower part of the glacial clay. The material, on extraction, was found to be scratced and polished. Under the hammer it proved exceedingly hard. The first ones examined were unfossiliferous, and further examination was only resumed during the last three summers. It is natural to suppose the glacial markings would disappear from shingle washed out and exposed to the action of the water and a sandy shore. In general, the shore shingle also is difficult to break up. Exception may be made to rocks derived apparently from an upper portion of the Hudson River series. This very circumstance led to a systematic enquiry as to whether any softer shingle than I had previously extracted existed in "the glacial clay." All doubt on a point formerly entertained was certainly removed by finding limestone shingle neither scratched or faintly striated, close to others which presented this peculiar appearance, containing precisely the same organic remains which the hammer reveals in the shingle washed by the water.

None of the tail shields of Asaphus Platycephalus, which I found at Winona during the past collecting season, were extracted from the glacial clay; yet I think they were embedded there originally. You may notice frequently along the beach, lumps of limestone presenting an appearance differing from all others. I am not acquainted with the New York *Bird's-eye Group*, but the specimens in question present crystalline spots of Calcspar all over the surface, and are non-fossiliferous. Apparently, while wondering how they come to be there, I accidentally came on a piece of the identical limestone embedded in the clay at the pond, a little to the east of the camp, and this satisfactorily settled the matter as far as the writer was concerned. The formation from whence their fragments were transported belongs to *the Black River group*, which underlies the Trenton.

I have for many years considered it improbable that all the corals found along the lake shore, formerly known to us as Stenopora fibrosa, Chætetes, could have been derived solely from the Hudson River series. Professor Foorde, a late Assist.-Palæontologist to the Canadian Survey, informed me that no true Chætetes had been as yet discovered in our rocks. In June, last, I extracted from the glacial clay near Winona a slab covered with the numerous characteristic white markings precisely similar to the ones scattered along the beach.

When we know that for ages the lake has been encroaching on its southern shore and removing the embedded material, it does not appear difficult to account for the derivation of many of the fossils collected on the lake shore.

The Cincinnati groups of United States Geologists received considerable attention from Professors Miller, James and others. It is said to represent the upper part of the

Trenton. The remainder belongs to the Hudson River series. Several years ago I was sent from the locality a parcel containing many well-preserved minute members of the so-called Chætetes family, named and placed by themselves in a paper tray.

Since Drs. Nicholson, Hinde and Foorde left Canada, I have not heard of any Palæontologist here who takes much interest in this class of Silurian organic remains. I have heard that Professor Ulrich, in the States, who already has contributed so extensively to our knowledge in other departments of Geological Science, makes a special study of things not calculated to attract general observation. Assuredly our lake shingles, hard and difficult to break up under the hammer, may reveal unknown species differing perhaps from the far better preserved forms discovered evidently in softer shales and under distinctly different conditions. Our specimens seem more robust, and, as far as I can see, present appearances not corresponding. Putting aside the few fossils known to be common to the Trenton and Hudson River series, such as "Plectambonites Sericeus," and one or two others, we must admit the undisputed Trenton specimens were obtained from shingle on the shore.

Lingula (Glossina) Trentonensis.
Conularia Trentonensis.
Modiolopsis Cincinnatiensis.
Ambonychia bellistriata.
Asaphus platycephalus, two tail shields.

While the writer believes the above list is incomplete owing to the difficulty of extracting from shore shingle specimens easily recognized, and which he considers were originally derived from *the Glacial Drift* itself, he must not forget to recall to the few members of the section yet remaining, a well preserved "Cyclonema bilix" which our friend, Mr. Bartlett, secured from the Beach there. True, the Gasteropod in question has also been discovered in Hudson River rocks, but from what its discoverer mentioned at the time, respecting the excessive hardness of the shore material at Winona as contrasted with other places, the beach for instance, I may not be far astray in believing the limestone containing it was embedded and washed out of the glacial clay there.

Where the specimens collected have not been found in situ and are known to represent lower Silurian organisms, the writer believes he is perfectly justified in adopting the term *Cambro-Sil.* remains. The Continental Glaciers took tribute from all formations they passed over. About London, Ont., as far as I recollect, the Drift was 100 feet deep, and hold many well preserved corals and other Devonian fossils. Singular to state, on one occasion I extracted from the river bank a fine specimen of the Niagara Coral, Halysites Catenulata. As far as we know it has never been found in Corniferous limestone.

The Geological Survey of this portion of the Dominion was undertaken nearly half a century ago, when roads and quarries were unopened or unknown. We members of the Geological Section of the Hamilton Scientific Association must admit they labored under very great disadvantages.

Whether the writer succeeds or fails in inducing members of the Section and others outside our circle to consider views opposed to such as have been generally accepted hitherto regarding the origin of the Lower Silurian fossiliferous shale along the lake shore, he can certainly declare that since A. E. Walker's original discovery, the subject has been carefully investigated, and more closely perhaps during the past three summers than previously. He felt it was absolutely necessary to make sure of the facts, which he believes can hardly be doubted. Probably too much time was lost last June in breaking up limestone shingle containing outside indications of well known specimens. There was an unusual display of fossiliferous material on the Beach last summer. I fear it possessed a sort of fascination I was unable to resist. An exceedingly large collection of well known Cambro-Silurians was made, many in good preservation; but it led to neglect-ing the less promising limestone slabs which afforded quite a number of Ohio and other rare organisms which I have not previously seen recorded as occurring in Canada.

It was only a few days before leaving the camp that I commenced breaking up limestones with no fossil indications, with an appearance (as far as I could recollect) of the ones which proved so unexpectedly rich in former years. The result proved satisfactory. It enabled me to forward to The Dublin Museum a very fine valve of the Ohio Lamellibranch of the late Dr. Jas. Hall, *Orthodesma Curiata.* In addition a valve (two I think) turned up of Dr. Billing's Modiolopsis Gesneri. A few more are undetermined. They were extracted from limestones difficult to break up, which probably were washed out of the banks of glacial drift clay.

While asserting the belief that many of our Lower Silurian fossils found on the lake shore were derived from glacial clay adjoining, let me hope I may not be misunderstood as conveying to the Section views I have never entertained. Wherever in present or past times, waters of lakes, streams or rivulets encroached on the land, they not only carried away sediment mud, but rolled fragments of limestone, sandstone or shale to be deposited at a lower horizon. It is by no means uncommon to find, as already mentioned, Clinton mottled sandstones containing fragments of Lingula (oblonga) Clintoni, evidently brought down from the quarries there by the Grimsby Rivulet in flood. The numerous fragments of Archæan rocks along the shore at Winona, presented similar specimens in the glacial clay.

NOTE A.—In the foregoing paper the chief object of the writer was to show that many (if not all) the Archæan rocks, found along the shores of Lake Ontario at Winona and Grimsby, were brought to the localities in question by land ice. He extracted a large number of specimens from the Glacial Drift corresponding with others lying loose on the shore. Somewhere to the north of us there must be valuable deposits of red and grey granites. I submit for inspection of the Section fragments of a few of the specimens which were embedded in the clay along the shore.

NOTE B.—When the writer read the first paper on last year's collecting season he produced specimens of Archæan and other rocks from the Glacial (Erie) Drift at Winona, a belief was expressed then that valuable deposits of Feldspar and Granites must exist somewhere north of the district, from the extract accompanying the former may be said sooner than was expected. Feldspar is extensively used also in the manufacture of the beautiful *Porcelain* from China.

EXTRACT.

"There has been lately a discovery of minerals some hundred miles north of Cobalt, and a substance called felspar has been found. The seam is a very valuable one, indeed, for a mixture formed from sand, clay and felspar, after being subjected to intense heat, forms a hard cement called kremite. It is used for buildings in most of the large cities in Russia, and has been found perfectly satisfactory; the bricks formed from the same being far superior to those made of clay alone. A company should be formed to develop that section of the country, where it is to be found."

Notes During The Collecting Season—CONTINUED.

Read before the Hamilton Scientific Association, December 28th, 1906.

BY COL. C. C. GRANT.

In pointing out recently what the writer believes to be the true origin of perhaps the majority of the lower Silurian fossils found along the lake shore near Winona last June, we probably left an important matter too slightly alluded to, if not unrecorded, viz: The numerous Archæan glaciated pebbles or shingle frequently observed there. Assuredly such could not have been derived from any place but the far North. This occurrence was clearly traced to the glacial clay cliffs along the shore, mingled with others containing similar lower Silurian organisms, as the hammer reveals on breaking up the shore shingle. Can local "field Geology" satisfactorily account for the presence of either? No. We must look far beyond the neighborhood of the lake itself for the solution of the difficulty. Here I may be permitted to remind a reader unacquainted with Geological terms that scientific men use the word *rock* for even a soft sedimentary deposit as our *glacial clay beds*. It may be necessary to direct attention to the circumstance, otherwise drift specimens may be excluded from local lists.

NIAGARA LOCAL CHERT BEDS.

The city quarry, at the head of the Strongman Road, presented so few specimens since its opening that the writer concluded not to waste much time there on the mere chance of finding a few new Graptolites. Yet a brief visit was paid almost daily during the working season, on the way to other localities which furnished Sponges and Bryozoons. In a recent visit I noticed a shot had been fired in the blue building beds at the base of the chert, which disturbed the thin limestone layer at the top, which contains many fucoid impressions. I turned over one of the slabs, and, instead of the plant expected, it presented (what I had never found at this horizon hitherto) a very fine and well preserved *Dictyonema.* Mr. Nichol informed me another Graptolite was badly fractured by powder some months previously, and showed me also *a coral* from the base of the blue building series, which the quarry men call *the sand beds.* Fossils are rare in the latter and generally ill-preserved ; yet one of the Jolly Cut quarries presented some years ago a fine cast of *Strophodonta Semifasciata.*

It may be admitted that while the corporation quarry proved so unproductive in organic remains, it had some compensating advantages, since it compelled one to devote more attention to the fields in the vicinity of the corporation drain and brow of the escarpment. It enabled one to make a more extensive collection of Niagara Sponges and Bryozoons unknown hitherto. I think only for this circumstance I would never have examined some of the fields from which hay had been taken, and which presented a poor prospect of success. Despite this unpromising outlook a larger number of rare specimens were discovered there than in any year previously, under far more favorable conditions. Fragments of a *circular cup-shaped coral* had often been found in former years, similar to the specimen now in the hands of Mr. Scriven, but too imperfect for restoration. The forms may mislead one to suppose it belongs to the grnera *Cyathophyllum* (cup corals) of Goldfuss, but it widely differs from that family and comes under the head *Caleopora* probably.

We were also enabled to devote more attention to *the flint-flake fossils* of the glaciated Chert beds, which are so rich in Bryozoon Cornulites and other organisms. It may be owing in a great measure to the long continued draught in the latter part of the collecting season, that its close was marked by securing as large, if not a larger, amount of specimens than usual; and, strange to say, in the very places where you would least expect to find them, in clover and grass fields. The green food for the cattle was not so plentiful as in former years. The cows laid bare the crops almost to the roots, and exposed a very large quantity of glaciated flint-flakes, which, under other circumstances, must have escaped observation. This enabled the collectors to turn over and examine the under surfaces of a very large quantity of material. The non-fossiliferous Chert flakes were placed in heaps on the head-lands—a practice followed for many years, which saves future labor.

Since Professor Bresler, of Washington, described and named the new Bryozoons from Hamilton, many more have been secured here. In one day alone I brought away from a meadow-field, and another on the opposite side of the corporation drain, five specimens of Dr. Jas. Hall's Genera *Lichenalia*; some were new species, probably 4 *Ptilodictyas*, two of which I had not found previously. The outer ornamental marking is unfortunately absent, while the form is well preserved and about an equal number of *Cladoporæ*. The upper or glaciated portion of our local Chert is particularly rich in this class of fossils, whose position as a *coral*, I believe, remains yet undetermined, although classified as such by many leading Palæontologists, since Dr. Parke, of Toronto University, informed the writer, he found some "*new species*" in a collection from Hamilton. Many more were obtained, some of which are now in "The British Museum," and others we can place in the hands of any one who takes an interest in and cares to describe an interesting but little known family of organisms. The internal appearance of these Silurian remains, collected by scores in the glaciated Chert beds here, assuredly would lead to *coral classification*. But on pointing out some years ago to Dr. Ami, of the Dominion Geological Survey, what I believed then to be the only specimen which ever displayed an outer skin, where pores apparently were absent, he called attention to another in the museum case where another fragment was preserved that the writer had not noticed. Possibly, like the Fenestellidæ of a similar horizon, the cellules may have been filled in and completely obliterated by the flinty material held in solution in the Ancient Silurian Sea. Our Hamilton Chert holds many dwarfed specimens of the latter, but as they never present the necessary cellules in order to determine the proper classification, the writer merely collects specimens whose forms appear to differ perhaps in a slight degree from others that doubtlessly have been discovered in more perfect preservation, either in the United States or elsewhere.

The internal coiled spiral arm process is rarely preserved in our Chert Bracheopods. I can only recall two or three instances in "*Atrypa reticularis*," and until recently it was not noticed, I think, in a "*Spirifer*" where the conical spires are directed outwards to the extremity of the hinge-line. This class is not so common in the Chert as the various forms of *Strophomena*, but on reference to the useful and exceedingly interesting work of my friend, Professor Chas. Schuchert's "Fossil Bracheopoda, America," while *Spirifer radiatus*, Sowerby, is credited as occurring at Hamilton, Ontario. *Spirifer Niagarensis*, Conrad, recognized by Billings, which appears to be of more frequent occurrence, seems to be omitted altogether. Probably this was owing to our own neglect in not furnishing our friends in the United States with a more complete list of Hamilton specimens. The locality is credited with producing many of the fossils named in the work in question, and when any deficiency is noticed, the writer believes we ourselves are answerable for it. This may be rectified in a future edition by transmitting absent specimens to the author. Even under favorable conditions the Geological Section may notice how very difficult it is to distinguish Bryozoons in the weathered Chert of the Niagara series here. All, as far as the writer can see, is of the same appearance—colorless like the Matrix. The only exception being one figured and described by Dr. Spencer some years back, Rhinopora venosa, the vein-like portion of which is black, and not unfrequently mistaken for a Graptolite when the rest of the Bryozoon presents a very faint impression on the surface of the Chert. It seems difficult to account satisfactorily for this singularly exceptional instance. A few other fossils, as far as the writer knows, yet undermined, were discovered in an Indian corn field south of the corporation drain, close to the McVittie farm. One of the specimens is circular in shape, and very likely belongs to the class of Bryozoons figured and described by the late Dr. Jas. Hall, of Albany, under the head Ceramopora Bernicea, in a Geological report of the New York State Survey.

NIAGARA SPONGES AND GRAPTOLITES.

Previous to the late collecting season the writer had little expectation of ever again contributing except by chance anything on the chief Silurian organic remains that would attract palæozoic attention to what my old friend, our President, A. T. Neill, has truly designated as a favored locality, the claim he expressed can hardly be disputed.

Long before the Hamilton Museum was re-established, on what we hoped to be a more permanent basis, prior even to the more important discoveries of Niagara Graptolites, fossil sponges and Bryozoons, which are now attracting considerable attention outside the Dominion, the late Rev. Professor Wright and others noticed the numerous Clinton organic remains which they were collecting from the States being removed in order to expose for building and ornamental purposes the Medina freestone bed rocks. These are no longer quarried here owing to the thickness of the overlying soil, the removal of which entails too much expense. We know unfortunately that such favorable conditions are unlikely to occur here ever again. This is more to be regretted since it appears impossible to replace many rare and a few undescribed (Clinton fossils) which your "Ex Curator" vainly sought for in the new cases. Even while we feel the absolute impossibility of making the City Museum what was intended, viz., a place to attract attention to one of the richest centres ever discovered for middle Silurian organisms on this American continent, when the writer expressed the opinion published in the proceedings of the Hamilton Scientific Association that no country as far as he could see, could ever hope to compete with Ontario in certain classes of Silurian fossils, he emphatically declares it was no idle boast put forth on behalf of the section. He knew he possessed then a very extensive collection of *Graptolites*, *Sponges*, *Bryozoons*, retained in his own possession until such time as additional room might be furnished and a few more cases provided. However much the President and members of the Section may regret their transference to other places where such things are appreciated, the loss is that of Hamilton itself, and not to our Section of the Association, since a wider field is open to investigation by many who little expected to find in an almost unknown locality, Silurian Sedimentary deposits far richer than the closest investigation revealed to the many trained professionals in Europe. Is not this circumstance no slight compensation to this Geological Section? It seems quite unnecessary to call attention to the numerous communications received regarding the extinct living creatures and plants, which lived and flourished in the old seas; millions of years before man himself appeared or even the uplifted sea beds, the rich vegetation which produced the coal measures of the after time.

The City Quarry, lately acquired at the head of what is known as "The Strongman Road," presenting mere surface soil with no glacial clay, acting as a preservative to the organic remains underneath assuredly lead to the conclusion that we had there fossiliferous beds, if such ever existed; that water penetrating from above utterly destroyed such organisms in the weathered layers themselves perhaps may be accepted. Yet I hardly think that a sufficient reason for finding so very few fossils where their existance was expected, while the writer suggested this may be owing to the deposit of a larger amount of mineral matter, earthy manganese oxide, which undoubtedly is found there in greater quantities than in any of the quarries opened up towards the east. Still it must be admitted that the few Graptolites found were confined to a part of the quarry where the beds were less decayed and least weathered. On returning recently from collecting Byrozoon, I noticed a shot had been fired after I passed in the morning. On investigating the result, I perceived a thin layer which rests on the building beds, which often holds a Fucoid. On turning it over I was surprised to find, not what was expected, but a fine Graptolite, the only one I ever found in the bed in question. Mr. Nichol has since discovered a different species in a decayed upper Chert bed. My old friend and fellow worker also placed in my hands a coral which was obtained from the base of " the blue building series, known here as "*the sand beds*" erroneously. It may be identical with the specimen now in Mr. Scriven's hands, from the glaciated Chert beds. Its flattened appearance is owing to pressure. An unworked quarry of these Niagaras has been reopened in the old Hancock quarry recently, and has already yielded a fine Graptolite.

Remonstrance Respectfully Submitted to the Council, with Additional Notes.

Read Before the Hamilton Scientific Association, March 22nd, 1907.

BY COL. C. C. GRANT.

In the Proceedings of the Hamilton Scientific Association recently published, we find it stated that it was intended to prepare a catalogue of the contents of "the City Museum." On the part of the Geological Section, I beg most respectfully to submit that such a proceeding would be exceedingly premature. We claim that the Silurian organic remains discovered here are not only incomplete in the cases as yet, but the greater part of recent acquisitions are more or less unknown and as yet undescribed. Even the Niagara Graptolites, to which Dr. Spencer first called attention (now in the Redpath Museum at Montreal), have only been replaced in a few instances, and several others in our upright cases are still undescribed and unnamed.

Although we have heard that the large collection of Graptolites from our local rock in the Smithsonian Institute was to be handed over to New York State for description, a long period may elapse before we learn anything regarding them.

Independent of that collection, more recently the Council of our Scientific Association figured in our Proceedings, yearly, a considerable number of Hydrozoæ, all probably new to science, and, as strangers remarked, unusually well preserved. None of the specimens in question are named, although the Genera, to which they belong, was mentioned (erroneously in one instance), for the figure represented, as a small *Dendrograptus* displayed the connecting bars in the branches characteristic of a different form, *Dictyonema*. In this case it appears to your collector that the mistake in nomenclature originated, perhaps, as much from impaired vision as carelessness on his part. It certainly seems unexcusable when previously he pointed out the distinguishing marks of the family itself, which stared him in the face when represented in our Proceedings. Absolute accuracy is very properly required by all Geologists where matters are submitted for investigation, and here we must regret the deficiency. No doubt the mistake can easily be rectified by any Palæontologist who takes an interest in our local Niagara Graptolites.

Again it may be necessary to remind the Council of the Association that the Geological Section recently heard from Ottawa that the collection of *Bryozoons* from Hamilton and Grimsby had been forwarded to Dr. Brasler at the Smithsonian Institute at Washington—a scientist who has made a particular study of these early and neglected Silurian fossil organic remains. The names given to new species, if such have been recognized, are to us as yet quite unknown. Dr. Jas. Hall's Genera *Lichenalia* undoubtedly presents a larger number of Chert species than was ever supposed to be obtainable on this continent. When the Bryozoons were submitted to the Smithsonian expert, Professor Brasler, for examination, a considerable number of the class in question were discovered. Some differ, at least in shape or form, from others previously obtained. Professional Palæontologists who make a particular study of these little-known Silurian organic remains, are, as far as I can see, most competent to name and describe the various specimens displayed in our local rocks of the district.

In a recent paper I alluded to the extraordinary number of fossils discovered in the Niagara glaciated Chert beds of Dr. Jas. Hall's *Cladopora*. Dr. Spencer recognized a single specimen rightly attributed to a similar one occurring in the United States. The recent discoveries here were quite unknown then to either Dr. Jas. Hall or Dr. Spencer. If a difference in mere outward forms, or even in internal ones, more rarely noticed, pointed to distinct species, we have here in our local glaciated Niagara Chert beds such a number of these ancient Silurian organic remains that they well may attract scientific investigation outside their restricted locality. While the writer has not the slightest claim to be recognized as a Palæontologist, he may be excused for ignorantly supposing that these *varieties* are frequently classified as *distinct species.* This view may be considered quite erroneous, but I would respectfully call attention to what I find recorded recently in the address of the retiring President of the British Association for the advancement of science, Professor E. Ray Lankester, Director of the Natural History Department of the British Museum :

"The observation of '*de Vries*,' showing that in cultivated varieties of plants a new form will sometimes assert itself suddenly and attain a certain period of dominance, though not having been gradually brought into existence by a slow process of selection, have been considered by him and by a good many other naturalists as indicating the way in which new species arise introduced in Nature. The suggestion is a valuable one, if not very novel, but a great deal of observation will have to be made before it can be admitted as really having a wide bearing upon *the origin of species*. The same is true of those interesting observations which were first made by 'Mendel,' and have been resuscitated and extended with great labor and ingenuity by recent workers, especially in this country by Bateson and his pupils."

Whatever may be stated either for or against the theory in question, regarding *variety* or *distinct species*, may be left to the most competent men for an ultimate decision, the Professional Palæontologists. Years may elapse before any satisfactory decision is reached on the subject. In the meantime it is absolutely necessary to recognize what Scientific Geologists in all civilized countries have established, the recognition of what is known as "family species." Assuredly any catalogue which would merely substitute known "Genera" for utterly unknown "species" or variety, would be looked upon everywhere as an eggregious mistake. As far as the City Museum is concerned, we may be permitted to remark, it certainly attracted more attention to this favored Niagara locality than even the most sanguine of the few members of the Geological Section could ever have expected. But fossils which hereafter the Dominion may find impossible to obtain, we are compelled to send away to places where such things undoubtedly are more appreciated. To include in the intended catalogue the few well known specimens common to Europe and the United States, while omitting all supposed new or rare ones now undergoing investigation by Professional Palæontologists, can hardly be seriously entertained and could lead to very great disappointment. Undoubtedly our Section must consider it is at present uncalled for and premature.

During the past Collecting Season (Spring, Summer and Autumn inclusive) the Geological Section of this Association forwarded to *the British Museum*, in the old country, upwards of 90 specimens from this favored locality alone, independent of many more furnished to *the Dominion Survey* at Ottawa and elsewhere. We are not in a position to claim more than some at least may prove to be new to Science, and we may well hesitate to accept the designated idea that any contemplated catalogue will be final, which necessarily must omit every recent acquisition our Section has brought to the notice of the most competent men in Canada, the United States and Europe. Such a catalogue as that may well prove disappointing, not only to our Section of the Association, but it would convey to others a false idea regarding a matter we wish to establish, the long neglected Chert and little known fossil, "*Fauna*" and "*Flora*," of the Niagara District. I feel satisfied the proceeding on the part of the Council would be ill-advised, certainly under present conditions, where probably three-fourths of our local specimens are yet unnamed. I am not aware that the oldest Section of the Hamilton Scientific Association (the Botanical) ever expressed any desire to furnish to the public at the present time what perhaps it may look upon as still incomplete, the very interesting "Flora" it certainly possesses of this neighborhood. That Section may entertain as valid objections as our own. The intended publication may well be postponed to a future time. To carry out such an intention at present would assuredly be looked upon as a serious mistake on the part of our Association.

I received the following comment from a letter contributed to a published paper furnished to this enlightened Ontario, not more remarkable for its adhesion to the olden Theological views of a few centuries ago, than for the marked unwillingness it displays to accept any knowledge by more recent Scientific study. The statements contained in the paper received may be accepted as the views of many individuals utterly opposed to Scientific pursuits which do not exactly agree with what they early learn. By all means let the writer express his views however opposed to more modern investigation, that appears to me the sole means we possess in combatting with that dense ignorance prevailing in Ontario, regarding matters long since recognized as finally settled in other civilized countries. "As regards the discredited theories that never had a particle of solid proof," remarks the writer, (pray note what follows): "Even if they were based on well-ascertained facts and sound inductive reason, they should not be taught in our schools, *inasmuch as they are opposed to the religious beliefs of the majority of the Canadian people affiliated with the Orthodox Churches.*" What an admission, if the gentleman truly represents their views—truth is not what they require. Between the true and false we recognize no distinction.

I have recently received the address of Dr. E. Ray Lankester to the British Association for the Advancement of Science, as President, the following extract shows how utterly mistaken a member of one of the Orthodox Churches is in asserting that *Evolution* has been discarded by leading Scientists. "In the field of Geological research, the main feature in the past twenty-five years has been the increasing acceptance of '*the Evolutionary*' as contrasted with the uniformitarian view of Geological phenomena."

Apparently no objection was made to this remark by the Director of "the Natural History Department" of the British Museum. I do not know exactly what views are held by our distinguished townsman, Professor Johnson, the Astronomer, or whether he would be inclined to concur in denouncing "*the Nebular theory*" as Atheistical. Whether they agree or not, perhaps we may hold their respective opinions of equal value.

Dr. Lankester's Paper was the increase of knowledge in the several branches of Science during the past twenty-five years. He alludes to the astounding properties of the New Chemical Elements discovered, of radio-activity and radium, of the five inert gaseous elements of Rayleigh and Ramsay, helium of Lockyer, X rays and Becquerel's discoveries in France, of the Curies and the loss Science sustained by the tragic death of the great Chemist, referring also to Professor Rutherford, Montreal. He points out the great revival in the oldest Science, Astronomy, since 1881, and Photography is credited with the expansion.

In Geology he states the oldest fossiliferous rocks known to us are still far from the beginning of life. The boring by Sollas, in Australia, of a coral reef 1114½ feet. The recognition of Graptolites as indices of horizons in Palæozoic beds. The ape-like skull found in Java in gravel of great age, he pronounces to be human. That the limbs of Vertebrates are correctly derived by Thatcher, Mivart and Balfour in the lateral fins of fish-like ancestors. In Botany the distinction between Phanerogams and Cryptogams was broken down.

Report of the Astronomical Society For 1906-07.

The Astronomical Section of the Scientific Association began its sixth year with very favorable prospects. Organization was begun early in the fall and a good program for the first half year was arranged and successfully carried out.

In December the Society was very unfortunate in losing its President, Rev. Dr. Marsh, who had held that position since its organization in 1901. Apart from the set-back the Society received in losing so energetic a member, the loss was more deeply felt coming as it did at such inopportune time, being in the middle of the season and too late to re organize for effective work for the balance of the year.

Consequently we have to report the holding of only seven meetings during this year, but otherwise, in respect to paid membership and finances, we are in splendid shape. The total number of members is sixty-four, and the cash balance, as shown by the Treasurer's Report, is $59.38.

The regular meetings held were as follows :

Oct. 19th, 1906—"Astronomy. Its Uses." Led by the President. General discussion.

Nov. 2nd, 1906—"Reading the Sky From Northern Ontario." G. Parry Jenkins, F.R.A.S.

Oct. 16th, 1906—"The Stars." Prof. N. F. Dupins, M.A., F.B.S., Professor of Mathematics, Queen's University, Kingston.

Dec. 7th, 1906—"Exploring the Solar Atmosphere." Illustrated. Prof. C. A. Chant, M.A., Ph.D., Toronto University.

Dec. 14th, 1906—"Notes on the Gyroscope." E. H. Darling, Associate Member Canadian Society Civil Engineers.

Jan. 10th, 1907—"Measuring Star Distances." G. Parry Jenkins, F.R.A.S.

May 28th, 1907—Annual Meeting.

At a special meeting held on Nov. 19th, 1906, an address was presented to Dr. Marsh upon his leaving Hamilton. The address was accompanied with a purse of gold.

At the meeting of December 7th, Dr. Marsh was finally elected an honorary member of the Society.

We have to regret that we have not accomplished more this last year, still it is to be hoped that with re-organization we will be able to make a better showing next year, carrying on the work so well begun. And if we do not reach the high standard of former years, we may still be able to keep alive the interests in Astronomical subjects which has been aroused, and carry out the object of our organization as stated in our Charter—"to study and popularize the study of Astronomy and Physics."

E. H. DARLING,

May 28th, 1907. *Secretary.*

Report of Camera Section.

SECRETARY'S REPORT.

The work of this Section, during the past year, has been done quietly and been the means of awakening the few active members to the necessity of doing something to increase their number, and already things are booming on lines to compare favorably with the growth of our city.

Since our Annual Section Meeting in April, we have secured new quarters, and hope at an early date to invite all interested in Photography to inspect these rooms, when there will be such a rush of applications for membership that a limit will have to be fixed upon.

While we have rented new quarters apart from the Association, we still retain our connection with the parent body in so far as paying the proportion of fees as before and using the Museum when desired for our meetings, but we trust the Association will continue in return to allow us the same proportion of rent, etc., as heretofore.

We propose, with the consent of the Association, to form a Junior Branch of our Camera Club for members under 17 years of age, at a reduced fee, but not to include such as members of the Association, and therefore not pay the Association Fee for these members.

Apart from the foregoing, the most important part of the past session was our Print Exhibition opened on the night of the Association Opening Meeting, which was a great success in numbers, quality of work, and the number of visitors who viewed the Exhibition during the three days it was open to the public.

During the Session we had some most interesting lectures and demonstrations of a Photographic nature, and for these we are indebted to Messrs. A. G. Alexander, Jas. Gadsby, W. E. Hill and J. M. Williams.

We did not enter the American Lantern Slide Interchange, as being the only Canadian Club in the previous year the duty and express charges were a heavy drain on our limited funds, but we had some Lantern Exhibitions of members' work, and are anxious, if possible, to organize a Canadian Interchange.

The same Officers were re-elected for the coming year, and are as follows:

President—Wm. Acheson, First Vice-President—Chas. C. Herald, Second Vice-President—Mrs. R. Campbell, Secretary—Sinclair G. Richardson, Treasurer—George Lees,	Members of Executive.
James Gadsby, A. H. Baker, Miss Dixon, Walter E. Hill,	Advisory Committee.

SINCLAIR G. RICHARDSON,
Secretary.

Trader's Bank Building,
May 14th, 1907.

Curator's Report.

SEASON 1906-07.

To the President and Council of the Hamilton Scientific Association :

GENTLEMEN :

I beg to report that we have made good progress in the re-arranging, sorting and naming specimens, and cleaning and storing curios. We have received a Cabinet and Catalogues of Canadian Minerals from the Department at Ottawa. For much of the above work we are indebted to G. Parry Jenkins, our corresponding secretary, who, in the case of the Cabinet of Minerals, was aided by Mr. Adam Zimmerman, M.P., who promptly followed up Mr. Jenkin's request by visiting the Department, and we also mention that our request for the Cabinet was very courteously and promptly treated by the Department.

J. M. WILLIAMS,
Curator.

Hamilton Scientific Association.

Treasurer's Statement for Year 1906-07.

RECEIPTS

Balance from 1906	$ 29 89
Government Grant	400 00
Members' Fees (general)	40 00
Members' Fees (Astronomical Section)	58 00
Members' Fees (Photographic Section)	50 00
Special Collections, re show cases	174 00
Horticultural Society (rent)	15 00
	$766 89

DISBURSEMENTS

Rent of Museum	$130 00
Rent of Dark Room	18 00
Caretaker and cleaning	69 75
Printing Annual Report (balance)	90 00
Printing Annual Report	214 00
Printing and Engraving	41 87
Postage and Stationery	39 93
Lectures	4 05
Insurance	16 00
Gas Account	9 80
Sundry Accounts	41 46
Camera Section, expenses	25 00
	$699 86
Balance on Hand	67 03
	$766 89

P. L. SCRIVEN, Treasurer.

Audited and found corresct.

E. H. DARLING,

May 15, 1907. Auditors.

LIST OF EXCHANGES

I.—AMERICA.

(1) Canada.

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

(2) United States.

Kansas Academy of Science...............Topeka, Kan.
Kansas University Quarterly.............Lawrence, Kan.

American Academy of Arts and Sciences....Boston, Mass.
Psyche................................Cambridge, Mass.
Library of Oberlin College................Oberlin, Ohio.
American Assoc. for the Advancement of Science
.....................................Salem, Mass.
Museum of Comparative Zoology........Cambridge, Mass.
American Dialect Society...............Cambridge, Mass.
United States Department of Agriculture..Washington, D.C.
Biological Society of Washington.......Washington, D.C.
Philosophical Society of Washington ....Washington, D.C.
Smithsonian Institute..................Washington, D.C.
United States Geological Survey........Washington, D.C.
American Society of Microscopists..........Buffalo, N.Y.
Buffalo Society of Natural Sciences..........Buffalo, N.Y.
California Academy of Sciences .... San Francisco, Cal.
California State Geological Society ....San Francisco, Cal.
Santa Barbara Society of Natural History.San Francisco, Cal.
University of California.....................Berkley, Cal.
Minnesota Academy of Natural Sciences..Minneapolis, Minn.
Academy Natural Sciences............Philadelphia, Pa.
Academy of Sciences.....................St. Louis, Mo.
Missouri Botanical Gardens...............St. Louis, Mo.
American Chemical Society..............New York City
New York Microscopical Society...........New York City
The Linnean Society.....................New York City
American Astronomical Society...........New York City
American Geographical Society............New York City
New York Academy of Science...........New York City
Terry Botanical Club.....................New York City
Central Park Menagerie..................New York City
American Museum of Natural History.....New York City
Scientific Alliance.......................New York City
Cornell Natural History Society.............Ithaca, N.Y.
Johns Hopkins University.................Baltimore, Md.
Kansas City Scientist..................Kansas City, Mo.
Wisconsin Academy of Science, Arts and
Letters..............................Madison, Wis.

Soc. of Alaskan Natural History and Ethnology ....Sitka, Alaska
University of Penn....Philadelphia, Pa.
Franklin Institute....Philadelphia, Pa.
Brooklyn Institute of Arts and Science....Brooklyn, N.Y.
War Department....Washington
Field Columbian Museum....Chicago
Academy of Sciences....Chicago
Agricultural College....Lansing, Mich.
Colorado Scientific Society....Denver, Col.
Museum of Natural History....Albany, N.Y.
State Geologist....Albany, N.Y.
Rochester Academy of Sciences....Indianapolis, Ind.
Indiana Academy of Sciences....Indianapolis, Ind.
Davenport Academy of Natural Sciences.. .Davenport, Iowa
Pasadena Academy of Sciences....Pasadena, Cal.
U.S. Board of Geographic Names....Washington, D.C.
Lloyd Library....Cincinnati, O.
Colorado College....Colorado Springs

(3) West Indies.

Institute of Jamaica....Kingston, Jamaica

(4) South America.

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

II.—EUROPE.

(1) Great Britain and Ireland.

England.

British Naturalists' Club.... Bristol
Literary and Philosophic Society of Leeds....Leeds
Conchological Society....Manchester
Royal Society....London
Royal Colonial Institue....London
Society of Science, Literature and Art....London
Geological Society....London

Manchester Geological Society................Manchester
Mining Association and Institute of Cornwall.....Camborne
Cardiff Photographic Society......................Cardiff
Owens College Conchological Society..........Manchester

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Glasgow Geographical Society...................Glasgow
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(3) Belgium.

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Academie des Nationale Science, Art et Belles
Lettres.....................................Dijon
Societe Geologique du Nord.........................Lille
Societe Geologique du France.......................Paris

(6) Germany.

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

(7) Russia.

Comite Geologique..........................St. Petersburg
Russich-Kaiserliche Mineralogische Gesellschaft
....St. Petersburg

III.—ASIA.

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Asiatic Societies of Bombay and Ceylon..........
Asiatic Society of Bengal........................Calcutta
Geological Survey of India..... ....Calcutta

(2) Straits Settlements.

The Straits Branch of the Royal Asiatic Society...Singapore

(3) Japan.

Asiatic Society of Japan...........................Tokio

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South African Philosophical Society.............Capetown

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

(2) New Zealand.

New Zealand Institute..........................Wellington

(3) Tasmania.

Royal Society of Tasmania.................. ..Hobartown

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