



# PROCEEDINGS

... OF ...

# The Canadian Institute.

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NEW SERIES.

Volume I.

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## ERRATA.

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Page 5, line 18, for "Macaites," read "Macaizes."

Page 6, line 36, for "Antoeus," read "Antaeus."

Page 6, line 37, for "capturing," read "attacking."

Same line, for "who became the willing slave of their Queen," read "that willing slave of Queen Omphale."

Page 6, line 40, for "Cassiopea," read "Cassiopeia."

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EXTRACT FROM THE ANNUAL ADDRESS OF THE PRESIDENT, A. B. MACALLUM,  
M.B., PH.D.

(Delivered November 7th, 1896.)

The success which the Council has achieved during the past session in the management of the Canadian Institute has enabled the Editing Committee to formulate an improved method of publication, a method which is more in accord with the present requirements of Science. In the past our volumes of "Transactions" appeared at irregular intervals, and in some cases very long after the papers published in them had been read before the Institute. Speedy publication for scientific papers of value is a great desideratum. No investigator relishes the prospect of having his results held over for an inconveniently long time, with the chance that when they are published they may be out of touch with the literature of the subject appearing between the date of presentation and that of publication. In this case, also, he must face the risk of his results being anticipated by another worker in the same field. He, therefore, looks for speedy publication of his papers, immediately they are completed, and those means are sought which offer this advantage.

In consequence of these considerations, and desiring to attract scientific papers of merit to the Institute, the Editing Committee has decided to change the present mode of publication. It will not affect the "Transactions," which will be published as heretofore, but at the end of the Session, and containing only carefully selected papers worthy of publication in extenso. The point of departure is in the institution of "Proceedings," one number of which is to appear every two months during the session, and each will contain the short papers, and the abstracts of others read before the Institute in the preceding interval. This will ensure speedy publication, and at the same time put a premium upon brevity, while it will enable the Editing Committee to exercise greater freedom in the choice of papers for the volume of the "Transactions." If the Institute is to maintain its large list of Exchanges, it must strive for a high standard in the papers which it publishes. Having had in the past but one mode of publication, it was natural that the Editing Committee should have difficulties to contend with. Papers which contained matter of interest, from a scientific, historical, or other point of view, but were of inordinate length, were frequently offered for publication. These had to be accepted outright or rejected summarily. There was no middle course. With the plan now adopted, the Editing Committee can offer, for very short papers of value, such an opportunity for speedy publication as will considerably offset the sacrifices made for brevity. I trust that the men of science in the Dominion will avail themselves of the advantages now offered, and that the new venture will be a success.

## RARE BIRDS TAKEN AT TORONTO. BY JOHN MAUGHAN, JR., ESQ.

(Read April 13, 1895).

Great Black-Backed Gull (*Larus Marinus*). Locality, 8 miles out from Toronto, Island in Lake Ontario. Date, 8th February, 1894. Measurements: spread 5 ft. 9½ ins., wing 2 ft. 7 ins., length 2 ft. 6 ins., leg 11 ins., tarsus 3¼ ins., tail 8½ ins., bill 2½ ins., bill, from gape, 4¼ ins., middle toe 3¼ ins. Sex ♂.

Peregrine Falcon or Duck Hawk (*Falco Peregrinus Anatum*). Locality, Toronto Marsh, Ashbridge's Bay. Date, 25th June, 1894. Measurements: length 19½ ins., tail 7½ ins., wing 19½ ins., spread 44¼ ins., tarsus 2 ins., middle toe 2¼ ins., bill 1 in., gape 1½ ins. Sex ♂.

Remarks.—Plumage very light ashy, feathers very much battered and bare.

Marsh Hawk (*Circus Hudsonicus*). Locality, Toronto Marsh, Ashbridge's Bay. Date, 20th May, 1894, and 2nd April, 1895. Measurements: length 18½ ins., wing 20 ins., spread 3 ft. 6 ins., bill 1 in., gape 1¼ ins., leg 10½ ins., tarsus 2¼ ins., middle toe 1¾ ins., tail 8½ ins. Sex ♂ and ♂.

Remarks.—Both these hawks are noted for their being old males in the "Blue Plumage." Colour: very light bluish ash, with pure white under wings and upper and under tail coverts. Measurements are practically identical.

Razor-Billed Auk (*Alca Torda*). Locality, Hamilton Bay, Ont. Date, 9th December, 1893. Measurements: spread 27½ ins., tail 3½ ins., wing 12 ins. Sex ♂.

Remarks.—This species is undoubtedly very rare here, as records of only two have been noted before this one. No doubt it came along with the Guillemots that were taken in such numbers at different points during the winters of 1893, 1894 and 1895.

Red Phalarope (*Crymophilus Fulicarius*). Locality, Toronto Island (east end). Date, 6th October, 1894. Measurements: bill 1 in., spread 15 ins., wing 6½ ins., tail 2 ins., leg 3 ins., tarsus 15-16 in., middle toe 15-16 in. Sex ♂.

Leash or Yellow Rail (*Porzana Noveboracensis*). Locality, Centre Island, Toronto. Date, 6th October, 1894. Measurements: length 6½ ins., spread 10½ ins., wing 4¾ ins., leg 3¾ ins., tarsus ¾ in., tail 7-16 in. Sex ♂.

Purple Sandpiper (*Tringa Maritima*). Locality, Toronto Island (east end). Date, 27th October, 1894. Measurements: length 9 ins., tail 2 ins., wing 7¾ ins., spread 15¾ ins., bill 1¼ ins., leg 3½ ins., tarsus ¾ in., middle toe 1 in. Sex ♂.



THE DWARF DOMESTIC ANIMALS OF PYGMIES. BY R. G. HALIBURTON,  
Q.C., F.R.G.S.

(Read November 14, 1896.)

For years I have enjoyed the honour of being a corresponding member of the Institute, but up to the present I have contributed nothing to its Transactions. If I have not shared the fate of the proverbial "unproductive fig tree," it is due to the forbearance of the Institute, and their charitable hope that, if spared by them, I might do better in future.

It is, therefore, with great pleasure that I offer my first instalment, a paper of interest, not on account of the way it is dealt with, but because it opens up for the first time an untrodden field of science that is likely, in proper hands, to yield important results. Whatever will hereafter account for the diminutive size of the domestic animals of pygmies will also explain the origin of the dwarf races of men; and, possibly, this may be true vice versa.

Before dealing with these little animals I must explain that, when my paper on "Dwarfs and Dwarf Worship" was read at the Congress of Orientalists at London, 1891, the subject of pygmy races was considered to belong rather to myths and marvels than to science. A quarter of a century ago Schweinfurth revealed the then incredible fact of the existence of little tribes of hunters and warriors, not much exceeding four feet high, and dwelling near the great lakes of equatorial Africa. At first he was discredited and ridiculed; but Stanley and others have since that more than confirmed his statements. But to reluctantly admit that this was the case in that remote region was the limit of endurance of incredulous scientists. When, therefore, I openly claimed that the very same race of dwarfs were to be found in the Great and the Saharan Atlas, some of them only a few hundred miles from the Mediterranean, there was a howl of indignant incredulity. My paper, which created an unexpected amount of public interest in London; and was reported in full in *The Times*, was denounced by it, *The Standard* and other papers in abusive and personal editorial critiques rarely seen in the press. I was called a Munchausen, and an inventor of Gulliver narratives; my Moorish servant and I must have been in league with the sixty or seventy natives who had testified to impose pygmies on the simplicity of the scientific world.

As the Congress had awarded a medal to me, I withdrew a reply which I had sent to *The Times*, and made up my mind that to republish these articles in four or five years' time, by the light of the discoveries that would be made, would be the most bitter reply that could be devised.

In my paper it was suggested that in early ages these Atlas dwarfs must have found their way to Europe, and that they still survive there in popular tradition as fairies and dwarf smiths with magic powers; and that dwarf tribes were also the subject of very similar traditions in the West Indies and America.

After that it was discovered and shown by me that there are dwarf survivals in the Pyrenees, and also in America.

One of my most persistent critics was among my friends, called "fascinating subject," as this was a pet term of his. Judge my dismay in June last, on reading in an article on "Pygmy Races," the following ominous sentence, with which it begins. "Professor Starr's article on 'Pygmy Races of Men' in *The North American Review* contains much interesting information regarding a curious and fascinating subject." To my relief I found that he admitted most fully all my contentions. The existence of dwarf tribes in the Atlas, similar to the Akkas of

Equatorial Africa, "had been demonstrated"; that there are diminutive Nanos in the Pyrenees was also admitted; and also that strong evidence had been adduced as to the existence of dwarf survivals in America. I could hardly believe that the writer was my old friend but for a significant omission. He fully accepted my discoveries, but forgot to mention my name in connection with them. Still, to have converted him to that extent was eminently satisfactory.

He concludes with some very sensible remarks, which are especially interesting in connection with an even still more fascinating subject, "The Dwarf Domestic Animals of Pygmies." "It is evident that the existence of pygmy races has passed out of the region of myth and fable into that of history and science. Our information regarding these strange races is still incomplete and inexact, but it is being steadily augmented and brought in line with accepted results in biology and anthropology. The facts already adduced suggest many interesting reflections, but perhaps raise more problems than they solve. It seems clearly impossible (?) to regard the pygmy races as owning a common origin, although their tendency to conform to a single fairly well-defined type is very curious.

"Is their case one of degeneration, owing to some special circumstances of climate and environment, or do they represent a remnant still remaining in a stage of development long since left behind by the rest of the human species? We cannot say with certainty, but such questions may yet become capable of solution, when our information on the subject has become more extensive and exact."

In 1890, when I visited Morocco to look into the subject of racial dwarfs there, one of my first informants as to their small animals was a halfbreed dwarf at Tangier, about four feet high, who is to be seen in the Soko, or market place there. In my "Dwarfs of Mount Atlas" (p. 25), we find him say, "the dwarfs are very brave, and great hunters of ostriches, having small, swift horses, that are called by a name, meaning 'those that drink the wind,' and that are fed on dates and camels' milk, and are very lean, and, judged by their looks, would be set down as worthless. This description of these ostrich hunters agreed with that given me by my Berber servant in 1888." A Rabbi from Ternata, on the Dra, also said (see p. 29), "There are many of them (the dwarfs) near the Soudan. The Arabs fear them, and pay to be allowed to pass through their country. Their horses can do without water for four days, and are called dwiminagh ('they that drink the wind')."

There is a place called Adwarfi, two or three days to the south-east of Taflet, which is a great resort of the dwarfs, and a part of the Saharan Atlas, in that region (I assume), is called the Black Mountains, where is the River Dora, and where there are many caves, in which the dwarfs live with their cattle. They have an Arabic name, meaning "the people that own cattle." A little Ait Atta from near Adwarfi, and also afterwards a Jew from that region, described the dwarfs there as living in hillocks, in which there are very small entrances, leading to a central chamber, into which, at night, they drive their cattle, which are very small. Mr. MacRitchie, in his "Testimony of Tradition," speaks of the "weems" of Scotland, which are precisely similar structures to the hillocks of the Sahara; and in one of them, he says, in its central chamber, were found the bones of a small ox.

In 1893 Mr. Carlo Bruzeau, of the Villa de France Hotel at Tangier, told me that twenty years ago, during a time of famine, he "saw a man bringing into Mogador for sale, a string of shaggy ponies. When asked whence they came, the Moor replied, 'from the mountains (the Saharan Atlas); there, horses, sheep, goats, cows, men, all are very small.'"

In the same year the dwarf tribe that inhabits the Great Atlas, not much more than a day's journey from the city of Morocco, were described to me as owning little sheep, donkeys, goats, and cows; and a Moor offered to bring some to Mogador, should I wish to buy some of them.

The Barbary donkey is well known, a pretty tiny specimen of the breed, generally black, and very active and strong for its size.

Nearly always, wherever pygmy tribes exist, or must have once existed, we find very small domestic animals. Bent, in his "Mashonaland," says that they are very diminutive throughout South Africa. This even extends to the poultry. A hen's egg there is hardly larger than a pigeon's egg.

This is also the case in Europe. Wherever there are survivals or very distinct traditions of early dwarf races, there we invariably find small breeds of domestic animals. In Brittany we not only have occasional survivals of very small people, but also very diminutive cows and ponies. In *Shetland and the Hebrides* we have very conclusive traditions as to dwarfs, and there, too, we find little Shetland ponies, small, "black-faced sheep," etc. In Wales, too, with its undersized, dark-complexioned people, we meet with little Welsh sheep and cows. In the same way in Kerry, where the tales of the Skillimilinks, and "the little red-headed blacks" are to be met with, there we have the same types of animals. The little Kerry cows are famed for their good qualities. In Galloway, too, in Southwestern Scotland, where history tells us of the warlike, small-sized Pechts, who claimed the right to lead the van in armies, we find the well-known ponies called "Galloways," as well as small cows.

The popular belief of the herdsmen and cheesemakers (Macaites) of the Vosges Mountains, not only that there are pygmy herdsmen there, who dwell in caves in the precipitous cliffs of that region, but also that these dwarfs have dwarf cattle, is most interesting. On this point I may quote the following passages from my paper on "Dwarf Survivals and Traditions as to Pygmy Races" (see Proceedings of the American Association for the Advancement of Science, Vol. XLIV., 1895):

"Thirteen years ago my attention was attracted by the name of some cliff dwellers in Abyssinia, which Jean Temporal, in his translation of an early Portuguese book on that country, calls 'Vosges.' As I had, in 1863, suggested (see Haliburton, *New Materials for the History of Man* (1863), pp. 14, 23, and note, 41, 74) that there must have been a migration from Africa to Europe in early ages, I made a note of these facts, intending some day to inquire whether there are not traces of cliff dwellings, or cliff dwellers, in the mountainous country of Alsace, 'the Vosges.' In 1892, as Admiral Blomfield Pasha, of Alexandria, and Mrs. Blomfield, were about to spend six weeks in the Vosges, I asked them to look into the question. In a few weeks I received a local guide-book, which more than bore out my anticipations. In the *Guide Joanne*, Geradmer (Paris, Libr. Hachette & Cie, p. 26), we are told that La Schaume, of Nisheim, which surrounds Wurtzelstein, it is believed, is inhabited by a kindly-disposed race of dwarfs, who, when the herdsmen descend to the lower valleys with their herds in the autumn, pasture their cattle, which are of very small size, in the upper pastures, and make cheese till the spring. Among different authorities cited is *The Foyer Alsacien*, by Chas. Grad." "In 1893 (i. e., after I had heard from Blomfield Pasha), I learned in Morocco that, two days south of the Great Atlas, there is a high mountain called Voshe, the inhabitants of which are dwarf cave-dwellers, who are called Ait Voshe (the Voshe Tribe). Professor Schlichter says that the Akka dwarfs of Equatorial Africa are known to their neighbors as Voshu, and also Tiki-Tiki, names connected with the Akka dwarfs of Southern Morocco, who are also called Jed-ibwa 'the Fathers of our Fathers')." "

The range of the name for dwarfs, Tiki, or Tiki-Tiki, is almost world-wide. Of the 49 primordial dwarfs, whose creation preceded that of the human race, according to Voluspa of the Icelanders, one was called Nain, and another Theckr. In Germany we meet with the name Tuecke-Kobbold, and in Polynesia with Tiki-Tiki, the name of the dwarf Creator, and in Peru the Creator was called Tici Ccapac.

When the Akka, or Tiki-Tiki of Equatorial Africa wandered north to Europe, they must have brought their diminutive cattle with them, for in Baker's "Albert

Nyanza" (1866, p. 91), a region where the widespread Akka, or Voshu, are to be found, we are told that "the cattle there are very small. The goats and sheep are quite Liliputian."

In Ceylon, the original inhabitants of which are the diminutive Veddahs (called often "Devil-dancers"), there is a very diminutive breed of sacred oxen, for their small size is put down to some wonderful myth about Buddha. These oxen are very nimble-footed, and are used in carriages by the natives, as they can easily travel eight miles an hour.

A friend of mine told me recently that in a part of Bengal where he lives, there is a very diminutive breed of oxen, which are very swift; and it is considered by the rich Hindoos the correct thing to have a carriage drawn by six or eight of them.

But all this was known to the ancients over 2,000 years ago. Ctesias, a physician of Artaxerxes, who travelled in Asia, and described the pygmy race that he there saw, says that they owned diminutive flocks, sheep the size of a lamb, small donkeys and oxen, and horses and mules not larger than a ram is in Greece. (See Ctesiae fragmenta, No. 57, 11, Didot).

Aristotle states that the pygmies live near the lakes from which the Nile flows, "and this is no fable, for there is really, it is said, a race of dwarfs, both men and horses, which lead the life of Troglodytes." (See Hist. Animal, VIII. 2).

Strabo, who was a sceptic as to the pygmies, though he described small races of men, says of the Western Ethiopians (evidently the dwarfs of the Dra and the Northern Sahara, whom I have alluded to), "their mode of life is wretched. They are, for the most part, naked, and wander from place to place with their flocks. Their flocks and herds are small in size, whether sheep, goats or oxen; the dogs also, though fierce and quarrelsome, are small" (See Bohn's Classical Library, Vol. III., p. 270, 1857).

It was pointed out in 1891, in my "Dwarfs of Mount Atlas," that pygmies are supposed in Northern Morocco and in Nubia to be Cyclops, and that, as the dwarfs of the Atlas, like other natives of Southern Morocco, wear a singular bournous, on the back of which is worked an immense eye, a yard in length, "the people with the eye" must in time have become "the people with only one eye." This view, as well as my contention that the dwarfs of the Atlas have little domestic animals, are confirmed by Robert Brown, Jr., who, in his "Neptune," says that the Cyclops of the Odyssey were an agricultural people of North Africa, who had diminutive cattle, the milk of which yielded very rich cream.

The dwarfs of the Atlas revenged the death of their giant brother, Antoeus, by capturing Hercules, who became the willing slave of their Queen. Under many different names, this great African Queen frequently appears in early Greek mythology. Dating back to an era before the dawn of astronomy, she and her daughter, as Cassiopea and Andromeda, were, with Hercules, placed in the heavens as northern constellations by that father of astronomy, Atlas, who, according to Homer, "knew all the stars, and the remotest parts of the ocean," and who taught Hercules astronomy. "The fat Queen of Pount" still survives on the monuments of Egypt, which, according to Mariette Bey, represent her as a pygmy, and in popular traditions as to the ruins of Poun or Pount, at the head of the Dra Valley, in Southern Morocco, where, in time of drought, Queen Mena is still invoked. Her mantle, no doubt, was believed to have descended on that brave Jewess, called by the Arabs, Queen Kahina ("the sorceress"), under whom the Berbers for a time rolled back the tide of Moslem invasion. A vague idea has for years existed south of the Atlas that Queen Victoria is destined to rule over that country!

I have omitted to refer to two curious points: that there are, in several isolated and inaccessible localities in the Southern States, little communities, composed of survivals of those pygmy tribes that have disappeared from the west coast of Africa; and also that there are on the Atlantic seaboard little ponies, the descendants,

probably, of a small breed that belonged to these dwarfs, and that were shipped with them to America. Strange to say, their name is "Teki horses."

Dr. Weir's interesting article in the *Popular Science Monthly* for June, 1896, on "The Pygmy in the United States" (which, however, does not refer to these small horses), will well repay a perusal.

I invite the attention, not only of anthropologists, but also of zoologists, to this subject: Are these little breeds the original stock and have domestic animals gradually become larger and stronger, just as cultivated plants have; or have scores of thousands of years of privation dwarfed them and their pygmy owners?

It is very desirable that zoologists should carefully study and apply the investigations of Yale naturalists and palaeontologists as to the origin of the horse in America, which would seem to indicate that the ordinary horse had an even smaller prototype than the little "drinkers of the wind" of the Sahara, in a fox-like animal with five toes, developing in later ages into a larger, horse-like animal with a cloven foot. "After that the deluge"—some catastrophe that put a final stop to horse-raising in America in primordial times.

I also suggest a point which zoologists may follow up with good results.

Mr. Cunninghame Graham, three or four years ago, in an article on Argentina, says that the horse of the Pampas differs from the ordinary horse, the lumbar vertebrae of which are one more in number than those of the Pampas horses. This, he says, also applies to Barbs, and he thinks that the Spaniards must have brought out Moorish horses with them to Argentina. I tried, when last in Morocco, to get a skeleton of a Barbary horse examined by a veterinary surgeon, but did not succeed.

If the Barb differs also from ordinary horses, it probably got its peculiarity from the little breed of ponies in the Sahara.

It is also very important to ascertain whether the latest type of fossil horses in America resembled the Barbs or the common horse in this respect.

Henceforth we have immensely improved chances of solving the problems of the origins of small breeds of domestic animals, and of pygmy races of men—for what will explain the one, will also settle the other.

As respects the latter, the tendency of scientific thought is to regard dwarf races of men as having been the original and earliest specimens of humanity on the earth, and to yield to them the place so long occupied by a supposed "missing link." The latest traveller in Africa, Professor Donaldson Smith, writing last summer to *The World* an account of Abyssinian dwarfs discovered by him, says: "Although they live among other native tribes, they differ totally from them as respects their principal ethnological features. This fact strengthens the theory that the African pygmies are not degenerate specimens of the tribes among whom they live, but are the remnants of the first and original population of the Dark Continent."

Mgr. Leroy, Papal Nuncio to East Africa, says the same thing, and asserts that the dwarfs think so, too, and despise all the larger races as parvenus. They claim to be the first, and oldest, and noblest inhabitants of Africa.

\* (Note)—After this paper was written it was found that the fossil horse resembled the Barb in this respect. It may be worthy of mention, that a review of the latest book on Anthropology, Hutchinson's "Prehistoric Man and Beast" (Appletons, N.Y.), says: "Certain analogies lend weight to the idea that possibly Stonehenge was erected by the dwarfs or fairies, who, in a previous chapter, are shown to have been a real people. Various writers have come to the conclusion that a dwarf population akin to the Lapps were the actual inhabitants of the 'fairy knowes,' or underground megalithic structures, and became in time the elves and fairies of folk lore."

THE GAMETOPHYTE OF *BOTRYCHIUM VIRGINIANUM*. BY EDWARD C. JEFFREY,  
B.A., LECTURER IN BIOLOGY UNIVERSITY OF TORONTO.

(Read November 21, 1896.)

A complete description of the gametophyte of the Ophioglossaceae has long been a desideratum.

Since the discovery by Mettenius, in 1856, of the subterranean prothallium of *Ophioglossum pedunculatum*, and by Hofmeister, in 1857, of that of *Botrychium lunaria*, nothing has been added till recently to their necessarily incomplete accounts of the gametophyte in these species. Our latest knowledge on this subject is derived from a brief description of incomplete material of the prothallium of *Botrychium virginianum* found in 1893 at Grosse Isle, Michigan, by Professor Douglas Campbell, which was published in the proceedings of the Oxford meeting of the British Association in 1894.

During the summer of 1895 the writer secured a large number of prothallia of the same species at Little Metis in the Province of Quebec. On examination it was found that the material thus obtained afforded a complete elucidation of the development and structure of the antheridia and archegonia, and a less satisfactory series of stages in the segmentation of the embryo. Last summer the remaining prothallia were removed to the number of about six hundred, and, although they have only been partially studied yet, owing to technical difficulties in embedding them, those examined have supplied all the lacking stages of the development of the young sporophyte.

It is proposed at the present time to furnish a brief account of the features of interest—a fuller description will shortly appear in the Transactions of the Canadian Institute.

All the younger prothallia were found in a single circular depression of sphagnum moss about ten feet in diameter, near a corduroy road, running through the wooded margin of a peat and huckleberry swamp at Little Metis, P.Q. Older prothallia were abundant with those bearing fertilized and unfertilized archegonia and younger embryos.

I have also found young sporophytes of several years' growth in the woods on the heights back of Metis; in the "Flats" below the "Whirlpool" on the Niagara river, and also in rich woods along the valley of the Don, near Toronto. In all the examples last referred to the young spore plant was still attached to the gametophyte. It seems probable that the prothallia of our common Canadian species of *Botrychium* are much commoner than has been hitherto supposed. It is necessary to add, however, that although my attention has been directed to the subject for some three years past, I have not yet succeeded in finding the younger stages of the prothallia in any other spot than the sphagnum basin in the swamp at Little Metis.

The gametophyte of *Botrychium virginianum* is of flattened oval shape, the narrower end of the prothallium being terminated by the growing point. My examples are from two to eighteen millimetres in length, by one and a-half to eight millimetres in breadth. Their thickness increases from the growing end backwards. The sides and lower surface of the prothallium are covered in younger specimens with multicellular hairs. In older plants these tend to disappear. The middle of the upper surface is occupied by a well-defined ridge, upon which the antheridia

are situated. The archegonia are found on the declivities which slope away from the antheridial ridge.

As might be expected, the younger sexual organs are found nearer the growing point than those of greater age.

A cross section of the prothallium reveals to the naked eye the fact that the lower part of the gametophyte is composed of tissue which is yellowish in colour, and from which a thick oil exudes, even when the plant has been lying in ninety per cent. alcohol for months. The upper portion of the prothallium tissue, upon which the generative organs are situated, is white in colour and free from oil. A long section of the prothallium shows the same distribution of yellow oil-bearing and white oil free tissue as the cross section, but demonstrates that the oil-bearing stratum is both absolutely and relatively much thicker in the older parts of the plant.

Microscopic examination shows that the oleiferous tissue has its cells occupied by an endophytic fungus and a very abundant protoplasm.

The fungus, so far as it has yet been studied, seems to be a sterile *Pythium*, possibly the same as that found by Treub, Goebel and others in the prothallium of species of *Lycopodium*. The writer hopes to study the fungus more closely in a living condition during the next period of vegetation. The fungus filaments can be seen passing from the prothallium to the outside medium by way of the root hairs.

The antheridia, as has been already stated, occur in numbers on a ridge running lengthwise on the upper surface of the prothallium. The young antheridia originate behind the growing point from a single superficial cell. This divides transversely the outer half, giving rise to the outer antheridial wall and the inner half by repeated simultaneous divisions to a large number of spermatocytes. The fully-developed antheridium is largely embedded in the antheridial ridge, and projects only slightly above its surface. The formation of the spermatozooids has not yet been carefully studied, but seems to resemble closely that described in the *Marattiaceae* and *Equisetaceae*.

The spermatozooids are unusually large in size, but otherwise resemble the ordinary fern type, and consequently differ from the biciliate, moss-like spermatozooids of the *Lycopodiales*.

The archegonia are confined to the sloping sides of the upper surface of the prothallium. Unlike the antheridia, young archegonia, although most abundant near the growing point, may be formed on almost any part of the archegonia-bearing surface. The archegonium mother cell is superficial, and is distinguished from its neighbours by a larger nucleus and a more abundant protoplasm. It first divides transversely into a shallow outer cell and a deeper inner cell. The inner cell divides again, and as a result the young archegonium consists of three cells. The most external of these, by subsequent divisions, gives rise to the neck of the archegonium. The internal cell is the basal cell. It also divides into a plate of cells, sometimes composed of two layers and distinguished by their richly protoplasmic contents. The middle cell of the young archegonium series gives rise by division to the neck canal cell and the ventral cell. The former becomes binucleate, but never divides into two cells. The latter, just before the maturation of the archegonium, divides into the egg-cell and the ventral canal cell. The ventral canal cell is broad, like that of the *Marattiaceae*.

In the ripe archegonium the nuclei of the cells of the upper stories of the archegonium neck become chromatolysed. I do not know yet whether this feature is peculiar to *Botrychium*.

The fully-developed archegonium is sunk into the prothallium, and only the neck projects above its surface. The cervical cells are in four rows as in the other *Pteridophyta*, and the terminal ones spring apart when the egg is ripe.

Spermatozooids are frequently found in contact with the egg. After fertilization the egg grows to many times its original size, and the reduced protoplasm contains a large hydroplastid.

The first division of the o-spore is across the long axis of the archegonium. The next division is parallel with the long axis of the prothallium, and at right angles to the first. The third cross wall is in the transverse direction of the prothallium, and at right angles to the other two. I have been unable to follow satisfactorily the subsequent divisions.

The organs appear very late, and only after the embryo has attained a large size. The root is the first of them to emerge, and the proliferation of cells, indicating its place of origin, is long unmarked by the presence of an apical cell. The cotyledon, stem apex, and foot appear nearly simultaneously.

The root and cotyledon originate from the upper part of the embryonic mass; the foot and stem apex from its lower cells.

The apex of the root in many cases is in the same straight line with the canal of the archegonium neck.

It seems hardly possible to derive the organs from definite octants of the embryo.

The growth of the root ruptures the calyptra, and its exit is followed somewhat later by that of the cotyledon. The latter is not a bi-laterally symmetrical structure, as in most ferns, but is of the same palmate type as is found in the Osmundaceae. The cotyledon begins to assimilate as soon as it reaches the surface of the ground, and thus resembles that of *Ophioglossum pedunculatum*.

There seems to be no evidence to indicate that more than the cotyledon appears above ground in the first season of the young plant's growth. In following summers apparently only a single leaf is produced, as is the case with the older plant. I have found young sporophytes, bearing their sixth leaf, still attached to the mother prothallium; and, as I have never found more than one leaf on the spore plants at once, and as the leaves, like other organs of this species of *Botrychium*, are extremely resistant to decay, I am reasonably certain that such examples were in the sixth year of their existence. This longevity of the gametophyte is of some interest.

One frequently finds two sporophytes on a single prothallium, and in many of these cases the apex of the prothallium is bifurcated. In one case I found two spore plants which had arisen from a single embryo. In another case I discovered two tracheids in a prothallium in the vicinity of a decayed young spore plant. The latter may have been of apogamous origin, as a similar phenomenon generally accompanies apogamy. I have not yet studied thoroughly the growing region of the prothallium, as it is best examined in longitudinal sections of the gametophyte. So far as I have investigated the matter, there seems to be evidence of the existence of an apical cell.



THE HISTOLOGY AND PHYSIOLOGY OF THE GASTRIC GLANDS. BY R. R. BENSLEY, B.A., M.B., ASSISTANT DEMONSTRATOR OF BIOLOGY, UNIVERSITY OF TORONTO.

(Read November 28, 1896.)

PRELIMINARY NOTICE.

In nearly all vertebrates, in which the histology of the stomach has been investigated, the mucous membrane of that portion immediately preceding the pyloric orifice has been found to contain glands differing in certain characters from the glands of the rest of the stomach, and known technically as the pyloric glands. The morphological relation of these glands to the other gastric glands in the lower vertebrates has excited little interest, but in the mammalia, in which the subject assumes great physiological importance, this relation has been the subject of numerous researches, and has been examined from widely different points of view. Heidenhain<sup>1</sup> and Ebstein<sup>2</sup> compared the cells of these glands with the chief cells of the fundus glands in respect to the action on them of dilute acids and alkalies, and to the appearances presented in different phases of secretory activity, and came to the conclusion that the two kinds of cells were of similar nature. Further force was imparted to this conclusion by the discovery that the pyloric mucous membrane contained a ferment capable of digesting fibrin in the presence of dilute hydrochloric acid, and by the experiment of Heidenhain,<sup>3</sup> who established a pyloric sac entirely separate from the fundus mucosa, which, even after five months yielded a secretion rich in pepsin.

The method adopted by Heidenhain and Ebstein in investigating the physiological and morphological value of the pyloric glands was to a certain extent the correct one, and the reason that it did not lead, in their hands, to a more convincing result was that they examined cells in which only a portion of the elements of the living cells was preserved. The researches of Langley,<sup>4</sup> alone, and in conjunction with Sewall, have taught us that the secretion of pepsin is intimately connected with the formation and disappearance of coarse granules in the chief cells, and he has offered us the most convincing proof that these granules are the zymogen of Heidenhain,<sup>5</sup> Ebstein, and Grutzner,<sup>6</sup> and comparable to the granules observed in the pancreas and salivary glands. Any cytological research which does not take into consideration these zymogen granules cannot fail to lead to erroneous results. Unfortunately, it has been found difficult to preserve these granules, and in his first observations on the mammalian glands, Langley depended largely on fresh, or living material. Subsequently he found that in some animals the granules could be fixed, and the part taken by them in secretion investigated by the use of solutions of osmic acid.

Langley and Sewall observed that the coarse granules discovered by them in the fundus glands were not to be found in the pyloric glands, and concluded that the appearance of granules in the cells was not a necessary feature of zymogenesis.

(1) Arch. fur Mik. Anat. Bd. VI., p. 368.

(2) Arch. fur Mik. Anat. Bd. VI., p. 515.

(3) Pflueger's Archiv. Vol. XVIII.

(4) Journal of Physiology. Vols. II., III., and others.

(5) Pflueger's Archiv. Vol. X., and Hermann's Handbuch, Vol. V.

(6) Pflueger's Archiv. Vol. VIII.

Relying on their observation that in the rabbit there is a gradual diminution in the number of granules in the chief cells, from the fundus along the greater curvature, and on the undoubted fact that the pyloric secretion contains a proteolytic ferment, these observers concluded "that the pyloric gland cells and the chief cells of the fundus are fundamentally the same," and that "the chief cells of the fundus" are "a highly differentiated form of the pyloric gland cells." Stohr<sup>7</sup> in 1882 arrived at a similar conclusion, as a result of his researches on the stomach of man, the cat, dog, and badger.

Many investigators, however, as a result of physiological experiment and observation, have come to the conclusion that the pyloric gland cells are something quite different from the chief cells of the fundus gland. Among these may be mentioned Nussbaum,<sup>8</sup> Sappey,<sup>9</sup> Bonnet,<sup>9</sup> and Bikfalve, who regard the pyloric glands as mucous glands. The most recent contribution to this subject is that contained in the *Lehrbuch der Vergleichenden Mikroskopischen Anatomie*, published this year by Opperl, of Freiburg. From an exhaustive examination of the literature of this branch of research, and from personal observation, this author concludes that "Die Pylorusdrüsenzellen sind Zellen sui generis welche sich sowohl vom Oberflächenepithel wie von den Hauptzellen unterscheiden. Sie sezernieren peptinhaltigen Magensaft."

One has only to consider the conflicting nature of the results achieved, or to observe the various ways in which similar observations have been interpreted, to convince oneself that the solution of the problem of the morphology and physiology of the mammalian pyloric gland is not to be attained by the ordinary methods of physiological research.

It appeared to me that some information might be afforded by a careful study of the structure of the cells of the various gastric glands, at different periods of digestion, together with a comparison of the structure of the cells in the various vertebrate classes. In order that this investigation might not be open to the objection I have urged in reference to the work of Heidenhain and Ebstein, it was necessary to find some agent that would fix equally well the form and contents of the cell. To the difficulty of accomplishing this, I have already alluded, in speaking of the work of Langley, who found that by the use of osmic acid he could preserve the granules in the chief cells of a few mammals only. It has since been found that mercuric chloride, in saturated aqueous solution, would fix perfectly the zymogen granules of many glands. This reagent, as well as the various osmic acid mixtures, were tried and found to possess certain disadvantages. Whilst they fixed perfectly and satisfactorily the cells of the surface, and of the deepest portions of pieces of mucous membrane immersed in them, the zymogen granules had quite disappeared from the middle regions of the glands. Alcoholic solutions of mercuric chloride were then tried, with the result that whilst the zymogen granules of the whole gland were well preserved, the cells themselves had undergone considerable change of form. It was subsequently found that the addition of an equal volume of two per cent. aqueous solution of potassium bichromate to the alcoholic solution of mercuric chloride, would prevent the shrinkage of the cells, and at the same time effect a satisfactory fixation of the zymogen granules in all parts of the glands containing them.

With the help of this reagent I have investigated the stomachs of several mammals, and of members of the lower vertebrate classes, and have been led to conclude, that the relationship of the pyloric glands to the glands of the fundus region is, within certain limits, a constant one, and that the pyloric glands are to be regarded as feebly differentiated structures, corresponding in the nature of their cells to the upper portions of the fundus glands.

(7) *Archiv f. Mik. Anat.* Bd. XX.

(8) *Archiv f. Mik. Anat.* Bd. XXI.

(9) See Opperl. *Lehrbuch der Vergleichenden Mikroskopischen Anatomie*, p. 269.

Among mammals, I have found the cat most suited to experimental research, on account of the large size of the zymogen granules, and in this preliminary paper I will confine myself to an account of the results attained by observation of the gastric glands of this animal in various stages of secretion, and reserve for the full paper, to be published shortly, the confirmatory facts elicited from an examination of the stomachs of other mammals, fishes, amphibia, and reptilia.

The chief cells of the fundus glands may be divided into two groups, those of the body and those of the neck of the gland. The differences between these two kinds of cells will be minutely described.

If the fundus glands of an animal that has fasted for twenty-four hours be hardened in the alcoholic sublimate bichromate mixture, the chief cells present the following characters:—They are cubical or pyramidal in shape the base of the pyramid being usually directed towards the lumen of the gland. In preparations stained in haemalum and eosin, the body of the cell is found to contain a network of large polygonal meshes of equal size, and pervading the whole cell. In secretions stained in saffranin, or gentian violet, or the iron alum haematoxylin of Heidenhain, the cell is filled with granules of large size, the zymogen granules. In the Ehrlich-Biondi mixture the network stains red, and it is then seen that each mesh of network corresponds to a zymogen granule. The apparent network is really the optical section of the partitions between the spaces in which the zymogen granules lie. The nuclei are round or oval, occasionally slightly irregular, and placed near the base of the cell. They possess a well-defined chromatin network, and one or two large eosinophilous nucleoli. I have directed considerable attention to the structure of the nuclei in the different phases of secretion, with a view of determining if changes similar to those described by Platner, Ogata, and others in the nuclei of the pancreatic cells are to be observed in the gastric chief cells. So far, however, I have been unable to demonstrate any changes, with the exception of the slight irregularity of outline sometimes seen in the resting cell. This, I feel inclined to attribute, rather to compression by the secreted products, than to spontaneous change of form.

In an animal that has been continuously digesting for a period of six hours the chief cell is distinctly marked off into two zones. The inner zone is still filled with large granules, between which may be seen in Ehrlich-Biondi stained sections, the red stained meshwork of hyaline protoplasm. The outer portion of the cell contains no granules, but is occupied largely by a substance which has a peculiar affinity for nuclear dyes, such as haematoxylin. This substance possesses an obscurely fibrillated structure, the fibrillae being placed side by side in the base of the cell, so that one is at first reminded of the appearance of the striated epithelium of the intralobular ducts of the salivary glands. On closer examination it may be seen that the fibrillation in the outer portion of the chief cell is not so regular, nor are the fibrillae as distinct from one another as in the salivary ducts. The fibrillae are also of larger size, and irregularly swollen at intervals so as frequently to mask the fibrillated structure. The form taken by this substance in the base of the cell, particularly when it is present in small amount, frequently reminds one strongly of the figures published by Macallum,<sup>10</sup> Eberth, and Mueller,<sup>11</sup> and others, of the nebenkerne in the pancreatic cells of the amphibia, and one is led to inquire if these structures are not of similar nature. The amount of this fibrillated substance in the cell, under normal conditions, varies inversely with the number of zymogen granules, and one can only conclude that the chromophile substance in the base of the cells breaks down during rest, and thus takes part in the formation of zymogen granules, which is then actively progressing. Mouret<sup>12</sup> takes a similar view of the nature of the chromophile fibrillated substance in the outer portion of the

(10) Transactions of the Canadian Institute. Vol. I 1890.

(11) Zeitschrift f. Wissenschaft. Zool. Bd. 53. Supplement.

(12) Journal de l'Anatomic. 1895.

pancreatic cells of the dog, and he suggests the name of "pre-zymogen" for the substance. Some information as to the nature of this substance is afforded by the researches of Dr. Macallum, who describes<sup>13</sup> the differences in staining exhibited by the nucleus and plasma of the exhausted and resting pancreatic cell, and explains this difference as follows:—"The chromatin of the nucleus of the pancreatic cell gives rise to a substance which we may call "prozymogen," sometimes dissolved in the nuclear substance, sometimes collected in masses (plasmosomata), and finally diffused into the cell protoplasm, uniting with a constituent of the latter as zymogen." In a subsequent investigation<sup>14</sup> into the distribution of assimilated iron compounds in animals and vegetable cells, Dr. Macallum found diffused in the cytoplasm of the outer zone of the chief cells, and, with two exceptions, in the cytoplasm of all other glands examined by him, a firm compound of iron, and his observations led him to conclude that this iron compound was the prozymogen of his earlier researches. It seemed probable that the fibrillar chromophilous element observed by me in the outer zone of the chief cell was the prozymogen of Dr. Macallum's investigation: and this proved to be the case. A convenient means of proving this was afforded by the fact that the chief cells of the greater curvature of the rabbit's stomach contain at all periods of digestion a very large amount of the chromophile substance, which in the exhausted phase almost fills the entire cell, the zymogen granules being then confined to a narrow band next to the lumen. Sections of this mucous membrane give no immediate reaction for iron with ammonium sulphide, but after three hours' treatment with a three per cent. solution of sulphuric acid in alcohol, at a temperature of 40 degrees C., those portions of the chief cells containing the chromophile substance take, with acid ferrocyanide solution, a deep Prussian blue color, which is so intense as almost to mask the nucleus of the cell. The Prussian blue reaction also shows the same fibrillar structure as is observed in sections stained in haematoxylin. We may, therefore, use the term "prozymogen" for this substance wherever it occurs.

It is not in the chief cells of the stomach and in the pancreatic cells alone that the prozymogen assumes the fibrillar form. I have observed similar structures in the serous glands of the gustatory area of the rabbit and dog, and it is possible that the rod-like structures described by Solger<sup>15</sup> in the basal portion of the cells of the human submaxillary gland, and by Erik Mueller<sup>16</sup> in the cells of the submaxillary of the guinea pig, may belong to the same category. The fibrillation in the prozymogen of the gastric gland cells may be observed in the fresh cell, examined in aqueous humour, and is, therefore, not the product of the action of reagents. It may be also seen in sections fixed in Hermann's or Vom Rath's osmic acid mixtures, and in aqueous sublimate.

The cells of the neck of the gland are quite different in appearance from those of the body. At no period of digestion do they contain either prozymogen or granules of zymogen. The same remark is applicable to the chief cells of the short collecting duct (sammelangang of Bizzozero), and to the cells of the lower portion of the mouth of the gland. The cells of these three regions have many features in common, and will be described together. As a starting point, I will describe the cells of the upper portion of the neck of the gland.

These cells are usually conical or pyramidal in shape, wedged in between the larger oval border cells of this region of the gland in such a way that the broad base of the cell is directed towards the lumen. In vertical sections of the mucous membrane, from one to four of these cells may usually be observed between each pair of the border cells. Two zones may be distinguished in the cells, an outer protoplasmic zone of fine reticular structure, staining readily with eosin, and an

(13) Op. Cit.

(14) Quarterly Journal Microscopical Science. Vol. XXXVIII., Part II. New Ser.

(15) Anatomischer Anzeiger. Bd. IX.

(16) Archiv f. Mik. Anat. Bd. XLV.

inner zone presenting an irregular network of much larger meshes, and containing a secreted substance, which behaves in a peculiar way to staining agents. By the ordinary stains this portion of the cell appears clear and transparent. The substance contained in the inner zone of the cell appears to be in some respects similar to mucin. It gives a faint metachromatic red stain with thionin, and stains intensely with Bordeaux R. and Indulin. The latter dye has rendered me considerable service in determining the distribution of this kind of secretion in the stomach. I have found the most satisfactory method of applying this stain to be in the form of Huber's blood fluid, consisting of two grammes each of indulin, eosin, and aurantia, dissolved in thirty grammes of pure glycerine, and diluted with four hundred times its volume of distilled water before use. Sections of the fundus mucous membrane immersed in this fluid for one-half hour or longer, show all parts stained red, with the exception of the blood corpuscles, which are yellow, the nuclei of the cells and the mucigenous borders of the surface cylindrical cells, which take a faint haematoxylin tint, and the secretion in the cells of the upper portions of the glands, which takes an intense dark blue color. Stained secretion may also be observed in the lumen of the gland. In sections stained thus the appearance of the inner zone of the cell is different from that above described. It is now found to be pervaded by a close-meshed network of coarse fibres, both the network and the substance enclosed in its meshes being indulinophilous, and often presenting a vacuolated appearance. This appearance seems to me to be due to the formation of a secondary reticulum by precipitation in this form of the solids of the secretion. At the junction of the two zones of the cell the reticulum of the outer zone is much finer in texture and is chromophilous, so that in sections stained in haematoxylin alone, the cell appears to be subdivided by a blue stained band into the two zones. In sections stained in the indulin mixture it is frequently seen that a small quantity of indulinophilous material is diffused through that portion of the outer zone of the cell, between the chromophilous band above referred to and the nucleus. The size of the indulinophilous zone varies with the position of the cell. In the upper part of the neck of the gland it involves only a small portion of the cell, but on passing down the gland, increases gradually in width, until at the lowest portion of the neck of the gland it fills nearly the whole cell. The nuclei of these cells are placed near the base, and vary in shape with the amount of secretion present; in those cells, which possess a large protoplasmic zone, the nuclei are oval or round; in the cell filled with secretion they are irregular and flattened. It is only in cells, however, in which the indulinophilous zone extends to the nucleus that any irregularity of shape is to be observed. Mitoses may frequently be observed in those cells, even when filled with secretion. Among the indulinophilous cells of the lower portion of the neck may be observed a few zymogenic cells. An occasional indulinophilous cell may also be observed among the chief cells of the body of the gland, and these are probably the cells observed by Pilliet,<sup>17</sup> Trinkler,<sup>18</sup> and others, and regarded as stages in the transformation of border into chief cells, or vice versa.

The cells of the collecting duct, and the lower cells of the mouth of the gland, also contain indulinophilous secretion, in the shape of a rounded clump in the midst of the protoplasm of the cell, near the nucleus, possessing the same structure and staining properties as the inner zone of the cells of the gland neck. Passing up the mouth of the gland, this clump gradually approaches the free surface, and loses its indulinophilous character, finally fading into the mucigenous border of the surface epithelium. In these cells, as Bizzozero<sup>19</sup> observed, the mitoses are more frequent than in the neck cells.

There is some evidence that the indulinophilous cells of the neck of the gland

(17) *Journal de l'Anatomie*, etc. No. 5. 1887.

(18) *Archiv f. Mik. Anat.* Bd. XXIV.

(19) *Archiv f. Mik. Anat.* Bd. XLII.

are young cells, which will ultimately grow down into the body of the gland, and take on the function of zymogenesis. This evidence will be offered in a later paper, in which also the regeneration of the surface epithelium will be discussed.

The discovery of the different nature of the cells in the neck of the gland affords a cytological basis for the division of the gland into two regions, called respectively, the neck and the body of the gland.

The length of the neck of the gland varies in the different portions of the stomachs of different mammals. I have not been able to demonstrate any change in the appearance of these cells in the different periods of digestion. In sections fixed in alcohol sublimate bichromate solution the branches of the lumen leading out to the border cells, as well as the fine intracellular secretion capillaries of the latter, may be perfectly seen.

The pyloric gland cells contain at no period of digestion either zymogen granules or prozymogen. They resemble closely in internal structure the cells of the middle portion of the neck of the fundus glands, and contain a similar secretion. As in the fundus glands, this stains intensely with indulin and Bordeaux R., and gives a faint metachromatic red stain with thionin. The reticulum observable in the indulinophilous portion of the cells is, as a rule, finer than in the neck cells of the fundus glands. Here, also, it may be observed that the indulinophilous cells pass, by gradual transition, into the mucous cells of the surface, and it is in the transitional portion of the gland that mitoses are most abundant, although they may be frequently seen even in the deepest portions of the glands.

The identity of the cells of the neck of the fundus gland with the pyloric gland cells in the cat may be demonstrated by a study of the so-called intermediary zone. Here I have found, not the mixed fundus and pyloric glands of other observers, but a gradual transition, brought about by the lengthening of the neck region of the gland, and the gradual disappearance, first, of the zymogenic cells, and finally, of the border cells, as the pylorus is approached.

### CONCLUSIONS.

1. During digestion a substance similar in chemical properties to the chromatin of the nucleus makes its appearance in the outer clear zone of the chief cells of the fundus glands. This substance, which may be called prozymogen, stains deeply and readily in haematoxylin, and presents a characteristic fibrillated appearance. During rest this prozymogen is used up in some way, giving rise to zymogen granules.

2. The chief cells of the neck of the gland do not contain at any period of digestion, either zymogen or prozymogen, but are engaged in the formation of a mucinoid secretion, which has a powerful elective affinity for indulin and Bordeaux R., and stains metachromatically in thionin.

3. The pyloric gland cells, likewise, form neither zymogen nor prozymogen, and are similar in structure, in staining properties, and in the nature of their secretion to the cells of the neck of the fundus gland.

4. The cells, both of the pyloric glands and of the neck of the fundus gland, pass, by gradual transition, into the mucous cells of the surface, to which they are obviously closely allied.

THE NATURAL RESOURCES OF THE COUNTRY BETWEEN WINNIPEG AND HUDSON'S BAY: OUR NORTHERN OUTLET. BY LIEUT.-COL. T. C. SCOBLE.

(Read December 5, 1896.)

The area draining into Lake Winnipeg embraces 432,000 square miles, and includes the valleys of the Red, Winnipeg and Nelson Rivers, the overflows of Lakes Dauphin, Manitoba and Winnipegosis, and nineteen tributary rivers. The area of the Red River Valley alone is nearly 42,000 square miles, of which 7,000 square miles are within the Province of Manitoba, and constitute the home of the famous wheat known to commerce as "No. 1 Manitoba hard." The only impediment to navigation on the lower Red River is at St. Andrew's Rapids, where there is a fall of about fifteen feet, distributed over ten miles of the river, and this could be easily overcome by dredging. North-western Ontario, being the height of land, draining through the Winnipeg River into the lake at its south-eastern extremity, and the Great Saskatchewan, with its 1,513 miles of navigable channels, enters at the north-western extremity. Lake Winnipeg is 270 miles in length and 72 miles in breadth, from east to west, at the mouth of the Great Saskatchewan, its area being 9,400 square miles, or 2,070 miles larger than Lake Ontario. The precise elevation above sea level, Col. Scoble considers not yet determined, as authorities disagree. The average depth is from 42 to 90 feet, and there are few obstructions to navigation.

So far only two industries have been developed, those of lumbering and fishing. The spruce lumber cut annually in the Lake Winnipeg district amounts to about ten millions of feet, board measure; value, \$170,000. The fisheries in 1894 yielded 5,443,780 pounds, valued at \$188,014. The Inspector of Fisheries was quoted with regard to the inexhaustible supply of whitefish and sturgeon in these waters.

The geological formation is Laurentian on the east side and Devonian on the west side of the lake, showing that the dividing line between the two systems is covered by its waters. In some of the islands the two systems are in juxtaposition. On Black Island there is a most valuable deposit of soft brown hematite iron ore, yielding from 44 to 62 per cent. of metallic iron to the ton. Gold and silver are also found on the same island, with several other minerals of economic value. At Berens River and other points red hematite iron ore exists in vast quantities, and gold had been discovered on Bad Throat River and at Pipestone Lake on the Upper Nelson River. Beyond Lake Winnipeg north and eastward the whole country is intersected by lakes and waterways existing in the depressions in the Laurentian formation. The falls and rapids of the Nelson River were described in detail.

The boat route over which the Hudson Bay Company carried its traffic for over a century was next described, and the curious phenomenon of two rivers, one flowing east and the other flowing west from a narrow height of land only twenty-nine yards in width, was commented upon. Then the lecturer pointed out that the difficulties to be encountered in improving either of the two routes before described might be overcome by crossing the height of land to Molson's Lake. By this route out of a distance of 681 1-2 miles from Winnipeg to Hudson Bay, only fifty-seven miles would need any improvement to secure continuous seven-foot navigation, and of this distance only ten and a half miles would require canalling. Eight dams and thirty-four locks were all he estimated as being necessary in order to overcome the descent. No "locking up" would be required to get over the height of land, and the whole drainage area of the Winnipeg basin could be employed if necessary to develop the system. A mineral belt, similar to that of the upper Lake Superior system, crosses the country, and promises well to explorers.

The varied resources of Hudson Bay were described, and the question was asked, "Why should not these resources be exploited for the benefit of Canada?" American whalers had taken out millions of dollars' worth of oil and bone, and would continue to do so until Canadian rights were asserted. It was necessary in the interests of Canada as a whole, as well as for the North-West, that a new outlet to the ocean should be opened via Hudson Bay.



THE PANIS—AN HISTORICAL OUTLINE OF CANADIAN INDIAN SLAVERY IN THE EIGHTEENTH CENTURY. BY JAMES CLELAND HAMILTON, M.A., LL.B.

(Read December 12, 1896.)

- I. Examples of early American slavery among the Portuguese, Spaniards, and New Englanders. Story of Inkle and Yarico. Reference to panis in writings of Hennepin, Charlevoix, Colonel Landmann, and Captain Knox. Dr. D. G. Brinton, J. G. Shea, and Horatio Hale as to the Pawnees and Pani stock and their habitat. The New York and other early Colonial documents referred to.
- II. The Lower Canada records as to panis in cities of Quebec, Three Rivers, Montreal, and elsewhere. The punishment of slaves, the pillory, carcan and the rack. Panis in Montreal Hospital, in the seigniories.
- III. Legal position of Canadian slaves: The statutes, ordinances, and edicts as to them.
- IV. Panis in Upper Canada, at Niagara and Amherstberg. The Huron Treaty of 1764. The last pani.

I. The Portuguese in 1500 sent out an expedition to North America under Gaspar Cortereal, which entered Hudson's Straits. They brought away fifty-seven natives, to be sold as slaves and used as laborers.

The supposed excellent quality of these kidnapped natives, and the large supply which the country was likely to furnish, caused it, as our author alleges, to be called Terra Laborador, or the land of laborers, whence its present name (1). This seems to have been the beginning of the subjugation of aborigines on the North American Continent to slavery by Europeans and their descendants.

Before this the Spaniards had been active in Hayti and Jamaica in reducing the natives there to servitude, working them in the mines, and exporting many to the home slave market. In 1498 Christopher Columbus sent 600 of the natives to Spain and wrote as to them in impious blasphemy: "In the name of the Holy Trinity there can be sent as many slaves as sale can be found for in Spain, and they tell me 4,000 can be sold." He is said to have repented of his cruelty after being in turn sent to Spain in chains by Bovadilla. Tennyson makes him thus bemoan his fate, and theirs:—

" Ah God, the harmless people whom we found  
In Hispaniola's island paradise—  
Who took us for the very gods from heaven,  
And we have sent them very fiends from hell.  
And I, myself, myself not blameless, I  
Could sometimes wish I had never led the way."

The Spaniards' cruelty in the Antilles was only paralleled by their conduct toward the natives of Mexico. The enslavement of red, as well as of black men,

(1) History of Nova Scotia and other British Provinces, by James S. Buckingham, p. 168. Other derivations have been given, but the above seems appropriate and well founded.

was not unfamiliar to even the Puritan Colonists. In 1675 many towns, villages, and farmsteads in Massachusetts and Rhode Island were destroyed by the Wampanoags, under the famous King Philip.

There were few families in the region attacked who did not mourn some of their members. When Philip had fallen, his chiefs, sachems and bravest men were put to death; the remainder were sold as slaves.

The son of Philip, whose only crime was his relationship to this great chief, was among the prisoners, and was sent as a slave to Bermuda, whence he never returned. An attempt to supply such labor for the New England home market led to speedy repentance.

A New Hampshire Provincial Law of 1714 recited that notorious crimes and enormities had of late been committed by Indians and other slaves within Her Majesty's plantations, and forbade the importation of any Indians to be used as slaves.

Washington Irving was among the first who criticized the stern and cruel features of the Puritans. They, he cried, trained the Indians for Heaven and then sent them there (2).

The story of Inkle and Yarico, as told by Steele, and familiar to all readers of *The Spectator*, illustrates the cruel practice of Europeans of the seventeenth century in treating all persons of darker complexions than themselves as proper subjects for barter.

Young Inkle, an English merchant adventurer, wanders from his ship on the American main, is found and saved by Yarico, an Indian girl, with whom he lived in tender correspondence for some months, when both escaped on a passing ship bound for Barbados. Here, as each vessel arrived, there was an immediate market of the Indian and other slaves, as with us of horses and oxen. The prudent and frugal young Englishman sold his companion to a Barbadian merchant. Had Yarico been carried to the old Province of Quebec she would have been called a *pani* (3).

From these instances of native American slavery beyond our immediate borders, we pass to consider how far such a system obtained in Canada.

Canadian negro slavery has been before described, (4) and reference is now made to the enforced servitude of red men in the French Province of Quebec, and the later Provinces of Lower and Upper Canada.

The Recollet Father, Louis Hennepin, was with LaSalle in 1679, and, writing at Niagara, says: "The Iroquois made excursions beyond Virginia and New Sweden \* \* \* from whence they brought a great many slaves." (5)

A vessel, called "the Griffin," was built on Lake Erie, and in this these early adventurers crossed through that lake, the River St. Clair, and Lake Huron to Mackinac, where LaSalle parted from Hennepin, the vessel having been, meantime, lost in Lake Huron. Hennepin professes to have gone down the Mississippi, and to have been the hero of many wonderful adventures. This part of the story is questioned by Mr. Shea and others, but such details as Hennepin did not personally witness are, no doubt, taken from LaSalle's Journal, and are substantially correct.

As the Pawnee nation had its habitat on, and west of, the Missouri, we do not find them or their relations, the Caddoes, Wichitas and Hæecos, mentioned in this interesting volume. It is stated that the Illinois Indians were accustomed to make

(2) As to Indian Slavery in the United States see Kent's Commentaries, part vi., lec. 61. and the authorities there cited. Winthrop's History of New England, vol. i. pp. 192 to 237. In Carolina hostilities were fomented among the tribes in order to purchase or kidnap captives and sell them as slaves to the West Indies. The sale and slavery of Indians was deemed lawful and the exile and bondage of captives in war, of all conditions, was sanctioned by the sternest Puritans. Bancroft's History, i, pp. 41-182. The war with the Pequots in 1637, and the confederacy of Indian nations in 1675 by Metacomb, Sachem of the Wampanoags, commonly called King Philip, would seem to have been formed for protection and through patriotic views. Chalmers' Political Annals, p. 291. Indian Slavery ceased in Virginia only in 1705. Magazine of American History, vol. 21, p. 62.

(3) *The Spectator*, No. 11, March 13, 1710.

(4) *Transactions of Canadian Institute*, 1890, vol. 1, p. 102.

(5) Louis Hennepin's "Discovery of America," cap. 18, pp. 19-37.

excursions far to the westward, and bring slaves from thence, which they bartered with other nations.

The southwestern Indians raided by the Illinoisans may be inferred to have been Pawnees. From their captors they passed to the white settlers in French Louisiana and Quebec.

Forty years after La Salle's time, intercourse between Louisiana and Quebec became comparatively common, and families coming up by the Mississippi, brought their negro and pani slaves with them.

Charlevoix, who visited Canada in 1721, refers to a nation settled on the banks of the Missouri, from whom persons taken captive were made slaves. He remarks: "The Arkansas River comes, it is said, from the country of certain Indians, who are called Panis Noirs—I have a slave of this nation with me (6)."

Next in date, refer to the story of the adventures of Alexander Henry, the fur trader at Michilimacinac in 1763, when that outpost of Canada was taken and the garrison massacred by the Chippewas and Sacs, he was led to a hiding-place by a faithful pani slave woman, and ultimately escaped. Her owner was Charles Langlade, a French halfbreed merchant and interpreter, and afterwards one of the early settlers in Wisconsin, but her name is not given. The Sacs and Chippewas were then at enmity with the Pawnee nation, and made slaves of such of them as they captured (7).

Colonel Landmann relates that, in 1800, when journeying from Amherstburg to St. Joseph's Island, he found a large Indian camp in busy preparation for the burning of a female prisoner, with a child at her breast. The usual horrors of torture had begun, and death was threatened, but the woman, in stoicism only expected from the other sex, was apparently indifferent to all. The Colonel negotiated for the purchase of both mother and child, and secured them in consideration of six bottles of rum, "that is," writes the careful chronicler "two of rum, mixed with four of water." The woman showed no apparent feeling, nor did she express thanks for her delivery from a terrible fate. This was but a part of the stoic manner of her race. She told all to her people, and before the young officer left St. Joseph's Island, a number of the woman's relations came and, to show their gratitude, made a considerable present of the finest skins they had been able at the instant to collect. The woman and child so saved were Pawnee captives (8). The Capitulation at Montreal had taken place on the 8th of September, 1760, and we find the word pani used in its 47th section, which provides that the negroes and panis of both sexes should remain in their condition of slavery, and belong to their French and Canadian masters, under British rule, as they had been before under the French regime, and that the masters were to be at liberty to retain them or to sell them, and to train them in the Catholic religion, except those who had been made prisoners of war.

Captain Knox visited Canada soon after this, and, commenting loosely on this section of the treaty, states his belief that panis imply convicts condemned to slavery (9). He gives no authority, and is entirely mistaken. This is the more to be regretted as others, assuming to write Canadian history, have copied his remark, traducing the character of the humble, early servant of the old Canadian homesteads. It is also remarkable that the part occupied by them in the social fabric has not been introduced into books of fiction and other writings descriptive of the seigniorial times.

May we not have a gentle Yarico, taking the place of Briseis or Helen, in an epic of the old regime; or even the story of a devoted Friday?

The stately mansion of Belmont, overlooking the St. Charles, home of the

(6) Charlevoix' Journal, vol. 3, pp. 212 and 410.

(7) Henry's Travels, part 1, cap. 10. Parkman's Conspiracy of Pontiac, vol. 1, cap. 18.

(8) Adventures and Recollections of Col. Landmann, vol. 2, cap. 6.

(9) Historical Journal, vol. 2, p. 428.

brave bourgeois, Philibert; the manor house of Tilly on the shores of the St. Lawrence; the Chateau of Beaumanoir, famous for the bacchanalian revels of the intendant Bigot; the castle of St. Louis, and other "Seats of the Mighty" in New France, have often been described, but who has pictured the little huts in their courtyards, of the negro and pani?

Dr. Daniel G. Brinton says that the Pani stock was scattered irregularly from the Middle Missouri River to the Gulf of Mexico. The Pawnees proper occupied the territory from the Niobrara River south to the Arkansas. The Niobrara River courses in an easterly direction through the northerly part of the State of Nebraska, and falls into the Missouri. The territory indicated embraces now the States of Nebraska and Kansas, and parts of Iowa and Missouri. It includes many cities and towns, among them being Des Moines, St. Louis, Topeka, and Omaha. The Arikari and Skidi branches of the nation separated at an early date and went north, while the Wichitas, Caddoes, and Huecos roamed over Eastern Louisiana and Western Texas.

The Pani stock, as a rule, had an excellent physique, being tall and robust, with well-proportioned features, the lips and eyes small. Their marriage customs were lax; agriculture was more in favor with them than generally on the plains. Their religion somewhat resembled that of the Mexicans, and indicates a southern origin. One of their divinities was Opirikut, who represented the deity of fertility and agriculture. At the time of corn planting, a young girl, usually a captive, was sacrificed to this divinity. The victim was bound to a stake and partly burned, her breast was cut open, her heart was torn out, and flung into the flames. Her flesh was then divided into small pieces and buried in the corn field, to secure an abundant crop. In Mr. Grinnell's book this divinity appears under the name of Ti-ra-wa, and this sacrifice seems to have been most used by that portion of the nation known as the Skidi, whose home was on the Platte and Loup Rivers in Nebraska.

In 1806 the Pawnee tribe had a population of 6,223, with nearly 2,000 warriors. The Caddoes were of the same stock, and were also numerous on the western plains. "Since the removal of these people to reserves, mostly in the Indian Territory, the evidences of their progress towards civilization are cheering: but their character has changed. In the old barbaric days they were light-hearted, merry, makers of jokes, keenly alive to the humorous side of life. Now they are serious, grave, little disposed to laugh. Then they were like children, without a care. Now they are like men, on whom the anxieties of life weigh heavily. Civilization, bringing with it some measure of material prosperity, has also brought care, responsibility, repression. No doubt it is best, and it is inevitable, but it is sad, too." Recent information as to the remnant of this nation is given by Mr. Geo. B. Grinnell, from whom we have just quoted. Many of the young men were embodied into companies of armed scouts, under Major North and other officers, during the construction of the Union Pacific Railway in 1863, to guard against the depredations of the Sioux and Arapahoes. They were brave and reliable soldiers, and it is to be regretted that the tribe of Pawnees proper is reduced to a few hundred souls, while the whole Caddoan or Pani stock does not probably exceed in number two thousand. (10)

The American Cyclopaedia, article Pawnee, describes the tribe as warlike, long resident in Nebraska on the Platte River and its tributaries. The name Pawnee or Pani is from the Illinois language, and is said to be from Pariki, meaning a horn, referring to the peculiar scalp lock, dressed to stand erect and curve slightly back like a horn; the rest of the hair was shaven off. They were constantly at war with the Sioux and other nations, and, being considered irreclaimable savages, were permitted to be held as slaves in Canada, when bought from other tribes; wherefore,

(10) U.S. Bureau of Ethnology, Vol. 7, pp. 61, 62 and 113, date 1885-6. "The present number of the Caddoan stock is 2,250, settled in Fort Berthold Reservation, N. Dakota, and some on the Indian Territory, some on the Ponca, Pawnee, and Ojibwa Reservations, and others on the Kiowa, Comanche and Wichita Reservations." They are now self-supporting.

any Indian held in bondage was called a panis. As to this our worthy and renowned Canadian ethnologist, Mr. Horatio Hale, writes me: "Panis and Pawnee are undoubtedly the same word, in different orthographies." He states that the article last quoted is from the pen of J. G. Shea, the distinguished ethnologist, and editor of *Charlevoix*: "All that he wrote on Indian matters is of the highest authority—what Mr. Brinton writes is also entirely trustworthy." "The Pawnees were true Ishmaelites. They had no friends upon the prairies, save those they had conquered and held by fear (11)." In addition to the Pawnees, there was certainly another tribe which contributed slaves to Canada (12). In 1712 the Renards, or Foxes, endeavored to capture and destroy Fort Detroit, but were defeated and compelled to surrender at discretion. Those found in arms were massacred, the rest were distributed as slaves among the victors.

There are a few references in the New York Colonial Documents to panis, or to Indians enslaved by whites. A narrative, presented to the Mayor's Court of New York City, 24th January, 1689, complaining of the violent acts of the Lieutenant-Governor, Jacob Leysler, states that an Indian slave of Philip French was, by him, dragged to Fort William on the 23rd of the previous December, and there imprisoned, but French was himself arrested by order of this bold Governor, and spent his Christmas in durance, for various matters of alleged contempt to His Honor. (Vol. 3, 676.)

Colonel Heathcote reports to Lord Townsend, British Colonial Secretary, July 16th, 1715, that the Indians complain that their children, who had been bound out for a limited time to be taught and instructed by the Christians, were transferred to other plantations and sold for slaves. He adds, "And I don't know but that there may be some truth in what they allege." (Vol. 5, 433.) M. La Galissoniere's *Journal of events in Canada*, under date Nov. 11, 1747, says: "The four negroes and a panis, who were captured by the English, would be put on board a small vessel bound for Martinico, to be there sold for the benefit of the proprietors." (Vol. 10, 138.) Colonel William Johnson writes to Governor Clinton, of New York, 22nd January, 1750: "I am very glad your Excellency has given orders to have the Indian children returned, who are kept by the traders as pawns or pledges, as they call it, but rather stolen from them, as the parents came at the appointed time to redeem them, but they sent them away before hand, and as they were children of our friends and allies, and if they are not returned next spring it will confirm what the French told the Six Nations, viz.: that they are looked upon as our slaves, or negroes, which affair gave me a great deal of trouble at that time to reconcile. I cannot find that Mr. Abeil, who has a Seneca child, or Vandricson, who has got a Missisagey, are to deliver theirs, which I am apprehensive, will cause a great disturbance." (Vol. 6, 546.)

We find references of a similar character in the diary of David Zeisberger, the good Moravian missionary (13). He was loath to believe that such cruelty was practised, and ascribed the stories he heard to "lying rumours." Yet it is clear that these were well founded. Writing in 1795 at Fairfield-on-the-Thames, now known as Moraviantown, Ont., he says: "We had many lying rumours which the Indians hatch out, that the Indians here are entrapped by the white people, and will not be let go until they have all been sold as slaves. . . . The Chippewas have war with the North-western Indians. They have brought into Macinaw one hundred prisoners, a part of whom they sold to the whites. This is a nation with which they have waged war for many years." (14)

II. Next refer to the records in the old Province of Quebec relating to Panis. For these we are mainly indebted to the Abbe Tanguay's researches, made and

(11) "Pawnee Hero Stories and Folk Tales," by Geo. B. Grinnell, 1889, p. 307.

(12) McMillen's *History of Canada*, p. 91.

(13) *Diary of David Zeisberger*, by Eugene F. Bliss, published by the Historical and Philosophical Society of Ohio, 1888, Vol. I pp. 411 and 491.

(14) A Travers les Registres, Montreal, 1886.

published in 1886 under the Quebec Government. In the church registers at the City of Quebec, under date 1718, it appears that "in the course of that year several Panis, being introduced from Louisiana, being slaves of Quebec families, were baptized."

In 1730 and following years the Church registers of Three Rivers contain records of baptisms and burials of several such slaves belonging to the principal families of the town.

November 4, 1756.—"Marie Judith, agée de trieze ans, a ete baptisee," appears on the register of the parish church at Longue Pointe.

January 22, 1757.—A record shows that a panis slave called Constant, belonging to Madame de Saint Blain, was condemned to the punishment du carcan, and to be perpetually banished from Montreal. The mischievous character of this red woman was fully equalled by a negro slave of Madame de Francheville, who, in 1734, caused a great conflagration which destroyed part of Montreal. This negress was born in Portugal, and purchased by her mistress in New England. She was subjected to severe examination ("a la question ordinaire et extraordinaire"), when, it is stated, she confessed her guilt. (15) These cases are mentioned together, as they seem to be the only instances on the published records of such slaves being punished through the courts of Quebec; nor do panis appear on the Civil Court records, though their darker companions' names are often to be found there.

The carcan was an iron collar, placed around the neck, and connected by a chain to a post or to a wall, so compelling the prisoner to stand for a stated time, often for long, weary hours, in a strained position, and subject to ridicule. It was similar to the English stocks.

"La question extraordinaire" was the French name for the rack. These modes of punishment were not abolished in France until 1832.

We will now look at the records of the Montreal General Hospital, and we find, in a table prepared by the Abbe Tanguay, of families possessing slaves of the nation of the Panis that seventy-nine such slaves died in that hospital between 1754 and 1799. The birth, age and time of death of each are here given, and we have a record full of interesting facts and suggestions. Each poor slave has his or her Christian name, and the names were evidently given when the rite of baptism was performed. Mons. De la Verandrie had two, Joseph and Marie. Saint Luc la Corne had his Panis, Marie Joseph, who died in 1799, aged 100 years.

Among the masters were some gentlemen of aboriginal stock, or connected with Indian missions: M. Perthuis, interpreter of the Iroquois; De Quiensck, chief, and De la Garde, missionary to the Algonquins. (16)

Seigniorial, or well-known, families are represented in the masters. Deschambault, De Bleury, Chevalier de la Corne, De Veaudreuil, Benoit, Desriviers, Perigny, Reame, Decharme, Dames Deslignery and Monier. Messrs. De la Ronde, Delisle, De Longueil, La Coste, Leschelle, Senneville, De Barne and Clignanceur.

There is nothing in the record relating to the origin of these Panis except in regard to the last two, when we find that M. Gamelin had Jacques Cesar and M. Longueil had Marie both put down as Panis noirs, or black Indians of the plains, who were of darker hue than those in wooded lands. This being a distinctive term, places them as derived from the Pawnee nation proper, as designated by Charlevoix.

The Montreal newspapers of 100 years ago had occasional advertisements as to runaway slaves, and these were adorned with wood cuts representing the lost chattel. When a negro was wanted, he was shown running with naked body, save a cloth around the waist. The Panis was represented standing erect, with a feather head-

(15) Abbe Ferland's History of Canada, Cap. 29.

(16) Holding captives as slaves was, as is well known, common with the Indians. The Cherokees and Choctaws also had many negroes in bondage. There are some instances in Canada of red men holding blacks. The most notable of these was Colonel Brant Thayendinagea, who had several, among them being his body-servants, Patton and Ganseville, referred to in the writings of travellers such as Colonel Landmann and the Duke de Liancourt.

dress standing upright and a feather waist-covering, the body tattoo-marked. This comical figure, whether by accident or design, coincides with Mr. Grinnell's description of Pawnee Picts, or tattooed Pawnees. Rollin Michael Barrin, Count de la Gallissoniere, above mentioned, was Governor of New France, and a gentleman of scholarly taste and refinement. He is one of the leading characters in Mr. Kirby's excellent story, "The Golden Dog," the opening scene being laid in Quebec in 1748. Among the masters of Panis is the name of De Veaudreuil, who succeeded as Governor, and of the Chevalier la Corne St. Luce, a gallant soldier, who remained after the capitulation, and became a loyal defender of British rule. Other names, such as Benoit De Longueil and La Coste, are familiar to all readers of Canadian history.

Some months ago a worthy member of the Canadian Institute, with a handful of ashes from an ancient kitchen-midden, by means of a microscope brought up the Huron inhabitants and their surroundings as they were when Champlain unfolded the fleur-de-lis on the Georgian Bay. Our attempt is now, with these disjointed historic fragments from the ashes of time, to produce for development some features of these humble persons, the domestic slaves, and of their surroundings in those grand old times, when slavery was a thing of course and the seigniorial tenure most flourished in the old regime. The Panis no doubt spoke in a patois of French and Illinoisan. His dress was a rude commingling of the styles of Quebec and the wild South. He had no taste for work at the tail of the plough, but supplied venison and fish, made bows and lacrosse sticks for the boys, and joined them in games and hunting. The squaws waited on table, were the ladies' maids, the children's ayahs, and fashioned moose-skin moccasins, adorned with bright-tinted quills of the bristling porcupine. Removed from his native wilds, the Panis doubtless followed, to some extent, the religion of his masters, with its rites and ceremonies. But when he gazed on the rising sun, away from the presence of the Black-robe, we may imagine him imploring the protection of the dread Opirikut, god of his fathers; and when, in the winter evenings, the aurora flashed across the vault above, he saw the spirits of his friends in flight from the far south land, and then his heart filled with longings for the banks of the Niobrara, where the ancestral tents were set and the buffalo shook the plains.

With such suggestions, names and facts as have been placed before us, it only needs the wand of imagination to raise the curtain of six-score years and show the home of the seigneur among his habitant friends and neighbours beside the St. Lawrence, the St. Francis or the Chaudiere. And when there comes that happiest hour of the day, when the work is done and the night as yet is young, they gather into the great room, beech logs blaze and cast their light on bronzed features as they enter, capotes are thrown back, waist-sashes loosened, and the snow is shaken from homespun coats and deerskin leggings. Pleasant greetings and kind enquiries pass around, and the news of the day is exchanged. The cure, the seigneur and the notary sit where all can see and hear. In and out flits on moccasined feet a dusky figure almost unnoticed, yet not unwelcome. He quiets barking dogs, brings a coal to light a pipe, or stirs the logs to a fresh blaze. He is the Indian slave, the panis.

III. The edict of Louis XIV. in 1688, authorizing the importation of slaves from Africa, referred only to negroes.

Some doubt seems to have existed as to the legal status of panis, and, to remove these, Jacques Raudot, Ninth Intendant, issued an ordinance at Quebec on April 13th, 1709, referring to negroes and the Indian people called Panis, and declaring, "We, therefore, under the good pleasure of His Majesty, order that all the panis and negroes who have been bought, and who shall be purchased hereafter, shall belong in full proprietorship to those who have purchased them as their slaves." Then followed an injunction, prohibiting the slaves from running away, and provisions for imposing on those who aided them in so doing a fine of 50 livres

Hocquart, Intendant under the Marquis de Beauharnois, Governor-General,

in 1736 issued an ordinance, declaring null all enfranchisements not made in compliance with certain regulations, and registered.

A declaration of the Paris Royal Council of 23rd July, 1745, declared that slaves who follow the enemy to the colonies of France, and their effects, should belong to His Most Christian Majesty.

This was a precedent of General Butler's famous order, made more than a century later, confiscating slaves coming into the Union ranks as "contrabands."

The Parliament of Great Britain was, when Canada was secured to the Empire, very favourable to the importation of slaves into the plantations, and had passed many Acts to aid that object.

Proceedings in the Montreal courts towards the end of last century tended to weaken the master's claims, and ultimately entirely broke them, with more regard to the rising public sentiment in England and France against slavery than to the actual state of the law, as has been shown in our previous paper. (17)

A census taken in 1784 states the number of slaves in Lower Canada at 304, of whom 212 were in the District of Montreal, 88 in that of Quebec, and 4 in Three Rivers. No distinction is there made between negroes and panis. An attempt was made in the first Parliament of Lower Canada, in 1793, to obtain an Act similar to that passed in the Upper Canada House at Niagara, which would have declared all slaves then held, to be in bondage for life, and only given freedom gradual y to their offspring; but this proposal, though warmly debated, was not successful. In 1790, and again in 1800, Mr. Papineau presented petitions from many inhabitants of Montreal referring to the ordinances of Intendants Raudot and Hocquart, also to the Quebec Act, maintaining the former laws and usages to the people of Canada, and also to an Act of George III., under cover of which the petitioners allege a number of slaves, panis and negroes, were imported (18). Bills brought in on these petitions were much discussed, but sentiment was against their object; the declaration of the rights of slave-holders, and they failed to pass into law—thus slavery disappeared from Lower Canada. (19) It practically ceased at this time in Nova Scotia also and New Brunswick. The Upper Province had no such judicial and legislative experience as Lower Canada in regard to domestic slavery. When separated from the Mother Province in 1791, civil rights, including the law and customs as to slaves, still held in force. The Upper Canada Act of 1793 passed without difficulty, and there was no enactment here between that and the Imperial Act, which freed the few remaining slaves in 1834. While slavery existed, its character was modified, and personal cruelty guarded against by the code noir and provincial ordinances. As for the Indian slaves, there was also sympathy through the fact that not a few of the inhabitants were connected with the tribes by marriage. Mr. Parkman says with much truth: "Spanish civilization crushed the Indian, English civilization neglected him, French civilization embraced and cherished him. (20)

IV. There are few instances of panis in Western Canada. That of Mr. Langlade, who saved the life of Henry, the trader, at Mackinac, has been referred to. By the second article of a treaty of peace and amity, made by Sir W. Johnson with the Hurons 18th July, 1764 (21), it is provided that "any English who may be prisoners or deserters, any negroes, panis, or other slaves amongst the Hurons, who are British property, shall be delivered up within one month to the commandment of the Detroit." It may be concluded that there were a considerable number of panis in this western region then.

(17) "De Lesclavage in Canada," by Sir L. H. Lafontaine, Proceedings of Societe Historique de Montreal, 1858, and "Slavery in Canada," by J. C. Hamilton. Transactions of Canadian Institute, 1890. Vol. I., p. 102.

(18) 14 Geo. III., cap. 83; 30 Geo. III., cap. 27.

(19) Journal of 1799, p. 123, and of 1800, p. 51.

(20) "The Jesuits in North America," p. 44.

(21) Mr. S. White has the original treaty, but for copy see N. Y. Colonial Documents Vol. VII., p. 65a.



In The Niagara Herald of 25th August, 1802, Charles Field forbids all persons harbouring his Indian slave, "Sall." Old residents of Essex County remember a paní who lived at Amherstburg fifty years ago.

Mr. Solomon White, lately member of the Legislative Assembly for Essex, is one of those who speak of him. When a child Mr. White saw "a little yellow man" at church, and he asked his mother who he was. "That is Mr. Caldwell's paní, Alexander," she answered. Though set free in 1834, he continued generally to reside at the old homestead, near the banks of the beautiful Detroit river. Here he was content to stay, passing an humble, happy existence.

There were many coloured people formerly slaves in the neighbourhood, and not far away was a settlement of the Hurons, but he preferred to look on the face and follow the footsteps of his old master, the late Mr. John Caldwell, enjoying the same civilization and religion. He died when on a visit to Detroit. His faith was that of his white protector, and his hope was, not to go to any happy hunting ground of his savage ancestors, but to participate in the white man's future. With him passed from Canada the last of the panís.

(22) As to Indian slavery in the south-west, see Mr. Lucien Carr's "Mounds of the Mississippi Valley," Smithsonian Report, 1891, p. 532, quoting "Narrative of Father Marquette," p. 32, and "Memoir of the Sieur de Tonti," pp. 56-71. "The Saukie warriors generally employ every summer in making excursions into the territories of the Illinois and Pawnees, from whence they return with a great number of slaves." As to sun-worship among these Indians, Mr. Carr states, p. 549, "According to Charlevois the Indians claimed to have received the calumet from the Panís, to whom it had been given by the sun. . . . In trade, when an exchange has been agreed on, a calumet is smoked in order to bind the bargain, and this makes it in some manner sacred. . . . The Indians, in making those smoke the calumet with whom they wish to trade or treat, intend to call upon the sun as a witness, and in some fashion as a guarantee of their treaties, for they never fail to blow the smoke towards that star." The Sieur de Tonti describes temples dedicated to sun-worship, met in the course of his trip with La Salle down the Mississippi, A.D. 1682, one such temple was like the cabin of the chief, except that on top of it there were the figures of three eagles which looked toward the rising sun. It was forty feet square, and the walls ten feet high and one foot thick, were made of earth and straw mixed. The roof was dome-shaped, about fifteen feet high. Around this temple were strong mud walls, in which were fixed spikes, and on these were placed the heads of their enemies whom they sacrificed to the sun. These temples were found from Arkansas to the southern extremity of Florida, and in point of time they cover the 180 years between the expedition of De Soto and the visit of Charlevois in A.D. 1721. When the Illinois came to meet Marquette on his voyage, the first ever made by a white man on the Lower Mississippi, they marched slowly, lifting their pipes to the sun, as if offering them to him to smoke.

(23) In P. Campbell's "Travels in North America in Years 1791-92," at p. 236, an account is given of adventures among the Ottawas. Campbell killed two Indians who had attacked him in his tent at night. He was soon after this made a prisoner, and said to his captors that he supposed they would avenge on him the death of the two Indians. He was answered that they cared little for what he had done, "that the men killed were not Ibawas but Pannees (sic), i.e., prisoner-slaves taken from other nations."

A PROBABLE SOLUTION OF THE SECONDARY UNDULATIONS FOUND UPON  
SELF-RECORDING TIDE GAUGES. BY NAPIER DENISON, ESQ., TORONTO  
OBSERVATORY.

(Read January 16, 1897.)

As this is the year set apart throughout the scientific world for special cloud observation and the study of the upper atmosphere as a means of improving the present methods of weather forecasting, and being one of those engaged upon this work for Canada, it seems an opportune time to bring the following investigations before the public :

In June last the writer's attention was first drawn to small, rapid changes of water level on Lake Huron, at the mouth of the river at Kincardine, where a rise and fall appearing to be regular, a set of observations with a temporary float were taken, and a uniform rise and fall of about three inches was found to occur, averaging nine minutes, that is about eighteen minutes for each undulation, the float moved up stream at the rate of a mile and one-half an hour. Upon returning to Toronto in July, by permission from Mr. Stupart, Director of the Meteorological Service, a simple instrument was devised to automatically record such oscillations, and set up at the mouth of the Humber River, where, ever since, most interesting results have been obtained. (1) By comparing these with the sensitive photographic barograph traces of the Observatory, it was found when a rise and fall of about four inches in water level occurred a corresponding, but slight change, in atmospheric pressure is noticeable, also a marked twenty-minute interval between these waves. To fully investigate this phenomenon another instrument, similar to that at the Humber, was placed at the Burlington Canal, and records from both instruments plotted, in conjunction with the barograph traces and different types of weather, as taken from the bi-daily weather charts.

It has been found, ever since the introduction of self-recording tide gauges throughout the world, peculiar oscillations within the normal tidal curves have been noted and commented upon, but to my knowledge, the cause not fully accounted for. These oscillations are most marked at tidal stations situated near the ends of bays, owing to the favourable configuration of the shore, and the shallowness of the water. They are not, however, of constant occurrence, but vary in intensity upon different days. Some months ago my attention was drawn to this peculiar phenomenon by a paper read before the Royal Society of Canada in May, 1895, by W. Bell Dawson, M.A., C.E., in charge Canadian Tidal Service, (2) who graphically demonstrated the existence of these secondary undulations, but left their cause unexplained. Thinking the above lake researches might help to solve the cause of these secondary tidal curves, through the kindness of Mr. Dawson, copies of the tidal records for Halifax, N.S., and St. John, N.B., were obtained for a number of days, including different types of weather. To fully investigate all the phenomena pertaining to these curves, days in succession were taken, chiefly those preceding and during stormy weather, for instance, the 5th, 6th, and 7th of February, 1896. These curves were plotted upon one-tenth inch squared paper, allowing one inch to the foot for Halifax, which has a range of about six feet, and one inch to five feet for St. John, which has a range of about twenty-eight feet, (3) and allowing one-tenth for every five minutes, being careful to minutely measure the extent and duration of every oscillation: above this was plotted the readings of the Halifax barometer, taken every three hours, also the hourly direction and velocity of the wind.

(1) A full account of these lake researches to be published shortly.

(2) Note on secondary undulations recorded by self-registering tide gauges. Vol. I., Sec. III.

(3) The St. John tidal curve is not included in above table, as only the most pronounced undulations are noticeable due to the reduced scale necessary where such high tides occur.

The following table gives a brief summary of results:—

Date.	Time.	HALIFAX, N.S.						Distance of Storm Centre from Halifax in miles.	Distance travelled during last 12 hours in miles.	REMARKS.
		Condition of Tidal Curve.	Atmospheric Pressure — Inches.	Weather	Wind		Precipitation			
					Vel.	Dir.				
1896. Feb'y 5th.	8 a.m.	Unbroken.	30.12	Cloudy	3	E.	0	1750	—	From noon to 11 p.m. decided undulations throughout, but not exceeding .2.
"	8 p.m.	Decidedly undulatory.	30.18	Cloudy	3	S.	0	1475	275	Barometer rising until 6 a.m. 6th, wind calm from 1 to 6 a.m., gradient for easterly gale extending to Boston.
"	8 a.m.	Most pronounced oscillations, often exceeding .4".	30.23	Fair	0	0	0	1000	475	Barometer falling rapidly, gale extending to Halifax. Grand Manan, in the Bay of Fundy, reports 60 miles per hour.
"	8 p.m.	Ditto.	29.90	Lt. Rain	26	S.	0	580	420	Maximum oscillations from 1 to 6 a.m., ranging from .8" to 1" with an average interval of 20 minutes; also time of max. vel., 41 miles from S. and S.E.
"	8 a.m.	Amplitude of oscillations about .6".	29.08	Foggy	10	SW.	11.22	300	280	Curve almost unbroken by midnight, a moderate gale still blowing from the N.W.; at time of forenoon high tide the curve was 1 1/2 feet above normal.
"	8 p.m.	Oscillations diminishing.	29.02	Cloudy	20	NW.	10	330	400	

From the tabulated data and the other tidal curves, studied in connection with the bi-daily weather charts, which bear out the increase of oscillations preceding the approach of atmospheric depressions, it appears that these secondary undulations are due to atmospheric waves or billows set up in the upper atmosphere.

We are told by the late Professor Von Helmholtz, (4) who has made a special study of these waves from theory and analogy with ocean waves, and has calculated their possible forms and dimensions, that "As soon as a lighter fluid lies above a denser one, with well-defined boundary, then, evidently, the conditions exist at this boundary for the origin and regular propagation of waves, such as we are familiar with on the surface of water. This case of waves, as ordinarily observed on the boundary surfaces between water and air, is only to be distinguished from the system of waves that may exist between different strata of air, in that in the former the difference of density of the two fluids is much greater than in the latter case. Since the moderate winds that occur on the surface of the earth often cause water-waves of a metre in length, therefore, the same winds, acting upon strata of air, say 10 degrees difference in temperature, maintain waves of from two to five kilometres in length. Larger ocean waves, from five to ten metres long, would correspond to atmospheric waves of from fifteen to thirty kilometres, such as would cover the whole sky of the observer."

Mr. Clayton, of the Blue Hill (Observatory (5) has graphically shown the coincidence and easterly progression of the larger atmospheric waves by means of the daily synchronous barograph traces from stations south and east of his, plotted upon the same time sheet, and has also shown that the maximum number of waves occur during a northeast wind, and the minimum when the wind is from the southwest, and that the greatest number were recorded during the winter months.

After referring to the above valuable investigations by two such well-known scientists, let us return to the foregoing table and frame a few leading questions, with the answers which appear to me most satisfactory. Further discussion will doubtless throw more light upon this subject.

I. Why do the secondary undulations become decidedly marked from noon of the 5th, although the barometer is steadily rising, and the wind at the earth's surface light or calm?

Because the upper part of the lower stratum of air, not being retarded by friction due to contact with the earth, and of greater specific gravity than that to the south and west of it, begins to move towards the region of lighter air, viz.: in a southwesterly direction, the barometric gradient being small, the movement is slow, but being in an opposite direction to the upper stratum, which is less dense, and rapidly moving polewards (mean winter rate, 112 miles per hour), (6) but inclined to the east. According to Helmholtz, this should be sufficient to produce along the boundary surfaces of the two strata, waves which may extend to the earth.

2. From 8:00 p.m., after the storm centre had passed to the north of Halifax, and a moderate gale still blowing from the northwest, why do the rapid undulations decrease until they almost form an unbroken curve by midnight?

The wind being westerly, a decided decrease of the undulations should be expected, on account of the lower stratum of the air, now moving approximately in the same direction as the upper layer, and as the force at the surface of the earth is still that of a moderate gale, greater velocities may be looked for at higher levels, where friction (viscosity not included), caused by contact with the earth, is inappreciable, thereby tending to equalize the easterly rate of movement of both strata: also well-defined boundary surfaces are not so likely to exist, owing to the more uniform temperature throughout both strata.

(4) Paper read before the Prussian Academy of Sciences at Berlin, on July 25th, 1859, and translated in the Smithsonian Reports by Professor Abbe.

(5) Blue Hill, Mass. Meteorological Observations. Vol. XL., Part III., Appendix E., 1893.

(6) From Blue Hill cloud observations.

3. Why do the greatest number of atmospheric waves occur during northeasterly winds, and the least number with southwesterly winds?

A stratum of lower air, set in motion from the northeast towards the southwest, would be moving in an opposite direction to the upper or poleward stratum, therefore, the greater the velocity of the lower layer towards the westward, caused by the differences of atmospheric pressure, over the earth's surface, the greater will be the opposing forces at the boundary surfaces of the two strata, where great atmospheric billows may be found, especially when the densities vary greatly, caused by large differences of temperature between the two strata. The result would be similar to a high wind blowing against a strong surface current of water.

The minimum number of waves recorded during southwesterly winds is due to the lower stratum of air moving in the same direction as the upper, or poleward stratum.

4. Why do the greatest number occur during the winter months?

The winter being the time of the greatest differences of temperature between the equator and the poles, and consequently a more rapid movement of the poleward current, slight changes of velocity of the lower atmosphere tend to set up waves along their boundary surfaces, where, in all probability, greater differences of temperature exist than in summer. As in the case of an important storm centre moving northeasterly from the Gulf of Mexico, bearing large quantities of heat and moisture, while pronounced anti-cyclonic conditions, attended by great cold, prevail in the northern portions of the continent.

5. How can these atmospheric waves, which correspond to only a few hundredths or thousandths of the barometric inch at the earth's surface, cause such rapid and extreme oscillations as appear upon the tidal records?

The peculiar configuration of the coast line and varying depths of water, being the main causes of the different heights of the tides at separate stations, may we not apply the same to account for these peculiar oscillations, by asserting that the atmospheric waves or billows, in passing over the surface of the sea (in this case in the vicinity of Halifax harbour), tend to form minute undulations upon the surface, corresponding to the length of these billows, which, as they move farther into the bay, become magnified as they reach narrower and shallower portions, until finally they assume the proportions as found upon the tide gauge, a distance of about nine miles from the entrance to the harbour. That these oscillations do become more pronounced the farther one enters a long bay, have been noted by those in connection with tidal work. (7)

In conclusion, if the above explanations are correct, would it not be of great scientific and commercial value, in place of eliminating these secondary undulations, when tabulating the primary ones, to increase the amplitude of these secondaries, by lengthening the cylinder, use one sheet per day to prevent confusion of traces, and make a special study of them, respecting their intensity and time interval, in conjunction with synoptic charts during different types of weather? It appears as if these gauges are extra sensitive barometers, locally forewarning the approach of important storm centres many hours previous, in fact, during a rising or stationary barometer and before the shift of wind.

Improved tidal gauges of such construction are likely to be of incalculable value at all coast stations, more particularly by those on a western seaboard, such as that of the British Isles.

(7) Among others by Major Baird, R.E., F.R.S., Manual for Tidal Observations, 1886.

#### NOTE ON THE PUBLICATIONS OF THE CANADIAN INSTITUTE.

In 1852 The Canadian Institute began publishing its Proceedings under the name of "The Canadian Journal" in quarto. In this form it issued forty-one numbers, making three volumes.

In 1856, with the same name, the form was changed to octavo, in which size, up to 1878, ninety-two numbers were issued, making fifteen volumes.

In 1879 the name was changed to "Proceedings of the Canadian Institute," under which title twenty numbers were issued, in seven volumes.

In 1890 the publication was enlarged and the name again changed to "Transactions of the Canadian Institute." In this form, up to the present, nine numbers have been issued, making four volumes and part of a fifth. It is now proposed to issue two sets of publications, the "Proceedings" to contain short papers and abstracts of longer papers, to appear more frequently than hitherto, and as soon after the reading of the papers as possible. The "Transactions" to be issued at longer intervals and to contain such extended papers as it may be deemed proper to publish in full.