CANADA

DEPARTMENT OF MINES

– Hon. W. A. Gordon, Minister; Charles Camsell, Deputy Minister

NATIONAL MUSEUM OF CANADA

W. H. Collins, Acting Director

BULLETIN No. 67

Annual Report for 1929

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OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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GENERAL ACTIVITIES OF THE NATIONAL MUSEUM OF CANADA

By W. H. Collins, Acting Director

Satisfactory progress was made in the work of the National Museum of Canada during the year 1929, in the collecting of material for purposes of scientific study and exhibition, in systematic scientific research, in the public display of material in the Museum halls, and in general educational activities.

Ethnological investigations were carried on among the Tsimshian Indians of Nass River region, British Columbia, the Kwakiutl and Nootka tribes of Vancouver island, the little-known Indians in the vicinity of Norman on Mackenzie river, and the Ojibway of Georgian bay, and a complete series of physical measurements was made of Indians of Peace River district. Collections were made, at these various points, of Indian material for purposes of study and exhibition, and moving pictures were taken among the Kwakiutl and Nootka tribes of Vancouver island and the Blackfoot Indians near Gleichen, Alberta. The investigation of ancient Indian village sites on the north shore of the St. Lawrence was continued.

Investigations into the mammal life of southern British Columbia were continued and good collections were obtained. These investigations are of particular interest because of the way in which the marked variations in climatic and topographic conditions are reflected in the fauna and flora. Mammals were collected, also, from that part of Quebec north of Ottawa. A member of the staff accompanied the annual Canadian Government Expedition to the Arctic and made observations on the fauna and on the conditions affecting faunal life.

The botanical survey of Wood Buffalo park, west of Slave river, was continued and valuable contributions were made to the herbarium. In connexion with a systematic botanical survey of the Maritime Provinces, field work was carried on in southwestern New Brunswick. Collections were also made from Matapedia valley, Quebec.

Additions were made to the systematic mineralogical and geological collections, and good collections of vertebrate and invertebrate fossil material were made. Some of this material will be exhibited, and all of it will be made the subject of careful study.

During the year the Museum equipment was increased by the purchase of thirty steel table cases specially adapted for placing against the wall. Two of these were placed in the Palæontological hall, three were given over to the exhibition of typical ores, rocks, and metallurgical products from three important mining districts, four are being used for geographical exhibits, and the remainder are to be placed along the north and south walls of the east Anthropological hall.

The Anthropological Division has made good progress in the preparing and exhibiting of splendid collections of articles of Indian design and workmanship, in the upright cases acquired over a year ago. The great variety of the objects, and the human element connected therewith, the beauty of the designs, and the brightness of the colouring admit of the assembling of exhibits of great attractiveness and interest.

As the National Museum of Canada is an outgrowth of the Geological Survey, and as its Acting Director is also the Director of the Geological Survey, the closest co-operation exists between the two institutions and in certain lines of activity no sharp line of division exists. The Museum is indebted to members of the staff of the Geological Survey for exhibits of a palæontological, mineralogical, geological, and geographical character.

Other government departments have shown a much appreciated interest in the work of the Museum and we are pleased to report that the Forestry Branch, Department of the Interior, has set up at considerable trouble a fine exhibit illustrating the manufacture of wood pulp and some of the products of wood pulp, and that the Entomological Branch, Department of Agriculture, has assembled and set up a fine exhibit illustrating the life history of the silkworm and showing a variety of silk products. The National Parks Branch and the North West Territories and Yukon Branch, Department of the Interior, have rendered assistance in the acquiring of material for purposes of study and the latter has turned over to the Museum valuable collections from Baffin island.

The Acting Director of the Museum here expresses his gratitude to the Entomological Branch, Department of Agriculture; the Canadian National Parks, the North West Territories, and Forestry Branches, Department of the Interior; the Department of Indian Affairs; the Royal Canadian Mounted Police; and the Geological Survey, Department of Mines; and other sections of the government services, for valuable assistance and friendly co-operation. He also wishes to express to many individuals and organizations, both Canadian and foreign, his most cordial appreciation for donations and exchanges, and for assistance rendered in connexion with scientific investigations.

MUSEUM LECTURES

A course of lectures in natural history and other scientific subjects is presented each winter in the lecture hall of the Museum. An outline of the history of this phase of the Museum's activities is given under the heading "Popular Education." The lecture committee, consisting of H. I. Smith, M. E. Wilson, and C. L. Patch, on which falls the responsibility of securing lecturers and organizing the course, reports a very successful year. The lectures are delivered to children Saturday mornings and the attendance is so great that they have to be repeated, the first lecture commencing at 10 o'clock and the second at 11 o'clock. Adults have the privilege of hearing them Wednesday evenings. Appropriate moving pictures are also shown. For the loan of films the Museum wishes to express its gratitude to the Province of Ontario Pictures; the Canadian Government Motion Picture Bureau; the Canadian National railways; the National Parks of Canada; the American Museum of Natural History; the United States Bureau of Agriculture; Ball Brothers, Muncie, Indiana; and Pathe Exchange, Inc.

It is gratifying to report that other government departments and persons outside the government service have manifested a willingness to co-operate in the lecture movement. Only three of the lecturers for the 1929-30 term were members of the Museum staff. This co-operation makes it possible to deal with a great variety of subjects.

The total attendance of children at the Saturday morning lectures of 1929-30 was 8,900, with an average of 593, and the total attendance of adults at the Wednesday evening lectures was 3,323, with an average of 222. Following is a list of the lectures delivered:

Brick, ancient and modern, by L. P. Collin.
The golden isles, by Madge Macbeth.
Germs—what are they? What are they like? And what do they do? by Norman McL. Harris.
The interior of the earth, by F. J. Alcock.
A cruise to the West Indies and Panama, by Wilfrid S. Lawson.
Indian whale hunters of Vancouver island, by Douglas Leechman.
Ridiculous birds, by H. F. Lewis.
The lighthouse service of Canada, by J. G. Macphail.
Ancient reptiles of sea and air, by C. M. Sternberg.
How glass is made, by L. Heber Cole.
The quest for ore deposits in the Canadian Shield, by J. F. Wright.
The Peace River country, by Donald Macbeth Kennedy, M.P.
Java, past and present, by Diamond Jenness.
The romance of wild flowers, by D. A. MacKay.
Glimpses of South and East Africa, by W. H. Collins.

POPULAR EDUCATION

Popular education is not the least important of a national museum's activities. A museum that aims only at accumulating a great mass of material for study, that provides the most adequate equipment and facilities for investigation, and that concentrates its energies on scientific research to the neglect of popular education, grows one-sided, and fails to attain to a maximum of usefulness to the community it serves. It separates itself from the common current of humanity and forfeits the interest, the enthusiasm, and the support of the public.

The members of the staff in many ways have shown their keen appreciation of the importance of educational effort.

In the museum halls attractive material in the possession of the institution is displayed, with legible labels giving information of a popular and scientific nature. Inquirers for further information and for the privilege of examining material not on exhibit are courteously received. Guides and instructors are provided for groups of tourists, students, and teachers, if requested.

Two courses of lectures are given each year in the auditorium of the Museum, one course during the last three months of the year, and the other during the first three months of the year. These lectures are given to children Saturday forenoons, when the attendance is so large as to necessitate their repetition, and to adults Wednesday evenings. To Mr. Harlan I. Smith, archæologist, is due the credit for starting the lectures. They were started in 1912 and were held at any convenient time in a vacant room on the top floor of the Museum, the cheapest kind of seating being improvised. Seating was installed later in the lecture hall and the lectures were continued here until February, 1916, when the Museum building had to be vacated to permit of the holding of parliamentary sessions therein until the Parliament Buildings which had been destroyed by fire could be replaced. After that the lectures were held in schools and other buildings until the Museum building was again made available.

The lecture hall was then equipped with a projection lantern and a moving picture projector, and lectures have been held here since 1920. The statement given elsewhere of attendance at the Saturday morning lectures is an indication of the appreciation in which they are held by the children of Ottawa.

Educational work of popular and semi-scientific character outside of Ottawa has not been neglected, and efforts are being made to extend it. Lantern slides illustrating a variety of topics are loaned to lecturers and teachers. The number of slides for this purpose is added to frequently, and new subjects are dealt with.

Use is made also of the moving picture for carrying on educational work throughout the country. A library of films is gradually being acquired. A number of films are purchased, but the exposures for several have been made by members of our own staff. Special mention should be made of pictures of Indians in western Canada. They illustrate the customs, the ceremonials, the home life, the industries, and the art of the Indians. They depict the intimate lives of the people in such a way that they can be obtained only by one who through fair treatment and a sympathetic understanding of the Indians' character can win their confidence and enlist their support. The films are thus of value not only for educational purposes of a popular character but also as scientific records.

Permission is given to members of the Museum staff to accede to the requests of various organizations for the delivery of lectures on subjects on which such members are specially qualified to speak, and as the members of the staff are engaged during the summer months in field work broadly distributed throughout Canada, these lectures reach a widespread public. For instance, C. M. Barbeau has lectured on ethnological subjects to students in the University of British Columbia, and on art, folk-lore, and folk-songs to organizations in eastern Canada; C. M. Sternberg delivers each year a lecture on dinosaurs to such organizations as Rotary clubs and Kiwanis clubs; and Clyde L. Patch has by his lectures on reptiles and amphibians stirred up a remarkable interest in these forms of life.

Assistance is given to local museums, particularly in suggestions as how to display to the best advantage the material in their collections with the limited means at their disposal. Assistance is also rendered by offering exhibition material in exchange. The Anthropological Division has taken advantage of a desire on the part of the Canadian National railways to exhibit Indian material in the larger cities of Canada and the United States, and several good collections have been displayed. A very fine collection of anthropological material, some of it irreplaceable, has been loaned to the Imperial Institute for exhibition in London. Exhibitions illustrating the work of the whole Department of Mines, of which the National Museum is a branch, have been made at annual meetings of the Canadian Institute of Mining and Metallurgy, and several small collections of minerals have been displayed by Canadian Trade Commissioners in foreign countries.

Three sets of economic minerals, rock-forming minerals, and rocks are prepared for sale to educational institutions. One set is prepared for use in the teaching of physiography in secondary schools, one is for use in

elementary classes in mineralogy and geology, and one for use in advanced classes in mineralogy and geology. In addition to these sets, for which many tons of material are collected annually, smaller sets are prepared for prospectors and students. All sets are sold at a nominal price.

The National Museum offers opportunities to commercial artists for suggestions in design. By means of circular letters and through the medium of the press this matter has been brought to the attention of the public, with the result that there has been a considerable correspondence, and a great many whose interest has been aroused have received assistance direct by visiting the Museum and discussing the subject with members of the staff.

The Biological Division is to be credited with a very important phase of the work of popular education. In addition to a few articles on special subjects in ornithology, P. A. Taverner has written two comprehensive general works on birds, namely, "Birds of Eastern Canada" and "Birds of Western Canada." Two large editions of "Birds of Eastern Canada" were printed and are now exhausted. The very favourable reception of this book led to the writing of "Birds of Western Canada." The first edition of 15,000 of this work was quickly exhausted and a second large edition was published. These books contain descriptions of the birds, their nesting habits, distribution, and other notes of interest. They are illustrated by a great many text figures in black and numerous coloured plates. The coloured plates are from paintings by Major Allan Brooks and Frank Hennessey and have received very favourable comment. The electros have been loaned frequently to printing companies in Canada, and inquiries regarding their loan have been received from the United States.

Sixty of the coloured pictures have been reproduced on post cards for sale to the public. The cards also carry descriptions of the birds.

"Birds of Eastern Canada" and "Birds of Western Canada" are in the library of almost every ornithologist in North America and of a great many ornithologists in other parts of the world, and they are widely distributed among amateur bird lovers of Canada. They have been a powerful factor in fostering an interest in birds and their preservation. There are few books printed in Canada that are better known, or more highly prized.

Those who have followed musical developments in Canada during recent years are impressed with the popularity attained by the folk-song. Much of this popularity is due to the activities of C. M. Barbeau, who has made a special study of Indian and French-Canadian songs. He has brought these to the attention of the public by lectures and in connexion with handicraft festivals and exhibits, and has assembled and interpreted collections of songs for publication. Mr. Barbeau has also been one of the organizers of concerts of Canadian music presented at many points throughout Canada under the auspices of the Association of Canadian Clubs.

The Chief of the Division of Anthropology, D. Jenness, acted as one of the two Canadian representatives to the Fourth Pacific Science Congress that was held in Java in May, 1929. This is the congress of the Pacific Science Association whose main objects are: *(a)* "To initiate and promote co-operation in the study of scientific problems relating to the Pacific

region, more particularly those affecting the prosperity and well-being of Pacific peoples; *(b)* To strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientists of all the Pacific countries."

An invitation from the Canadian Government to hold the fifth congress in Canada in 1932 was accepted by the association and preparations for the same are already under way. Mr. Jenness has been requested to act as chairman of the committee on anthropology and is making good progress with important plans in this connexion.

DIVISION OF ANTHROPOLOGY

D. Jenness, Chief of the Division, reports:

Field Work

The division had six parties in the field during the summer. D. Jenness studied the Ojibwa Indians of Parry Sound region in Georgian bay; C. M. Barbeau completed his ethnological researches among the Tsimshian Indians of northern British Columbia; H. I. Smith collected ethnological and archæological specimens on Vancouver island, and took motion pictures of the various tribes he visited; W. J. Wintemberg excavated a number of archæological sites on the west coast of Newfoundland; J. C. Boileau Grant, Professor of Anatomy in the University of Manitoba, investigated the physical characteristics of the Cree and Beaver Indians on Peace river; and C. B. Osgood, of the University of Chicago, who went down Mackenzie river in the summer of 1928 to winter among the Hare Indians of Great Bear lake, completed his studies of that tribe during the spring and returned south on the river steamer in the late summer.

D. Jenness, representing, with Professor C. McLean Fraser, the National Research Council of Canada, attended the Fourth Pacific Science Congress that was held in Java during the month of May, and participated in the sessions and anthropological excursions that featured the congress. He returned to Ottawa early in July and left a few days later for Parry Sound, where he spent two months on the Indian reserve. Although the Ojibwa of this area have been under the influence of European civilization for three centuries, they retain a surprising number of their ancient beliefs and customs. Mr. Jenness was, therefore, able to gather a considerable body of material that throws new light on this people, and, incidentally, on the beliefs of the Huron Indians who bordered them to the south.

C. M. Barbeau continued his Tsimshian researches, from May to October, among both the Niska tribes of the Nass and the Tsimshian proper of Port Simpson. As during his investigations on Nass river in 1927, his study covered the social organization, the heraldry and privileges, the hunting grounds, and the oral traditions of the various Niska families. He explored the upper canyon of Nass river and Lava lake, districts of some importance in the Indian traditions; and during a visit to the deserted Tlinkit village of Cape Fox, on the Alaskan border, he photographed a number of totem poles, several of which had been carved by Niska workmen. His field work among the Tsimshian Indians is now completed, and

he will present its results in a series of monographs. The first, on the "Totem Poles of the Gitksan," is in the press, and another on the "Songs of the Tsimshian," in preparation. Later monographs will describe and give the history of the phratric groups in the following order: the Eagle, the Wolf, the Raven-Larhsail, and the Fireweed-Killer-whale. During the period of field work Mr. Barbeau photographed a considerable number of Tsimshian and Haida carvings in the Municipal Museum, Vancouver, in the Provincial Museum, Victoria, and in the private collections of the Messrs. Newcombe, also at Victoria. He collected a number of specimens for the National Museum, and some totem poles for the Royal Ontario Museum of Archæology, Toronto.

Harlan I. Smith secured 6,000 feet of motion picture film illustrating the Coast Salish, Kwakiutl, and Nootka Indians of Vancouver island, and 360 ethnological and archæological specimens, among them a doorway consisting of two large carved posts and a crossbeam. He discovered and photographed a number of petroglyphs on Hornby island, some of which are being rapidly destroyed by tidal action.

W. J. Wintemberg, in his investigation of the west coast of Newfoundland, discovered traces of Eskimo occupation in ten different localities, the southernmost being at Bonne bay. He obtained from these settlements a considerable number of stone and bone implements, which so closely resemble specimens of the peculiar Eskimo culture found a few years ago at Dorset, in Hudson bay, that they must have been made by an offshoot of the same people. There was no trace of iron in any of the sites, which were, probably, occupied before 1500 A.D., when European fishermen began to frequent the island.

J. C. Boileau Grant successfully measured one hundred and ninety-one Beaver and Cree Indians on Peace river, and tested the blood-groupings of one hundred and three. He is withholding a detailed account of his results pending investigations of the Indians of Great Slave Lake area, when he will unite the data from the two regions in a single monograph. In lieu of a full report on his own seasons' field work he is analysing and preparing for publication the anthropometric data obtained by D. Jenness in 1924 at the headwaters of Peace river and in the adjoining districts of British Columbia.

C. B. Osgood, who spent the winter 1928-9 at the outlet of Great Bear lake, made a complete circuit of the lake during the spring, visiting all the camps of the Hare Indians, and finishing up his study of that tribe. Since his return to Chicago at the end of the summer he has been working on his report, which he hopes to submit shortly.

Office Work

The division published two reports during the past year: "Some Shell-Heaps of Nova Scotia," by Harlan I. Smith and W. J. Wintemberg, and "Anthropometry of the Cree and Saulteaux Indians in Northeastern Manitoba," by J. C. Boileau Grant. Three other reports are going through the press: "Totem Poles of the Gitksan," by C. M. Barbeau; "Sacred Stories of the Sweet Grass Cree," by L. Bloomfield; and "Anthropometry

of the Chipewyan and Cree Indians of Lake Athabaska," by J. C. Boileau Grant. Two other reports, by outside workers, should come in within the next few weeks, one on the ethnology of the Indians of Great Bear lake, by C. B. Osgood, the other on the anthropometry of the Carrier and Sekani Indians of British Columbia, prepared by J. C. B. Grant from the field data of D. Jenness. W. J. Wintemberg, the assistant archæologist, has completed his report on the Roebuck Village Site, which will be submitted for publication as soon as the illustrations are prepared.

Mr. Jenness has completed the first part of his text book on the Indians of Canada, and rather more than half the second part. The work should be ready for publication before the end of the year. He also prepared about half of the final report on the results of his last summer's field work. In preparation for the Fifth Pacific Science Congress to be held in Vancouver in 1932, he is attempting to arrange for the compilation of a volume of essays, by leading scientists in Canada and the United States, on the origin and antiquity of the aborigines of America. A tentative plan of the volume calls for eleven papers, five of which have already been promised.

Mr. Barbeau has been working at a monograph on the Songs of the Tsimshian, for which he has transcribed and drawn for reproduction seventy-five songs, besides preparing the necessary text. Various other activities have required his attention; the preparation of an exhibition of French-Canadian handicrafts for the Ottawa Art Association in May, 1929; correction of the proofs of his monograph on Gitksan totem poles; correspondence relating to Indian and folk-lore research; the organization of two programs of Canadian folk-songs (French, Indian, and English) given in a trans-Canada tour under the Association of Canadian Clubs; and the preparation of a few lectures and magazine articles on totem poles, the Skeena district, folk-songs, and Canadian art as derived from native sources.

Mr. Smith set in order during the winter the negatives of six motion picture reels illustrating the Pacific Coast Indians, and arranged in rough continuity the positives of four additional reels. It is impossible at this date, when the Pacific Coast Indians have been in contact with Europeans for a century and a half, to illustrate adequately by photography their ancient life and customs; but the moving pictures taken by Mr. Smith during the last four years should be of great value to teachers and lecturers, as well as interesting and instructive to the general public. In the earlier months of the winter he devoted part of his time to drawing the attention of manufacturers, artists, etc., to the wealth of designs on Indian specimens in the Museum, some of which may be utilized for commercial purposes.

Mr. Wintemberg, after completing his report on the Roebuck Village Site, commenced a similar report on his excavations at Lawson, an early Iroquoian village of slightly different date from the Roebuck. He also prepared for this annual report of the Museum a paper outlining the differences between Iroquoian and Algonkian remains in Canada, a subject that has never before been elucidated, despite its crucial importance, for the interpretation of archæological sites in the eastern provinces of the Dominion.

Among the visitors to the division during the past year were Dr. Warren K. Moorehead, of Andover, Mass., who made a detailed study of its collections of stone axes and adzes; Mr. N. C. Nelson, archæologist at the American Museum of Natural History, New York, who made a rapid survey of the Museum's archæological collections; Mr. H. B. Collins, assistant archæologist of the Smithsonian Institute, Washington, who dropped in for a day when returning from field work in Alaska to examine the division's collections from Bering strait; and Dr. E. M. Box, of Toronto, who investigated the teeth in all the Indian and Eskimo crania to determine the frequency and character of their dental diseases.

The number of loans to Normal School students has been slightly less than in former years, but these and other students still make considerable use of the division's collections. In September the Windsor high school received a small loan of Indian specimens. In October a loan was made through the Department of Trade and Commerce to the Imperial Institute, of a representative collection of Indian specimens from the whole of Canada, which is now being exhibited for an extended period at the Imperial Institute, London, England; and between October and January the Canadian National railways received on loan from the division five collections of specimens illustrating Indian art, music, games, weapons, and embroidery, for exhibition throughout Canada and a part of the United States. The preparation of these loans has required the expenditure of much time, but they should make the Museum better known throughout the country and react to its ultimate benefit.

Museum Work

A complete series of exhibits from the Plains' and Plateau tribes of Canada was installed during the year in the new upright cases allocated to the east Anthropological Hall. Many of these specimens, which occupy sixteen panels in the cases, or 1,152 square feet, have never before been displayed. Mr. Leechman is now working on a series of synoptic exhibits for the remaining upright cases; he has an exhibit of Indian cradles ready for installation, and is assembling a series of musical instruments. Twenty-one new table cases acquired for the same hall have been arranged around the walls; they will be devoted to an exhibition of Canadian archæological specimens. One large upright case and four table cases, near the entrance to the hall, are being reserved for the palæolithic specimens from the Old World gathered by Dr. H. M. Ami. During the winter Dr. Ami placed in the museum's charge a cast of the magnificent bison figures discovered a few years ago at Tuc d'Audoubert in France, and the division is arranging to exhibit it in a special case borrowed from the Biological Division. Ultimately, however, it hopes to make this cast the central feature of a habitat group depicting the artistic achievements of man during the last centuries of the Ice age.

Specimens

The number of specimens obtained during the fiscal year, mainly from the field staff, totalled 1,720:

Ethnological	517
Osteological	3
Archæological	1,200

Two exchanges were arranged and completed, one with Monsieur Paul Coze, of Paris, who gave a large oil painting of a Sioux war chief for some specimens from the west coast. The painting is now framed and suspended in the east exhibition hall. Mr. Falkinder, of Falmouth, Tasmania, exchanged a series of forty-seven representative Tasmanian specimens for some archæological material from Ontario and the Arctic coast.

The entire collections of the division have been inspected monthly, to guard against insect pests. No specimens were damaged by their depredations during the year, although a small number became infected.

Publications

The following articles were published by the staff of the division during the past fiscal year:

Ivory Carving of North America. By D. Jenness. Encyclopædia Britannica, 14th Edition, vol. 12, 1929.

Three Songs of the West Coast. Recorded from singers of Nass River tribes. By C. M. Barbeau in collaboration with Dr. Ernest MacMillan. The Frederick Harris Company, Oakville, Ont.

Chansons Canadiennes (French Canadian Folk Songs). By C. M. Barbeau in collaboration with Dr. Ernest MacMillan. The Frederick Harris Company, Oakville, Ont.

The Church of Saint-Jean, Island of Orléans, Quebec. By C. M. Barbeau in collaboration with Ramsay Traquair. The Journal, Royal Architectural Institute of Canada, June 1929.

Totem-pole Decorations of the Jasper Room, Chateau Laurier. By C. M. Barbeau. Canadian National Railways Magazine, July 1929.

Some Shell-heaps in Nova Scotia. By Harlan I. Smith and W. J. Wintemberg. Bulletin No. 47, Anthropological Series No. 9, National Museum of Canada, Ottawa.

Uren Prehistoric Village Site, Oxford County, Ontario. By W. J. Wintemberg. Bulletin 51, Anthropological Series No. 10, National Museum of Canada, Ottawa.

Representations of the Thunderbird in Indian Art. By W. J. Wintemberg. Thirty-Sixth Annual Archæological Report, Provincial Museum, Toronto, Ont.

Eskimo Music. By Douglas Leechman. The American Mercury, Sept. 1929.

Lectures

By D. Jenness:

Java, Past and Present. National Museum of Canada, February 15 and 19, 1930.

By C. M. Barbeau:

Folk-songs of French Canada. Ottawa Arts Association, April 24, 1929.
How the Skeena Was First Peopled. The Women's Canadian Club, Prince Rupert, B.C., September 30, 1929.

By Harlan I. Smith:

Mackenzie Park in the Norway of Canada. Home and School Club, Hilson Avenue School, Ottawa, February 13, 1930.
The Bella Coola Valley. Y.M.C.A., Ottawa, March 6, 1930.

By W. J. Wintemberg:

Archæological Work in Canada. Fireside Club, Unitarian Church, Ottawa, December 1929.

By Douglas Leechman:

Indian Whale Hunters of Vancouver Island. National Museum of Canada. December 14 and 18, 1929.

Accessions to Museum

(a) From Staff:

From D. Jenness:
12 Ojibwa specimens.

From C. M. Barbeau:
35 West Coast specimens.

From Harlan I. Smith:
104 Blackfoot specimens.
240 West Coast specimens.
16 archæological specimens from the west coast.
2 osteological specimens from the west coast.

From W. J. Wintemberg:
1,000 (about) archæological specimens.

From C. B. Osgood:
56 Hare specimens.
1 osteological specimen from Great Bear lake.

(b) Donations:

From J. D. Soper:
3 specimens from cape Dorset, Baffin island.

From Martin Nordegg:
1 Stoney saddle.

From E. F. G. White:
1 Prairie Indian bow.
2 West Coast bows and 1 arrow.

From K. G. Chipman:
1 pair of moccasins from the Loucheux Indians.

From Dr. C. Bourget:
15 photographs.

From Dr. W. Bell Dawson:
7 chipped stone points from the prairies.
1 chipped stone point from Galiano island, B.C.

From Harry Loken:
1 iron ax-head from Quebec.

From G. C. Monture:
Iroquois corn bread.

From A. Willett:
1 chipped stone point.

(c) Purchases:

From Richard White, Nain, Labrador:
78 Naskopi specimens.

From J. Gillett, Massett, B.C.:
9 Haida specimens.
4 stone objects.

From The Gabaoosa Estate:
1 MS. on the Ojibwa.

(d) Exchange:

From J. Falkinder, Tasmania:
47 archæological specimens.

From Paul Coze:
1 oil painting of Sioux Chief.

Folk-Lore

The Lemieux (J.-M.) Collection:
50 song texts from Gaspe county, Que.

The Traquair (Ramsay) Collection:
277 photographs of Quebec sculpture, architecture, and manual arts.

The Côté (Rev. Georges) Collection:
37 photographs of architecture, sculpture, and silversmith's work.

Other Collections:
E. Z. Massicotte, 2 song texts.
Mlle. Georgiana Leblond, 18 traditional designs for hooked rugs.
Miss Harriet Wallace, 3 photographs of artifacts.
Madame Mariel R. Delamarre, 5 photographs of old houses.

DIVISION OF BIOLOGY

R. M. Anderson, Chief of the Division, reports:

Field Work

R. M. Anderson attended the Eleventh Annual Meeting of the American Society of Mammalogists held April 10 to 13, 1929, in the Museum of Zoology, University Museum, University of Michigan, Ann Arbor, Michigan. Mr. Anderson gave an address on "Mammal Life in the Eastern Canadian Arctic," illustrated by slides and motion pictures, and also by request presented a paper, illustrated by slides and specimens, by Dr. Seymour Hadwen, Head of the Department of Veterinary Science, University of Saskatchewan, on "Colour Changes of *Lepus americanus* and other Animals." The latter paper was subsequently published in *The Canadian Journal of Research*, vol. I, No. 2, July, 1929, pp. 189-200, and the specimens and a set of slides deposited in the National Museum. Mr. Anderson also investigated the new University Museum, opened in 1929, which embodies the latest methods of combining scientific research with university education.

Mr. Anderson also planned and carried out with Mr. Laing and Mr. Elgin Hall an extensive campaign of field work in southern British Columbia during the season of 1929, in continuation of a biological reconnaissance of the region in the vicinity of the International Boundary between the province of British Columbia and the states of Washington, Idaho, and Montana. This region is of particular biological interest because of the extraordinary and sharply defined variety of topographical and climatic conditions that occur from west to east, and because it differs also in these respects from the country to the north and these differences are reflected in the fauna and flora. Although the principal part of this work consisted in making collections of mammals and birds, other forms of life were studied and collected whenever practicable, and in addition to large systematic series of the different species, material was collected for several habitat groups for the exhibition halls of the Museum. Full and careful notes were kept on the habits and range of species, their abundance and economic relations, as pests to agriculture and stockraising interests, food and fur value, etc., as well as other information that has an authentic historical value bearing upon the life history and conservation of these animals.

The data and specimens collected are expected to be used as a basis for a later faunal report on the mammals of the International Boundary region of southern British Columbia from the strait of Georgia to the Alberta boundary.

This project, which is hoped to be a definite contribution to an intricate and complicated faunal area of Canada that has been comparatively little studied in a systematic way, was begun in the spring of 1927 and carried on by C. H. Young, senior collector-preparator on the Museum staff, assisted by H. M. Laing, of Comox, B.C. They made extensive collections in the low, humid Pacific coast belt and continued over the Hope-Princeton summit to the eastern slope of Cascade mountains. In 1928 Mr. Laing continued the work, beginning at Sterling creek (elevation 1,700 feet) on the east slope of Cascade mountains near Hedley,B.C., carrying the survey as far east as Westbridge in Kettle River valley (elevation 2,075 feet), going back later in the autumn for investigations on Juniper mountain, south fork of Ashnola creek (elevation 4,500 feet).

In 1929, Mr. Laing began work on May 4 in the arid belt of southern Okanagan valley, his Camp 1 being on the west side of Osoyoos lake (elevation 913 feet), one-fourth mile north of the International Boundary. This area contains some newly opened irrigated land, but on the sagebrush lands below the first benches several square miles were in a raw state, changed from its native condition only by heavy pasturing by domestic stock. Though the region was not particularly suited to large numbers of species, good series of dry belt forms were collected, including pocket mice *(Perognathus)*, sagebrush white-footed mice, western white-tailed jackrabbits, packrats, etc.

Camp 2 was made on Boundary creek at Midway, B.C., in the valley of Kettle river (elevation 1,800 feet), from May 27 to June 15. The valley of Kettle river at Midway is flat, sandy, and dry, with a timbered range of hills rising abruptly on the southerly side. Elsewhere the valleys of Kettle river and Boundary creek were open, rather barren, and timberless —all typical transition zone; first class stock range, with many farms abandoned on account of former drouth. Good series of long and short-tailed voles were taken and white-footed mice, jumping mice, long-tailed and water shrew, and one pocket-mouse.

Camp 3 was made near Rossland, B.C., on Alfred Morgan's ranch, near Rossland reservoir (elevation 4,000 feet), from June 15 to August 6. R. M. Anderson left Ottawa on June 27 and reached Rossland on July 2, remaining with the party until the close of the season, returning to Ottawa on October 18.

The country is well timbered in the vicinity of Rossland, with western coastal types at this elevation, western cedar, western hemlock, western larch, Douglas fir, western white pine, etc. Much of the country eastward showed ravages of fire and smelter gas, until in the vicinity of Trail at about 5 miles distance and at 2,000 feet lower elevation in the valley of Columbia river a condition of aridity prevailed. Trapping was carried on mainly from camp at reservoir: down watersheds running northward; also about the base of Red mountain and its eastern slopes; and the base of Old Glory mountain. The last included only the trail from 5,800 feet,

approximately at the headwaters of Rock creek, across the dividing line to the rock slides and rills at 7,000 feet in the vicinity of Forestry Look-out camp—timber-line conditions. Roughly, three life zones were represented in cross-section—Canadian, and Hudsonian, with the top of Old Glory mountain (elevation 7,900 feet) rising into the Alpine. The Canadian zone extended to about 6,000 feet. Snow fell on the summits commonly in July, the snow-bank at the foot of Old Glory mountain (7,000 feet) disappearing about mid-July. Temporary camps were also made at different periods near top of Green mountain (6,500 feet) through the courtesy of Mr. R. E. Plewman, an experienced mountaineer in this region, to whom the party was also indebted for much information on the district.

A considerable variety of small mammals were taken in this region, including four or five species of voles (among them the large water-vole, *Microtus richardsonii*), white-footed mice, jumping mice, at least three species of shrews, red squirrels, flying squirrels, and weasels. Brown pocket gophers were abundant in all open spaces and clearings from 2,000 feet up to 6,000 feet. Columbian ground squirrels, and yellow-bellied marmots were excessively abundant in favourable sites, due to numerous clearings and berries, and probably also to the intensive trapping of all predatory fur-bearers. Small chipmunks *(Eutamias)* were abundant up to timber-line, and the large mantled chipmunks were found only on rock slides. As this region has been extensively prospected, mined, lumbered, and burned over during many years the large mammals were noticeably scarce. Signs of black bears were occasionally noted, but the grizzly bear was nearly extinct in the region. Mule deer were not numerous, and white-tailed deer were reported as still rarer. Packrats were said to have once been abundant, but seemed to have forsaken the area.

On August 6, the party left Rossland by rail to Nelson, by steamer on Kootenay lake to Kootenay Landing, and by rail to Creston. Camp 4 was situated on flat lands west of Kootenay river, 6 miles southeast of Creston (elevation of Creston 1,983 feet), and the party remained here until August 23. The overflow lands are about 5 miles wide along Kootenay river, with some reclamation ditches and dykes, fairly dry in summer and heavily grown with coarse sedge and rushes. The higher ground back from the flats is quite heavily timbered where not cut away. The fauna was somewhat different from the districts worked farther west, but voles and chipmunks were more numerous. Pocket gophers were abundant, as well as Columbian ground squirrels, the latter mostly going into æstivation and seldom seen after August 10. Coyotes, packrats, and three or four species of bats were numerous; white-tailed deer were more numerous than farther west, but the mule deer are said to be only transients in the valley. The intention was to go up Boundary creek on the Idaho border and work at the higher elevation of Summit lake, but extensive forest fires persisted for a month in that district and gradually worked over the mountains from the south and the party was ultimately compelled to move out of Creston district.

On August 23, the party moved by truck to Goatfell (elevation 2,910 feet), on the highway about 20 miles southeast of Creston, and established Camp 5 on a little stream about 1 mile from Moyie river. Small mammal life was not abundant, as a large part of the valley was burned-over land

and the hillsides were too dry. A small collection was made here, including various voles, mice, flying squirrels, and mantled chipmunks. A scouting expedition to Yahk resulted in meeting Mr. H. B. Murray, Bush Superintendent of the Tie and Transportation Branch, Canadian Pacific railway, which operates a private logging railway branch running southeast from Yahk, B.C., for about 40 miles of track along Meadow creek, a tributary of the Moyie, and around the headwaters of Yahk river near the Montana border, with several lateral branches. The company was running logging trains along the branch every day, and Mr. Anderson accompanied Mr. Murray over the line on a gasoline speeder to investigate the country. Mr. Murray generously offered the party the use of various abandoned logging camps and transportation for party and baggage over the logging lines. The party, therefore, moved from Goatfell camp to Yahk on August 30.

Camp 6 was established on August 31 at old Camp 6 of the Canadian Pacific railway on Meadow creek (elevation 3,500 feet) about 3 miles from the British Columbia-Idaho-Montana corner. Work was carried on from this camp until October 3. The work was much facilitated by the privilege of jumping the morning logging trains or speeder and going from 5 to 15 miles along the line, and returning the same way later in the day. This valley had been largely burned over in the big 1910 fire, and some parts burned again later, but growing up again to willow and poplar and in places with the original growth. A dense growth of fireweed and other herbs affords good food for white-tailed and mule deer, both species being rather common. The bottoms and lakes along Meadow creek were apparently unforested from the first. Some large stands of the heavy original forest are still remaining in place. Considerable collecting was done on American creek, which runs down from Flatiron mountain on the Idaho-Montana border, and on Cold creek. Mr. Hall also spent over a week at logging camp No. 3, near the head of Cold creek at about 4,500 feet elevation. Short trips were made to tops of neighbouring mountains up to about 6,000 feet elevation. Small mammals, as elsewhere, were not very abundant except in favoured spots, as the prolonged drouth had reduced the visible food supply for many species. Probably in some areas the smaller mammals had been exterminated by bush fires and they had not yet come back. Signs of Columbian ground squirrels were more numerous than usual, probably due to the opening of the forested country by logging operations and fires. Badgers were more than usually common here, perhaps on account of the large ground squirrels population and the lack of intensive trapping, which has recently all but exterminated the badgers in the interior valleys of British Columbia. Coyotes were also numerous, but rabbits were scarce here, as at all other points visited this season.

After completing the field work at Yahk, Mr. Anderson went on to Vancouver and interviewed the Game Commissioner of the province, Mr. A. Bryan Williams, obtaining information on some of the big game species; he also examined the Kenneth Racey collection of mammals and birds of British Columbia. At Victoria he spent some time at the Provincial Museum and made notes on the British Columbia mammals in the collection. On the return trip he stopped off at Okanagan Landing, B.C., and

examined the large collections of Major Allan Brooks and of J. A. Munro, also checked up mammal notes with Major Brooks, and made preliminary arrangements for a series of coloured drawings, of big game and fur-bearing mammals of Canada, for a work on the mammals of Canada, which Mr. Anderson is preparing for the Department. Twenty-four plates of mammals were completed by Major Brooks later in the year. Mr. Anderson attended the 47th Annual Meeting of the American Ornithologists' Union, held at Philadelphia, October 21 to 25. While there he spent some time carefully examining and making notes on a rather large number of British Columbia mammals in the collections of the Academy of Natural Sciences, which include several types of mammals collected and described from southern British Columbia by the late Samuel N. Rhoads of Philadelphia, and interesting Canadian material from other collectors.

P. A. Taverner, ornithologist, accompanied the Canadian Arctic Expedition of 1929 as naturalist on the S.S. *Beothic* to Greenland, the eastern islands of the Canadian Arctic archipelago, Hudson strait, and into Hudson bay to Chesterfield inlet. The *Beothic* left North Sydney, N.S., July 20, with Mr. George P. Mackenzie, Officer in Charge, making its first call at Godhavn, Greenland, on July 27. The ship then proceeded to Dundas Harbour, Devon island, and from thence to cape Sparbo, on the north coast of Devon island, where a well-known herd of musk-oxen is still found, and many excellent still and motion pictures of musk-oxen were secured. From Sparbo the ship proceeded to Craig Harbour, Ellesmere island, and thence to Buchanan bay, where supplies for the Bache Peninsula post were landed at cape Rutherford; turning south, stops were made at Etah and Nerke settlement, north Greenland; Dundas Harbour, Devon island; Ponds inlet, Clyde river, Pangnirtung, and Lake Harbour, all on Baffin island, and then proceeded into Hudson bay to Chesterfield inlet to land provisions and coal for the Royal Canadian Mounted Police detachment, and building material for the medical officer to be stationed there. On the return the *Beothic* stopped at Carys Swan Nest on Coats island; Lake Harbour, Baffin island; Acadia cove, Resolution island, where a direction-finding station is being established by the Department of Marine; touched at Port Burwell, on the south entrance to Hudson strait, and cruising down the Labrador coast, reached North Sydney again on September 3, after travelling 7,800 miles.

While at Sydney, N.S., Mr. Taverner examined a colony of cormorants, which were not previously well known to ornithologists.

Joseph Rochon, osteological preparator, left Ottawa on July 16 and proceeded to Trout lake and lake Pourri, Labelle county, Quebec, returning August 25 with 107 specimens of small mammals.

Clyde L. Patch, chief taxidermist and herpetologist, D. Blakely, taxidermist, and Claude E. Johnson, artist, did some field work in Ottawa district, principally collecting local material to fill out the collections and obtaining accessories for habitat group work.

Charles H. Young, senior collector-preparator, was unable to continue field work this year on account of poor health, but was able to do Museum cataloguing and other office work.

Publications

R. M. Anderson continued work as general editor of scientific reports of Canadian Arctic Expedition, 1913-18. No new parts were issued during the year, but preparations are being made to close up some of the unfinished volumes, and some progress has been made in preparing some of the completed volumes of the series.

At the request of Professor Julian Huxley, Departmental Editor of Section Biology and Zoology, Mr. Anderson wrote the article on "Fur-bearing Animals (Land)" which was published in the 13th Edition of the Encyclopedia Britannica, issued in 1929. He has also completed one section of the manuscript for a museum bulletin on "Methods of Collecting and Preserving Animals for Study." Some progress has been made on the "Check-List of Canadian Mammals" and a large amount of data has been accumulated, adding to its completeness. A good start has also been made in the preparation of an illustrated book on "Mammals of Canada," planned to include analytical keys for determination of species, adequate descriptions of every form of mammal known to occur in Canada, distribution maps, bibliographical data, and general accounts of life histories and habits of the most important species. Several book reviews and mammal notes were published in *The Canadian Field-Naturalist*, Ottawa, of which Mr. Anderson is Associate Editor in Mammalogy.

Mr. Taverner prepared an article on "Some Zoological Aspects of the Canadian Arctic Expedition of 1928," which was published in *The Canadian Field-Naturalist*, vol. XLIV, 2, February, 1930, pages 25-27. Mr. Taverner also completed the manuscript and drawings for a bulletin on "Water Birds, Game Birds, and Hawks of Canada." This work was originally undertaken as a scientific account of the water birds of the Atlantic coast for the Biological Board of Canada. When the Biological Board abandoned its project, the scope of the work was enlarged to cover the wading-birds, game birds, and diurnal raptores of Canada, to provide ornithologists, sportsmen, and others practically interested in game birds, and other groups related therewith ecologically and genetically, with a manual on all the groups, covering the same ground as the corresponding part of the New American Ornithologists' Union Check-List. The work is illustrated by abundant line drawings made by the author. It has been decided to prepare a new work on the "Birds of Canada," combining "The Birds of Eastern Canada" and "The Birds of Western Canada" into one volume not much larger than "The Birds of Western Canada." As a step towards preparing a "Birds of Canada," Major Allan Brooks completed thirty new bird paintings to replace earlier drawings now in use, and Mr. Taverner expects to prepare the manuscript during 1930-31. Mr. Taverner also contributed several reviews of ornithological publications for *The Canadian Field-Naturalist.*

During the year an edition of 3,000 copies of sixty picture postcards of birds was issued about December 18. The coloured illustrations were made from plates of "Birds of Western Canada," some from "Birds of Eastern Canada," and some from new paintings by Major Allan Brooks. Each card contains one coloured illustration, accompanied by descriptive text, and the cards are supplied in sets, in carton, for sale at $1, and also loose, for sale at two for 5 cents.

A valuable paper on "Freshwater Mollusca from Central Ontario", by Frank Collins Baker and Alvin Robert Cahn, based on recent collections made in Ontario and on other material in different collections, has been received for publication as a museum bulletin. The senior author is Curator of the Museum of Natural History, University of Illinois, and the junior author is also a well-known zoologist on the faculty of the same university. The authors have generously offered to give the National Museum of Canada duplicate specimens of the species collected on the expedition, as well as cotypes of new forms that are described. This report is a contribution of interest both in the field of recent zoology and of invertebrate palæontology.

Lectures

By R. M. Anderson:

Canada's Arctic Regions. National Museum lecture course, January 12 and 16, 1929. Illustrated by slides and motion picture film of the Canadian Arctic Expedition of 1928 "In the Shadow of the Pole".

Canada's Arctic Regions. Young Men's Club, Y.M.C.A., Ottawa, January 20, 1929.

The Large Mammals of Canada. The McIlwraith Ornithological Club of London. London Life Auditorium, London, Ontario, April 8, 1929.

Mammal Life in the Eastern Canadian Arctic. 11th Annual Meeting of the American Society of Mammalogists, University Museum, University of Michigan, Ann Arbor, April 10, 1929.

Colour Changes of *Lepus americanus* and Other Animals. Presented by request for the author, Dr. Seymour Hadwen, at 11th Annual Meeting of the American Society of Mammalogists, April 12, 1929. (Paper published in the Canadian Journal of Research, vol. I, No. 2, July, 1929, pp. 189-200.)

Canada's Arctic Regions. At Des Moines, Iowa, West High School, to about 400 teachers of geography and history, 4.00 p.m. To Powwow Club, 8.00 p.m., April 15. East High School, to about 1,700 students and teachers 9.00 p.m., April 16, 1929.

Canada in the Arctic. Women's Canadian Club of Ottawa, Chateau Laurier, May 14, 1929.

By Clyde L. Patch:

Amphibians and Reptiles. Gastronomic Club, Ottawa, March 20, 1929.
Amphibians and Reptiles. Creighton St. School, Ottawa, May 10, 1929.
Amphibians and Reptiles. Rockliffe Vacation Club, Ottawa, July 17, 1929.
Amphibians and Reptiles. Young Men's Club, Ottawa, Y.M.C.A., Dec. 11, 1929.
Amphibians and Reptiles. Unitarian Women's Alliance, Ottawa, January 6, 1930.
Winter Birds. McKay Church, Ottawa, January 31, 1930.
A Trip to the Queen Charlotte Islands. Gastronomic Club, Ottawa, February 5, 1930.
Winter Birds. Chalmers Church, Ottawa, February 6, 1930.
Winter Birds. St. Paul's Church, Ottawa, February 14, 1930.
The Museum. Unitarian Church, Ottawa, February 16, 1930.

Museum Work

The lack of space in the Museum halls has caused overcrowding and such progress as has been made in installing biological exhibits consists largely of removing old exhibits or replacing them by newer ones. A few new specimens and groups were placed on exhibition, including eared grebe, Franklin's gull, coot, Florida gallinule, red-shouldered hawk, Arkansas kingbird, Say's phoebe, Canada jay, song sparrow, housewren, macaw, red-backed mouse habitat group, and two white-tailed deer. Three hundred and forty-three birds and smaller mammals were prepared in the taxidermy

section for the study collections, including a large series of dovekies, gulls, ducks, and geese that were received in a dry, salted state. Forty-nine large mammals were prepared and tanned, including bear, wolf, seals, deer, caribou, and musk-ox. Three hundred and thirty-one specimens were loaned for nature study work in schools and art work.

Forestry Branch, Department of the Interior, has made a beginning of exhibition of certain forest products, and has filled one large case with two exhibits: (1) The Manufacture of Wood Pulp, illustrating the groundwork, sulphate, sulphite, and soda processes; (2) Some Products of Wood Pulp, including rayon thread and weaves, wallpaper, twine, rope, fibreware, wall-boards, and artificial wood. Part of the material for four large tree exhibits has been shipped in but not yet installed.

The Honorary Curator of Insects, Mr. Arthur Gibson, Dominion Entomologist, has aided in the installation of a case of Silk Products, the bulk of the material being supplied by the General Silk Corporation.

As a result of field work by members of the staff, a considerable number of additions have been made to the study collections, and much material obtained suitable for subsequent mounting. The material, which comes in a fresh or semi-prepared state, requires considerable attention from the taxidermy section.

The identification and arrangement of current collections and the assembling of data obtained from field notes form an important feature of the work and the results are embodied, from time to time, in the Museum reports and scientific journals. The officers of the Division of Biology are prepared to identify and return Canadian specimens of mammals, birds, reptiles, or amphibians, which are sent in a fair state of preservation and with sufficient data in regard to locality, data of collecting, and sex if possible. Where possible the Museum would be pleased to have duplicate specimens sent for deposit in the National collection. The Chief Botanist will only attempt to determine plants when properly pressed, showing roots, stems, leaves, and, if possible, flowers or fruit, and it is requested that one or two duplicates of each form be sent for dissection and for permanent preservation in the National Herbarium.

The National Parks of Canada, Department of the Interior, through the Commissioner, Mr. J. B. Harkin, has kindly continued to send in many specimens of large game, predatory or fur-bearing mammals from the various national parks. The North West Territories and Yukon Branch, Department of the Interior, through Mr. O. S. Finnie, director, and the members of various detachments of the Royal Canadian Mounted Police, through the Commissioner, Colonel Cortlandt Starnes, have continued to send in valuable materials from the Far North, which are very acceptable to the Museum. The area of the Dominion of Canada is so large that the only hope we have of obtaining needed material from many districts is by donations from interested friends and public-spirited sportsmen and travellers.

The Hudson's Bay Company, the largest establishment engaged in the fur business in the British Empire, has for some time been interested in having studies made of the periodical fluctuations in the numbers of wild animals in the districts where the company operates trading posts. Although

the periodical fluctuations of the more valuable fur-bearing mammals have been noted for many years, the smaller mammals which have little or no economic value in themselves have been studied less than they deserve, as the presence and abundance of the smaller species have an important relation to the food supply and consequent abundance of some of the species more valuable to man. There is often some confusion in regard to data based on inadequate and inaccurate determinations of species of these smaller mammals. To check up these data it was considered necessary to have collections of small mammals made at different points and properly identified. Collecting mammal specimens in such shape that they are of value to museums is little more expensive than collecting specimens of practically no value at all. Representations to this effect were made to Mr. C. V. Sale, Governor of the Hudson's Bay Company, and he authorized Chief Factor Charles H. French, Fur Trade Commissioner of the Company at Winnipeg, to co-operate with R. M. Anderson in the matter in the spring of 1929. Forty small sets of collecting equipment were accordingly prepared at Ottawa and shipped to Montreal, Winnipeg, Saskatoon, North Bay, Edmonton, and Vancouver, and from thence distributed to the forty posts of the Hudson's Bay Company selected as being in suitable positions to give a cross-section through a great part of northern Canada. It is hoped that much scientific data will be obtained to the advantage of both the Hudson's Bay Company and the National Museum. As the posts are in most cases remote, results can hardly be expected to come in very quickly, but small lots of mice were received in the autumn of 1929 from Ile-à-la-Crosse, Saskatchewan, and two species of lemmings from Lake Harbour, Baffin island, and more are expected during the summer of 1930.

C. E. Johnson continued to act as artist to the division. He also collected and prepared yellow warbler's nest and eggs in situ, and completed groups of ring-billed gull and Labrador iris. Mammal and bird skins were also collected.

Accessions

ACCESSIONS TO THE ZOOLOGICAL COLLECTIONS:

Mammals received and catalogued	846
Birds received and catalogued	293
Amphibians and reptiles received and catalogued	96

MAMMALS:

By members of staff: 712 specimens
By gift: 116 specimens

Fenley Hunter, Flushing, Long island, N.Y., 1 skin and skull of Dall mountain sheep, 1 skull and scalp of black bear from South Nahanni river, Mackenzie district, North West Territories.

National Parks of Canada, Department of the Interior, 3 skins and 4 skulls of black bear from Yoho park, British Columbia; 1 skin of prairie red fox, from Prince Albert National park, Saskatchewan; 1 skin and skull of grizzly bear from Panther river, Rocky Mountains park, Alberta; 1 moose skin and skull, from Elk Island park, Alberta; 1 buffalo head, from Wainwright Buffalo park, Alberta.

J. S. Charleson, Brandon, Manitoba, 1 Baird whitefooted mouse, 1 Drummond meadow mouse, 1 least upland vole, 1 Loring red-backed mouse, 1 jumping mouse, 1 short-tailed shrew.

MAMMALS—Continued

J. Robert Mutch, Mount Herbert, Prince Edward Island, 1 red squirrel, 1 chipmunk, 1 short-tailed shrew, 1 long-tailed shrew, 2 Acadian meadow mice, 1 jumping mouse (skull), 1 mink skull.

John Bingham, Ottawa, 1 young white-tailed deer for mounting, from Hawk Lake inlet, Quebec.

Wm. H. Moore, mouth of Keswick river, New Brunswick, 1 skeleton of Nova Scotia wild cat.

Royal Canadian Mounted Police, 1 skeleton of narwhal, from Constable S. H. G. Margetts, Ponds inlet, Baffin island.

Herbert Howie, Carp, Ontario, 1 flying squirrel in the flesh.

J. M. Stewart, City View, Ontario, 1 woodchuck in the flesh.

J. Shellard, City View, Ontario, 1 woodchuck in the flesh.

Hudson's Bay Company, 13 specimens of white-footed mouse, from Ile-à-la-Crosse, Saskatchewan, through district manager, Saskatchewan Fur Trade District, 5 skins of brown lemming, 4 skins of Greenland lemming, from Lake Harbour, Baffin island, through district manager, Montreal.

North West Territories and Yukon Branch, Department of the Interior, 1 skin and skull of red fox, taken by Chief Warden M. J. Dempsey, in Wood Buffalo park; 56 mammals collected by J. D. Soper, in southwestern Baffin island, on expedition of 1928-29.

Major Allan Brooks, Okanagan Landing, British Columbia, 1 skin and skull of Vancouver Island marmot (melanistic specimen), taken by Arthur Peake, at Battle mountain, Vancouver island.

Heirs of the late Dr. F. Montizambert, Ottawa, 1 mounted head of plains buffalo, obtained by Colonel A. G. Irvine, former Commissioner of the Royal North West Mounted Police, in Saskatchewan, in 1885.

Ed. G. White, Ottawa, 5 skins and 3 skulls of small mammals from collection of his brother, the late Geo. R. White of Ottawa.

Arthur English, St. Johns, Newfoundland, 1 weasel.

G. S. Blanchet, Ottawa, 1 weasel from Tavane, Keewatin district.

By exchange:

W. E. Saunders, London, Ontario, 1 Ungava *Phenacomys* from French river, Ontario.

By purchase:

One skin and skull of barren ground caribou, female, pure albino, purchased from Indian, near Resolution, Great Slave lake, North West Territories, through North West Territories and Yukon Branch, Department of the Interior.

BIRDS:

By members of staff: 155 specimens

By gift: 135 specimens

R. A. Cummings, Vancouver, British Columbia, 4 skins and 1 nest of bush-tit; 8 skins and 5 eggs of other birds.

R. W. Tufts, Wolfville, Nova Scotia, 4 Canada jays, in the flesh.

Stuart Criddle, Treesbank, Manitoba, 1 screech owl, red phase, in the flesh.

Arthur English, St. Johns, Newfoundland, 3 rock ptarmigan.

G. H. Blanchet, Ottawa, 1 northern raven, from Ferguson river, Keewatin district, North West Territories; 23 bird skins from Tavane, Keewatin district.

D. McDonald, 1 golden eagle, in the flesh, from Moose lake, Renfrew county, Ontario.

J. H. Fleming, Toronto, 1 skin of tree duck from Corpus Christi, Texas.

A. Stewart, Ottawa, 1 red-winged blackbird, in the flesh.

John Arkell, Britannia, Ontario, 1 red-shouldered hawk, 4 eggs and nest; 1 great blue heron found dead.

Dr. B. D. Kennedy, Ottawa, 1 macaw, in the flesh.

R. Wickware, Ottawa, 1 oven-bird, in the flesh.

Miss Marion Harmer, Ottawa, 1 scarlet tanager, killed by cat.

Dr. R. E. DeLury, Ottawa, 4 birds in the flesh, killed accidentally.

Robert Lockwood, Rockcliffe, Ontario, 1 nest of wood thrush.

BIRDS—Continued

J. Moffat Ross, Wolf Lake, Quebec, 1 loon, in the flesh.
Major L. T. Burwash, 1 albino duck from cape Colborne, shore Dease strait, North West Territories.
Copley Amory, Washington, D.C., 1 white heron, from Pigon, near Cormorant islands, east Moisie bay, Saguenay county, Quebec.
Royal Canadian Mounted Police, 6 blue geese, 5 snow geese, 1 black-bellied plover, 1 golden plover, 1 turnstone, 1 red phalarope, 1 northern phalarope, collected by Sergeant O. G. Petty, Pangnirtung, Baffin island; 1 Hudsonian curlew from Arctic bay, Admiralty inlet, collected by Constable S. H. C. Margetts.
John Marshall, Ottawa, 1 Holboell grebe, in the flesh.
Ed. G. White, Ottawa, 1 ring-necked duck, 1 greater scaup, 1 lesser scaup, in the flesh, for mounting exhibit.
Ernest W. Brown, New York city, 1 juvenile or winter plumaged loon.
D. C. Heron, Stittville Fur Farm, Ontario, 1 great horned owl, in the flesh.
North West Territories and Yukon Branch, Department of the Interior, 128 birds and 62 sets of eggs collected by J. D. Soper in southwestern Baffin island, expedition of 1928-29. Includes specimens of nests, eggs, and downy young of blue goose, downy young of lesser snow goose, and skin European corn crake.
Ed. G. White, Ottawa, 1 bird skin from collection of his brother, the late Geo. R. White.

By exchange:

From Stanley S. Jewett, Portland, Oregon, 2 Farallon cormorants, 1 white-faced glossy ibis (skins).

AMPHIBIANS AND REPTILES:

By staff:

R. M. Anderson, Creston and Yahk, British Columbia	7
H. M. Laing, Comox and Midwing, British Columbia	4
C. L. Patch, Burbidge, Quebec	1
Harlan I. Smith, Courtney and Ucluelet, Vancouver island and Hornby island, British Columbia	10
P. A. Taverner, Cambridge, Massachusetts	2

By gift:

Ernest Ball, Portland, Ontario	1
C. H. Beal, Hornby island, British Columbia	11
J. Roland Brown, Hamilton and Port Maitland, Ontario	11
Talbot Criddle, Onah, Manitoba	1
Vera Dickson, Tenaga, Quebec	1
D. A. Fleming, Govenlock, Saskatchewan	1
Alexander Gilmore, Alberni, Vancouver island, British Columbia	1
Nairn Grant, Lac des Isles, Quebec	1
Robert Lockwood, Ottawa, Ontario, and Hull, Quebec	2
E. B. Shelley Logier, Long point, Ontario	19
R. Owen Merriman, Kingston, Ontario	8
Ottawa Fruit Supply Co	1
E. M. Rosenes, Britannia, Ontario	1
H. L. Seamans, Morrin, Alberta	1
Melville Spence, Ottawa, Ont	9
Unknown, Cache bay, Ontario	1
Margaret White, Vancouver, British Columbia	1

FISHES:

By gift:

B. C. Furlong, Good Hope, Mackenzie district, North West Territories, two specimens.

National Herbarium

M. O. Malte, Chief Botanist, National Herbarium, with W. R. Watson, as student assistant, made a botanical survey of St. Andrews and vicinity, New Brunswick. More than 600 species and varieties of flowering plants and ferns were collected.

H. M. Raup, assisted by Mrs. Raup, continued investigations on the flora of Wood Buffalo park, Alberta.

J. Rousseau made a botanical exploration of the districts of St. Urbain and Matapedia, Quebec, collecting about 500 flowering plants and ferns, aggregating approximately 3,000 herbarium sheets.

M. O. Malte continued work on Arctic botany in co-operation with Professor C. H. Ostenfeld, Copenhagen, Denmark, who spent about one month at the National Museum determining collections and preparing manuscript for a "Flora of Arctic Canada."

Through the co-operation of the Forestry Branch, Department of the Interior, samples of five trunks of different trees were secured for exhibit in the Museum.

Plants distributed:

Prof. C. H. Ostenfeld, Copenhagen, Denmark	47

Plants received outside of collections made by staff:

Gray Herbarium, Cambridge, Mass.	28
Prof. M. L. Fernald, Cambridge, Mass.	12

DIVISION OF MINERALOGY (Geological Survey)

Eugene Poitevin, Chief of the Division, reports:

Field Work and Laboratory Work

(*See also* under Geological Survey in Annual Report of the Department of Mines.)

Keeping pace with the general progress of recent years the Division of Mineralogy during the year just ended has collected, exchanged, and placed on exhibit a large number of mineral specimens. It has also contributed to the knowledge of mineralogy by the scientific investigation of many mineral species.

More than three thousand rock and mineral specimens were examined and studied and 50 per cent of these were added to the systematic and economic collections.

Several table cases were filled with exhibits, thus adding to the large number of cases already on display in the Museum.

In addition to the identification of a large number of minerals intended to be placed in the systematic collection, the mineralogists of the division have carried out the following research work:

Eugene Poitevin and R. J. C. Fabry have completed their study of the lithium minerals from the pegmatites of the Silver Leaf property in southern Manitoba.

Eugene Poitevin has, in addition, completed the study of a new mineral, robertsonite, from British Columbia, and has also completed the revised study of the ptilolite group of minerals.

H. V. Ellsworth made a study of a deposit of cobalt nickel minerals occurring on Calumet island, of cenosite, a very rare yttrium mineral, and of a Canadian occurrence of gadolinite.

R. J. C. Fabry, analyst, has completed chemical analyses of the following rocks and minerals:

4 rocks of granitic type from Killarney district, Ont., for T. T. Quirke.
Thomsonite from Johnson asbestos mine, Thetford, Coleraine township, Megantic county, Que.
Stannite, Snowflake mine, Albert Canyon, B.C.
Robertsonite, Penticton, B.C.
Aphrodite, Jacob Asbestos mine, Thetford Mines, Que.
Pink diopside, Montreal chrome pit, Coleraine township, Megantic county, Que.
Green diopside, Orford, Brompton Lake, Que.
Two samples of vesuvianite—one from American chrome pit, one from Southwark asbestos pit, Coleraine township, Megantic county, Que.
White serpentine, Megantic Lambly mine, Ireland township, Megantic county, Que.
Chlorite, Montreal chrome pit, Coleraine township, Megantic county, Que.
Fine asbestos, King asbestos mine, Que.
Coarse asbestos, Vimy Ridge asbestos mine, Que.

Eugene Poitevin collected a series of specimens derived from the dunite and the granite rocks of Thetford mines, and A. T. McKinnon made extensive collections of gold ores from northern Ontario and Quebec.

Educational Collections

The number of collections distributed to educational institutions has been maintained.

This year more than 7,500 mineral specimens and 138 bags of mineral chips were distributed. These collections were assembled by Mr. McKinnon and required almost 20 tons of rocks and minerals for their preparation.

Province	Standard	Grade 2	Grade 3	Miscellaneous	Minerals, prospectors	Rocks, prospectors	Mineral chips
British Columbia	1	0	1	0	4	0	0
Alberta	0	0	1	0	1	0	0
Saskatchewan	0	0	0	1	5	0	0
Manitoba	0	1	1	2	3	0	0
Ontario	9	5	46	13	45	6	1
Quebec	3	0	5	5	17	1	1
New Brunswick	0	0	3	1	4	0	1
Nova Scotia	1	0	0	0	1	0	0
Foreign	0	1	1	8	24	0	0
	14	7	58	30	104	7	3

Total number of collections distributed = 223.

Accessions

Donations

Shimmatsu Ichikawa, Fukui-Ken, Japan. Two carved specimens of rock crystal.
A. English, L. Plat. Areas, Ltd., Maandagshoek, N. E. Transvaal, S. A. Platinum-bearing dunite.
A. Hall, Asst. Director, Geological Survey, Pretoria, South Africa. Platinum concentrates from dunite reefs, Overwacht, Lydenburg dist., E. Transvaal; concentrates from platinum ore, Potgietersrust, north of Pretoria; two specimens of chromite, Mooihoek. Lydenburg dist.; Corundum ore, Thorncliffe, Lydenburg dist., E. Transvaal.
James F. Kapner, Managing Director, Manica Trust, Ltd., Salisbury, Rhodesia. Three bags of tin ore.
G. E. DeLong, Pres. Acadia Gold Mines. Native gold in quartz and arsenopyrite, from Nova Scotia.
Wm. P. Crawford, Assistant Engineer, Calumet and Arizona Mining Co., Bisbee, Arizona, U.S.A. Native selenium.
Chas. A. Smart, Director, Can. Int. Corp., Ltd., Montreal, Que. Copper ore, Scotch Settlement, Kings co., N.B.
The Bwana M'Kubwa Copper Mining Company, Ltd., Bwana M'Kubwa, N. Rhodesia. Malachite.
W. F. Ferrier, Toronto, Ont. Eleven crystals of zircon, McLaren property, North Burgess township, Lanark co., Ont.
Chas. Gordon Earle, Haliburton, Ont. Titanite.
J. Cavanagh (Through L. L. Bolton). Two specimens of sylvite from Malagash salt mine, N.S.
Mond Nickel Co., Ltd. Series of samples showing pure nickel crucibles, wire, miscellaneous samples of nickel silver, etc., made by Henry Wiggin and Co.
L. Laybourne Smith. Vanadic ochre from Leighs creek, S. Australia.
C. W. Hoadley, Englewood, N.J. Albite, chabazite, prehnite, analcite and heulandite, laumontite and heubandite, from Paterson, N.J., U.S.A.
C. C. Jeffrey, Port Perry, Ont. Specimens of quartzose rock carrying free gold, etc., from Medicine rock property, Ontario, Woman Lake gold mines.
Lake Shore Mines, Ltd., per E. B. Knapp, Supt. Two specimens gold ore—one 24 pounds, the other 26 pounds.

Presented by Officers of Department of Mines

F. J. Fraser, Geological Survey. Tin concentrates from Sullivan mine, B.C.
T. L. Tanton, Geological Survey. Specimen from a palladium-bearing nickel deposit near Shebandowan lake, Thunder Bay dist., Ont.
A. J. C. Nettell, B. C. Office, Geological Survey. Stannite from Snowflake mine, Albert Canyon, B.C.
W. E. Cockfield, Geological Survey. Three specimens of galena, native silver, and ruby silver from Lucky Queen mine, Treadwell-Yukon Co., Ltd., Keno Hill, Yukon.
H. S. Spence, Mines Branch. Przibramite from McNally mine, North Burgess, Ont.
H. V. Ellsworth, Geological Survey. Galena from near Hybla, Ont.
L. H. Cole, Mines Branch. Feldspar from property owned by Frank Toutloff, Gatineau Point, Que., lot 1, con. XIII, Hull, Que.

Among some outstanding specimens collected by Mr. McKinnon, the following may be specially mentioned:

Group of selenite crystals exhibiting twinning—approximate weight 61 pounds; three selenite crystals weighing 55 pounds, 25 pounds, and 10½ pounds, respectively; a series of other specimens such as calcite, galena, and celestite, from Kingdon mine, Kingdon Mining and Smelting Company, Galetta, Que.

Purchases

Ontario Radium Corporation. Three pounds of uraninite.
A. E. Prince, Renfrew Gold Mines, Renfrew, N.S. Slate carrying gold.

Acknowledgments

The thanks of the Department are tendered the following gentlemen for gifts of specimens and aid in securing specimens, in various ways: Capt. J. G. Ross, Manager, Asbestos Corporation, Thetford Mines, Que.; S. J. Kidder, General Manager, Consolidated Copper and Sulphite Company, Eustis, Que.; The President, Algoma Steel Corporation, Sault Ste. Marie, Ont.; Mr. Griffith, Chemist, Algoma Central railway, Sault Ste. Marie, Ont.; Mr. H. Huxtable, Day Agent, Hawk Junction, Ont.; Mr. H. A. Staniland, Night Agent, Hawk Junction, Ont.; Mr. J. G. Dickenson, General Manager, O'Brien mine, Cobalt, Ont.; Capt. W. Hermeston, O'Brien mine, Cadillac township, Blake creek, Amos, Que.; Mr. Earl Rogers, General Manager, Sylvanite Gold Mines, Ltd., Kirkland Lake, Ont.; Messrs. Frank Smith and Jack MacGuire, Wright-Hargreaves Gold Mines, Ltd., Kirkland Lake, Ont.; Mr. John W. Bell, Chemist, Haileybury, Ont.; Mr. Dick Porritt, General Manager, Waite-Montgomery mine, Rouyn, Que.; Mr. E. Hibbert, General Manager, Mr. Joseph Howard, Supt. of Smelter, Mr. Wm. C. Coe, Supt. of Ore, Noranda mine, Noranda, Que.; Mr. J. H. Stovel, General Superintendent, The Dome Gold Mines, Ltd.; Mr. M. J. Mosley, Goudreau Gold Mines, Ltd., Goudreau, Que.; The Manager, Newbec mine; Mr. V. C. Clauson, General Superintendent, Mr. R. Downey, Superintendent, Treadwell-Yukon mine, Bradley, Ont.; Mr. J. Tuttle, General Manager, Mr. C. E. Anderson, Assistant Manager, Amulet mine, Rouyn, Que.; Mr. E. A. Collins, International Nickel Co., Ltd., Copper Cliff, Ont.; Chief Engineer, McIntyre Porcupine Gold Mines, Ltd.; Mr. Wm. Sixt, General Manager, Kirkland Lake Gold Mines, Ltd., Kirkland Lake, Ont.; Mr. E. B. Knapp, General Manager, Lake Shore Gold Mines, Ltd., Kirkland Lake, Ont.; Mr. D. L. H. Forbes, General Manager, Teck-Hughes Gold Mines, Ltd., Kirkland Lake, Ont.

DIVISION OF PALÆONTOLOGY (Geological Survey)

E. M. Kindle, Chief of the Division, reports:

Field Work and Collections

(*See also* under Geological Survey, in Annual Report of the Department of Mines)

Fossil collections by members of the Division of Palæontology include an extensive collection of fossil plants from the Cretaceous of southern Saskatchewan, made by F. H. McLearn and C. M. Sternberg. Ordovician fossils from Thurso map-area and near Westport, Ontario, were collected by Miss A. E. Wilson. Collections from the south side of Gaspe peninsula by E. M. and C. H. Kindle include Cambrian, Ordovician, Silurian, and Devonian horizons. A Cambrian fauna discovered by C. H. Kindle near Percé, Quebec, includes specimens of the oldest known graptolites, and these will form the types of a new genus.

Collections from western Canada include a novel Pleistocene marine fauna collected by F. A. Kerr from the terminal moraine Ghost glacier in Stikine River valley some miles inland from the present seashore. A collection of finely preserved Devonian fossils from Clearwater River area some miles east of the Rocky Mountain front range was made by C. S

Evans. Fossil collections have been submitted, by the following members of the Geological Survey, for reports indicating stratigraphic sequence and age: H. S. Bostock, C. E. Cairnes, H. C. Gunning, G. Hanson, G. S. Hume, B. R. MacKay, F. H. McLearn, W. G. H. Norman.

The following vertebrate fossils have been collected by C. M. Sternberg, from the Lance formation.

Triceratops. Posterior two-thirds of skull. About 9 miles southwest of East End, Sask.
Triceratops. Tibia and fibula. Frenchman river below East End, Sask.
Triceratops skull. Nose and one side of face missing as well as lower jaws. East side Rocky creek, Sask.
Four turtles: one nearly complete carapace and complete plastron; a complete carapace and plastron; about half of carapace and all of plastron, tail, both limbs of left and right hind; a carapace and poor plastron. Rocky creek, Sask.
Turtle with carapace and plastron. Rocky creek, Sask. Upper Ravenscrag formation (Palæocene).
Crocodile *(Leidyosuchus multitentatus* Sternberg*).* Skull, left dentary, part of right dentary, and fragments of the skeleton and scutes. Southeast of Montague lake, Sask.

Museum Exhibits

Three new cases with exhibits of plants and invertebrates have been added to the Hall of Palæontology during the year.

A fine specimen of horned dinosaur, *Anchiceratops longirostris*, has been prepared as a wall mount. This will occupy a position in the entrance hall of the Museum.

Type Material

The types added to the Museum collections during the year by the description of new fossils in its collections are summarized below:

Plants: Published in	
Contributions to Canadian Palæontology	
Bulletins 54 and 58	2 species
Invertebrates: Published in	
Contributions to Canadian Palæontology	
Bulletins 54 and 58	35 species
Canadian Field Naturalist, Oct. 1929	4 species

Accessions

Donations

Two lots of Pleistocene fossils. S. Humphry, Unity, Sask.
Pleistocene invertebrates from near Churchill, Man., F. Johansen.
A small collection of fossils from the interior of Gaspe peninsula, I. W. Jones, Quebec Bureau of Mines, Quebec, Que.
A collection of Ordovician fossils from the Eshuleeungni plateau near Foxe basin, Baffin island, J. D. Soper, Department of Interior.
Two Mesozoic Echinoids from Cornwall, Eng., C. H. Young, Biological Division, National Museum of Canada, Ottawa.
A collection of Tertiary plants from Mission creek, B.C., John Gervers, Kelowna, B.C.
Humerus of extinct bison. G. A. Gaherty, President Calgary Power Co., Alberta.

Exchange

A 2,500-pound slab of mammal bones from Agate Springs, Nebraska, U.S.A., Professor W. A. Parks, Royal Ontario Museum, Toronto.
Cast of hind limbs of *Gorgosaurus*, A. Brown, American Museum of Natural History.

Purchase

Upper Devonian fishes from Maguasha, Que., Theodore Roy and A. Plourde.
Specimen of *Porana* and insect wing from Mission creek, B.C.

A STUDY OF BRANTA CANADENSIS (Linnaeus) THE CANADA GOOSE

(Based upon breeding or summering specimens)

By P. A. Taverner

Illustrations PAGE

Of late years much interest has been taken in the characters and complex relationships of the various geographical races of *Branta canadensis*. Several attempts have been made at their unravelling, but the difficulties involved in dealing with mixed migrant material far from their distinctive distributions have been great and it must be admitted that no generally acceptable or convincing solution of the problem has yet been presented. With the return of Mr. J. Dewey Soper and his collections from Baffin island, and with breeding and summering material available in the National Museum of Canada, it seems that another attempt can be made with a greater prospect of success. The following results may not clear up all the disputed points, but they at least give us more accurate data than was previously available.

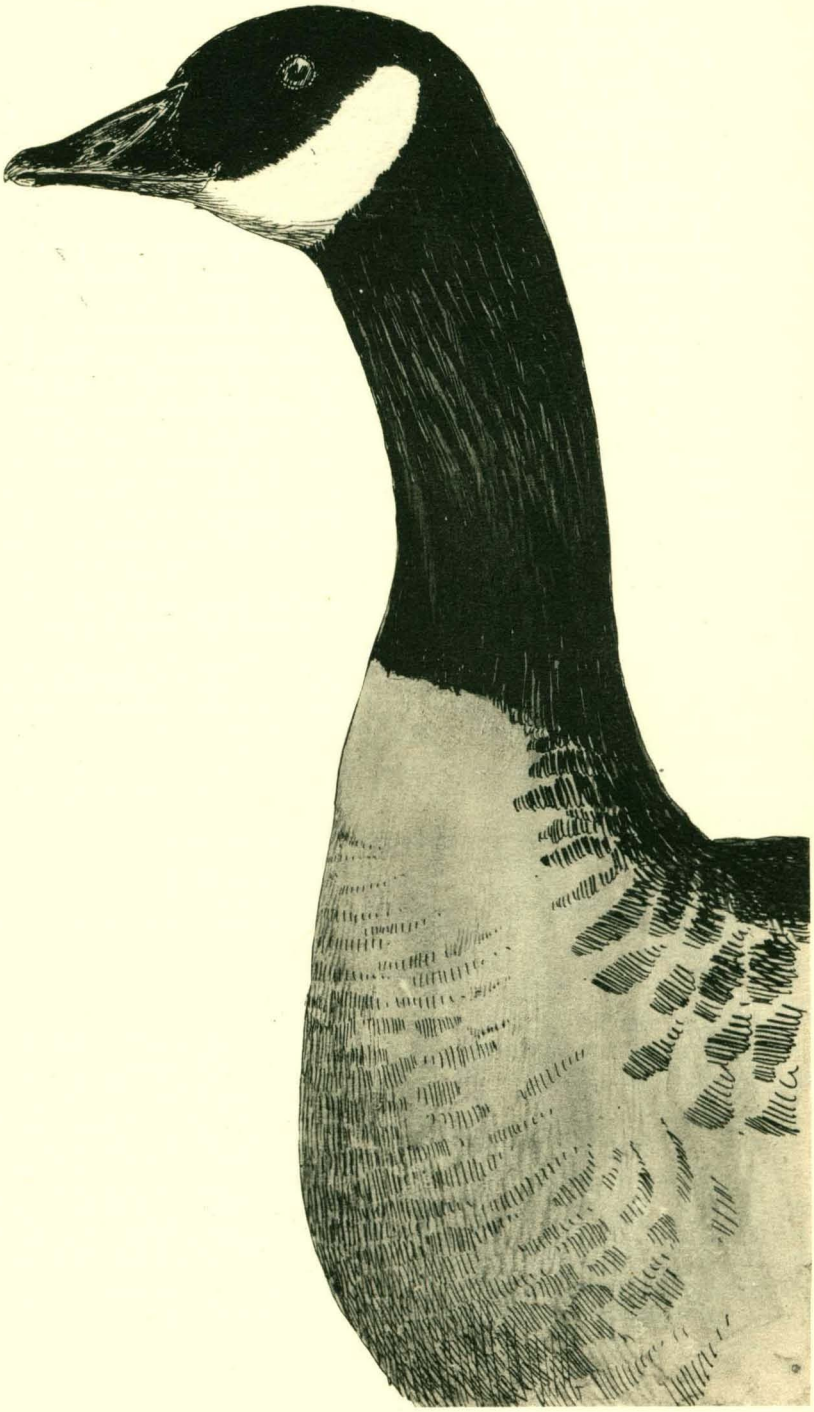
After studying many specimens in various collections and considering the whole subject for a number of years the following confusions can be eliminated.

The fundamental and genetic differences between several of the races may be far wider than is evident from a superficial examination of specimens. In life, experienced sportsmen have far less difficulty in recognizing the various forms of Canada geese than has the systematist with his specimens. There are distinctions obvious to the experienced field observer that are lacking to the laboratory worker. So marked is this that many shooters instinctively regard what seem to the ornithologist to be very closely allied races as absolutely distinct and are mildly and somewhat critically surprised at any ornithologist thinking otherwise. The differences seem to be shown in habit, stance, action, and voice. Unfortunately these characteristics that may be distinct enough in life are lost in specimens and it seems necessary for the ornithologist to find factors giving rise to them or that correlate with the groups so readily distinguished by the laity.

The occurrence of black or blackish throat streaks separating the white cheek patches or the white ring about the base of the black stocking are of no systematic significance and can be disregarded in classification. The black throat has some sexual associations, as it is usually best developed in the male, but females also sometimes show it to a greater or less extent. Although both or either of these characters are sporadic and may occur in any individual of any race they are of less common occurrence in the east than in the west and in *canadensis* proper than in other races.

The number of tail feathers is too variable throughout the group to be considered racially diagnostic.

All the geese are subject to rust-staining from the water they inhabit. The extensive red and yellowish hue on the under parts, flanks, and even the backs, especially of the dark-breasted western forms, is of this purely



Branta canadensis, the Canada Goose.

adventitious character and must be allowed for in judging the colours of these birds. Mr. F. H. Kennard had such feathers from specimens of *minima* chemically examined, with the result that a strong ferrous reaction was obtained and the more red there was on the feathers the more iron was revealed. The feathers after treatment showed little of the original red. There is probably not a shade of rufous natural to any *Branta canadensis*.

Young geese, birds of the year, and until at least a year old, can be distinguished by the type of featheration and pattern of the breast. The breast feathers in the juvenile are soft and narrow and the massed colouring is broad and even. In the adult the feathers are stiffer, broad and square-cut across the tip with paler edges, producing soft, wave-marked cross-barring. Juveniles, particularly in the dark-breasted western forms, have whiter breasts than adults but the character is variable and all do not show it to the same degree. Some juvenile *occidentalis* or *minima* may be nearly as light as occasional representatives of the pale-breasted eastern forms, whereas others may be quite dark. It is probably due to these light juveniles that the darkness of *minima* and *occidentalis* has not been generally recognized as a determinative racial character. Probably light and dark-breasted individuals can be found that are not explained by this age sequence, but they are not common and can be referred either to intergradation between adjoining races or to straight hybrids, depending upon the view taken as to whether the distinction between the parents is specific or subspecific.

With these premises established, the material under review divides into the following consistently distinct groups, each with well-defined ranges.

I. A large, light-breasted form breeding across the continent. Undoubtedly *B.c. canadensis*.
II. A large, dark-breasted form breeding on Queen Charlotte islands and probably adjoining localities in Alaska; evidently *B.c. occidentalis*.
III. A medium-sized, light-breasted form breeding in the northwest. The bird hitherto generally called *B.c. hutchinsi*.
IV. A small, dark-breasted form said to breed along the east coast of Bering sea, *B.c. minima*.
V. A small, light-breasted form breeding in the eastern Arctics. A hitherto unrecognized race.

Branta canadensis canadensis (Linnaeus)

The Honker or Typical Canada Goose

(These birds are either definite breeding specimens or were taken in close association with breeding birds.)

Museum number	——	Sex	Age	Mid toe and claw	Tarsus	Mid toe into tarsus	Culmen	Depth of bill	Depth into culmen	Wing	Wt.
				Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Lbs.
23324	Osoyoos , B.C., May 17, 1929	♀	Ad.	91	90	0·98	51	25	2·04	455	
2971	Penticton, B.C., April 29, 1903	♂	Ad.	97	99	1·02	55	26	2·11	500	
2906	" " April 15, 1903	♀	Ad.	89	90	1·01	54	26	2·07	475	
16442	Cypress lake, Sask., June 2, 1921	♀	Ad. N.B.	90	91	1·01	54	23	2·34	460	10½
16519	" " June 11, 1921	♀	Ad. N.B.	92	86	0·93	52	22·5	2·31	420	
10549	Red Deer r., Alberta, July 18, 1917	♀	Ad. N.B.	85	86	1·01	50	26	1·92	M.	
23965	Churchill, Man., June 19, 1930	♂	Ad.	86	88	1·02	50	25	2·00	450	
17383	Peace river, Alberta, May 19, 1921	♀	Y.	80	81	1·01	48	23	2·08	435	
16199	South Twin is., James bay, July 22, 1920	♀	Ad.	85	82	0·95	50	22	2·27	M.	
21014	Cape Dorset, Baffin is., June 13, 1926	♂	Y.	89	88	0·98	50	25	2·00	420	
21015	Cape Dorset, Baffin is., June 13, 1926	♀	Y.	80	80	1·00	47	25	1·88	405	
21142	Markham bay, Baffin is., June, 1926.	?	Ad.B.	82	82	1·00	50	24	2·08	445	
21077	Cape Dorset, Baffin is., July 7, 1926.	♂	Ad.B.	79	82	1·03	49	22	2·27	435	
21078	Cape Dorset, July 8, 1926	♀	Ad.B.	84	82	0·97	50	24	2·08	410	6½
	Average			86·35	86·21	0·99	50·71	24·14	2·10	442·5	

Ad.=Adult. Y.=Yearling. N.B.=Non-breeding. B.=Breeding. M.=Moulting wings.

Subspecific Characters. Large size, pale breast and underbody, long bill, and feet large in proportion to the tarsus. This and *occidentalis* are the largest of the Canada geese. Wing from 405 mm. to 500 mm. and over, weighing up to 12 pounds and occasionally even more. One has been reported 18 pounds. The culmen (in adults) runs from 49 mm. to 55 mm. and up. The bill is long and the depth goes into the length from 1·88 to 2·27, averaging 2·10 times. The feet are approximately as long as the tarsus, the nail and claw going into the tarsus from 0·93 to 1·03, averaging 0·99 times. It is notable that eastern birds are larger than western or northern ones. This is not shown in the above schedule, but is evident from migrant specimens incidentally examined.

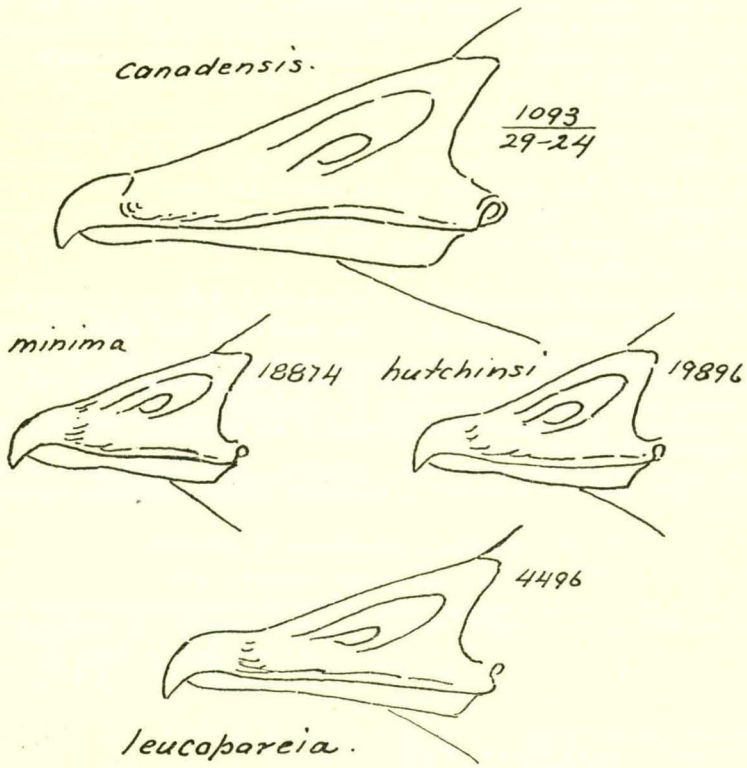


FIGURE 1. Typical bills of the races of the *Branta canadensis* group. Natural size.

Distribution. Canadensis breeds across the continent, in the east as far north as the southern Baffin Island coast, in the west an undetermined distance north of the prairies and southern British Columbia. As determined by Jack Miner's banding records and available specimens it is the common breeding goose of James and Hudson bays for most of the east coast and the west side at least as far as Churchill, probably stopping somewhere south of cape Eskimo where it appears to be replaced by *leucopareia.*

Branta canadensis occidentalis (Baird)

The Western Canada Goose[1]

(The white-cheeked goose of previous authors)

(Birds taken close to known breeding grounds of similarly characterized birds. Unfortunately by the unbarred breasts they are all juveniles. No. 14145 by its darker coloration and slight crossbarring on flanks may be a yearling.)

Museum number	——	Sex	Age	Mid toe and claw	Tarsus	Toe into tarsus	Culmen	Depth of bill	Depth into culmen	Wing
				Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
14145	Graham is., Queen Charlotte is, B.C. Sept. 2, 1929	♂	Jv.	96	96	1·00	53	26	2·03	465
14144	Graham is., Queen Charlotte is., B.C., Sept. 2, 1919	♂	Jv.	95	97	1·02	51	28	1·82	455
14146	Graham is., Queen Charlotte is., B.C., Sept. 2, 1929	♀	Jv.	85	86	1·01	45	25	1·80	430
14134	Graham is., Queen Charlotte is., B.C., Aug. 22, 1929	♂	Jv.	90	93	1·03	45	27	1·66	460
14130	Graham is., Queen Charlotte is., B.C., Aug. 21, 1929	♂	Jv.	79	83	1·05	46	24	1·91	420
	Average	.....	.....	89	91	1·02	48	26	1·84	446

Jv.=Juvenile.

Subspecific Characters. Large size, dark breast and underbody, long bill, and feet large in proportion to the tarsus.

Probably in size and proportions indistinguishable from *canadensis*, but differing greatly in colour of breast and underparts, which are solidly, except for lighter feather-tips in adult, brownish plumbeous—"hair brown" of Ridgway Nomenclature XLVI. There is often much rust stain that obscures the basic coloration. The type specimen of this race in the United States National Museum is an extreme sample of this adventitious coloration. It seems very improbable that this large form should intergrade directly with little *minima*, although it is likely to do so with *canadensis* or the hitherto so-called *hutchinsi* (=the herein revised *leucopareia*), but demonstrations of these intergradations should be based on fully adult specimens, not light-breasted juveniles.

Distribution. Breeding on Queen Charlotte islands and reported to do so on the Alaskan coast north of Prince William sound. Practically resident with little migrational movement.

[1]Considering that the name "White-cheeked" was applied to this form under a misapprehension as to its actually distinctive characters, that the same name in latinized form must be revived as the scientific appellation of another race, and that it is not very familiar in common usage, I propose that this race be known henceforth vernacularly as the "Western Canada Goose", a satisfactory descriptive title expressive of its scientific one.

Branta canadensis leucopareia (Brandt)

(*B. c. hutchinsi* of previous authors)

The Lesser Canada Goose

(None of these birds is a demonstrated breeder, but all, from their northern geography or dates, can be regarded as representative of their given localities.)

Museum number	—	Sex	Age	Mid toe and claw	Tarsus	Toe into tarsus	Culmen	Depth of bill	Depth into culmen	Wing
6522	Teslin lake, Yukon, July 12, 1912	♀	Y.	73	82	1·12	38	23	1·65	M.
6521	" " July 27, 1912	?	Y.	79	87	1·10	40	22	1·81	M.
6520	" " 1912	♀	Y.	80	87	1·08	39	21	1·85	M.
6551	" " Aug. 28, 1912	♀	Y.	75	81	1·08	42	22	1·90	410
6657	" " Sept. 22, 1912	♂	Y.	76	80	1·05	42	21	2·00	445
6656	" " Sept. 22, 1912	♂	Y.	71	77	1·08	40	21	1·90	400
4496	Alaska-Yukon boundary—Arctic circle, summer, 1911	?	Ad.	.....	.....	.....	43	21	2·04	
7938	Barter is., Alaska, June 15, 1914	♂	Ad.	68	74	1·08	36	19	1·89	415
9862	Herschel is., Yukon, Aug. 1914	♀	Ad.	68	70	1·02	38	18	2·11	M.
9861	" " Aug. 1914	♀	Ad.	70	75	1·07	38	20	1·90	M.
12951	Walker bay, Victoria is., July 16, 1917	♀	Ad.	65	71	1·09	36	20	1·80	380
7691	River du Rocher, Mack., Aug. 3, 1914	?	Jv.	.....	.....	.....	42	22	1·90	
6726	Cape Fullerton, Hudson bay, June 12, 1904.	?	Ad.	72	78	1·08	37	23	1·60	400
24422	Mistake bay, July 8, 1930, Hudson bay	♀	Ad.	70	75	1·07	37	20	1·85	370
	Average	.....	.....	72·25	78·08	1·07	39·14	20·92	1·88	402·85

Jv. = Juvenile of year. Y. = Yearling. Ad. = Adult. M. = Moulting wings.

Subspecific Characters. Intermediate size, light breast and underbody, bill shorter for its depth and feet smaller in proportion to the tarsus than in *canadensis*.

Between *canadensis* and *hutchinsi* in size. Wing between 380 mm. and 445 mm. The culmen runs from 36 mm. to 43 mm. The bill is long but not as long as in *canadensis*, the depth going into the length from 1·60 to 2·00, averaging 1·88 times (in comparison, *canadensis* 2·10 and *hutchinsi* 1·60). The feet are shorter than the tarsus but not quite as short as in *hutchinsi*, the middle toe and claw going into the tarsus length from 1·02 to 1·12, averaging 1·07 times, as against *canadensis* 0·99 and *hutchinsi* 1·13. There is considerable overlapping in these characters and no one seems individually determinative, but the birds laid out in series in comparison with series of the related races make a convincingly consistent group.[1] On the whole, the length of the culmen makes the best distinctive character and probably most birds with culmen over 35 mm. or under 45 mm., with middle toe and claw decidedly shorter than tarsus, can be referred to this form.

It is to be noted that these specimens show a tendency towards small size, even, towards the Arctic coast, approaching that of *hutchinsi*. This cannot be regarded as a gradation towards *minima*, for it is not accompanied

[1] In view of their immaturity but rather large size, doubt can be entertained as to whether these Teslin Lake birds should not be referred to *B.c. canadensis*. A general impression on viewing the series, however, induces the writer tentatively and in the absence of adult material to include them here.

by any darkening of the breast. Various authorities might regard this variation in size as grounds for splitting the subspecies into a small northern and a larger more southern race, but to the writer it does not seem advisable to dignify with name intermediates between named extremes.

Some west coast birds combine the form and size of this race with the dark breast and underparts of *minima* or *occidentalis*, but such never occur in the interior of the continent and are to be regarded as either intergrades or hybrids with those races.

This middle-sized goose is commonly well distinguished from the larger *canadensis* or "honker", and probably also from *minima*, the cackling goose, by sportsmen of little ornithological knowledge, inferring a more distinctive specific individuality than can be detected in specimens by the keen-eyed, feather-splitting, laboratory specialist. The weight of this incidental evidence should not be disregarded. A common vernacular name, obviously derived from life characters, is "Short-necked Goose", and suggests a measurement distinction in the flesh that is lost in specimen, but one that may possibly be more diagnostic than details that are commonly available to the systematist. It is generally and widely stated that the voice of this bird is recognizably different from that of other allied forms. A goose's honking apparatus is fundamentally a trumpet, and like all trumpets the longer it is the deeper the tone of the note it emits. If the neck and windpipe of this bird is consistently shorter than in *canadensis* it would not be surprising if the voice made a more reliable recognition character than the appearance, for the ear is susceptible of far finer discrimination between small quantities than is the eye.

Nomenclature. This bird has long been firmly incorporated in literature as *B. c. hutchinsi* and it is very regrettable that it must now be changed, or worse, that its traditional name be transferred to a comparatively unknown but entirely different form of the genus. There seems to be no alternative. It is evident that the name *hutchinsi* was applied by Richardson to a much smaller bird and from now on must be associated with an entirely different concept. *Anser leucopareius* Brandt, Bull. Sc. Ac. Petersb. I, p. 37 (1836), further characterized and figured by the author in "Description et Icones Animalium Rossicorum Novarum (1836)", is generally regarded by taxonomists as a synonym of *B. c. hutchinsi* as currently understood. I have examined both these papers and the type appears to be the dark-breasted, medium-sized, Pacific Coast bird which may be either an intergrade with *B. c. occidentalis* or a distinct race (*See* Brooks 1926). In the latter case the light-breasted, middle-sized bird of the interior of the continent may demand a new name, but in the absence of definite evidence to that effect I propose to include it under *leucopareius.*

Owing to the confusion that this very unfortunate transference of name will cause I propose that the vernacular term "Hutchin's Goose" be dropped from future use and that the middle-sized bird hitherto so called be designated the "Lesser Canada Goose" and the small one to which the name properly belongs be known as "Richardson's Goose".

Distribution. Breeding from west coast of Hudson bay to Alaska and from the Arctic coast indefinitely southward. Migrating through the interior west of the Great Lakes and along the Pacific coast.

Branta minima Ridgway

The Cackling Goose

(Though no breeding or summering birds are available in this study a large number of migrant specimens have been examined in the United States National Museum, the Academy of Natural Sciences of Philadelphia, and, especially, a magnificent series in the collection of Mr. F. H. Kennard. The selection is probably fairly typical of the form.)

Museum number	——	Sex	Age	Mid toe and claw	Tarsus	Toe into tarsus	Culmen	Depth of bill	Depth into culmen	Wing	Wt.
				Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Lbs.
86614 U.S.N.M.	Nushagak, Alaska, Aug. 10, 1881..	♂	Ad.	60	66	1·10	29	17	1·75	358	
62149 A.N.S.P.	Colusa co., Calif., Dec. 4, 1913...	♂	Ad.	62	69	1·11	28	18·5	1·51	390	
62148 A.N.S.C.P.	" " Dec. 5, 1913...	♀	Ad.	57	64	1·12	30	19·5	1·55	365	
F.H.K.	" " Dec. 28, 1912...	♂	Ad.	63	70	1·11	28·5	18·5	1·54	370	
F.H.K.	Glen co., Calif., Nov. 20, 1928..	.....	Ad.	63·5	68	1·07	27	19	1·42	330	2¾
F.H.K.	Colusa co., Calif., Dec. 28, 1912..	♂	Ad.	65	70	1·07	25	19	1·31	375	
F.H.K.	" " Jan. 6, 1913..	♂	Ad.	65	70	1·07	28·	21	1·33	390	
F.H.K.	" " Dec. 3, 1929..	♀	Ad.	55	63	1·14	29	17	1·70	360	2¾
F.H.K.	Glen co., Calif., Nov. 20, 1928..	♀	.....	56	64	1·14	28	15·5	1·80	325	2¾
18875	" " Feb. 27, 1923..	♂	Ad.	65	75	1·15	30	19	1·50	370	
17507	Klamath Falls, Ore., Nov. 24, 1921.....	♀	Ad.	58	67	1·15	27	18	1·50	355	
18874	Glen co., Calif., Feb. 27, 1923..	♂	Ad.	61	70	1·14	30	19	1·57	390	3
F.H.K.	Colusa co., Calif., Nov. 28, 1929..	♂	Ad.	60	70	1·16	30	16	1·25	360	
	Average.....	.....	.....	60·77	68·15	1·11	28·19	17·76	1·49	295·07	

Ad. = Adult.

Subspecific Characters. Very small size and very dark breast and underbody. With *hutchinsi* the smallest of the Canada geese, not much larger than a mallard, but confined to the vicinity of the west coast and never appearing in the interior. Wing 390 mm. or smaller. Weight usually under 4 pounds. Culmen 30 mm. or less. Bill short and stubby, the depth going into the length from 1·25 to 1·80, averaging 1·49 times. Feet small in comparison with tarsus, the middle toe and claw going into the tarsus length from 1·07 to 1·16, averaging 1·11 times.

Probably in size and proportions indistinguishable from *hutchinsi* but differing greatly in colour. Breast and underparts are solidly brownish plumbeous—"Hair Brown" of Ridgway's Color-Nomenclature, Plate XLIV—broken when adult only by the broad, squarish, pale feather-tips, common to the genus. There is usually much rust-stain on the plumage to obscure the basic coloration. The breast darkens markedly towards the base of the neck where it blends in more or less completely with the black stocking. If a white collar is shown it is always high enough on the neck to show an appreciable amount of black below it.

Young of the year are likely to be much paler breasted in a variable degree, but always lack the slight wave marking that crossbars the breast and flanks of the adults. Some of these juveniles may be as light in this respect as some of the eastern pale-breasted forms, whereas others are quite dark. Yearling birds often have intrusions of darker new plumage coming into light breast, suggesting that adult coloration may not be

assumed until after the second summer. *Minima* probably occasionally crosses with adjacent races with which it comes in breeding contact. Whether the results of these matings are intergrades or hybrids depends on whether the difference between the races is regarded as subspecific or specific.

Distribution. Breeding on the Bering seacoast of Alaska and the Aleutian islands, migrating down the Pacific coast to California. Never appearing far inland or east of the mountains.

Branta hutchinsi (Richardson)

Richardson's Goose

(All but one of these are breeding birds or taken on the known breeding grounds of its race. The single Southampton Island bird is also probably a breeder.)

Museum number	——	Sex	Age	Mid toe and claw	Tarsus	Toe into tarsus	Culmen	Depth of bill	Depth into culmen	Wing	Wt.
				Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Lbs.
21108	Cape Dorset, Baffin is., July 20, 1926	♂	Ad.B.	58	67	1·15	35	20	1·75	370	
23631	Camp Kungovik, southwest Baffin is., June 14, 1929	♀	Ad.	60	67	1·11	31	17	1·82	365	
23632	" " June 15, 1929	?	Ad.	63	70	1·11	34	20	1·70	365	
23636	" " June 16, 1929	♀	Ad.	60	69	1·15	31	19	1·63	360	4
23638	" " June 18, 1929	♂	Ad.	59	68	1·15	34	21	1·62	365	
23643	" " June 26, 1929	♀	Ad.	60	68	1·13	31	20	1·55	350	
23645	" " July 2, 1929	♂	Ad.B.	59	68	1·15	31	20	1·55	380	3¾
6727	Southampton is., Hudson bay, 1904	?	Ad.	60	69	1·15	30	17	1·76	345	
	Average.....	....	.....	59·87	68·12	1·13	32·12	19·25	1·67	362·5	

Ad.=Adult. B.=Breeding.

Subspecific Characters. Very small size and light breast and underbody. A diminutive edition of *leucopareia* and *canadensis* and bearing the same relation in colour to *minima* that *canadensis* does to *occidentalis*. Probably only distinguishable from *minima* by colour, but widely separated from it in range. Wing 380 mm. or under. Culmen 35 mm. or less. Bill short and stubby, the depth going into the length from 1·55 to 1·82, averaging 1·67 times instead of 1·88 as in *leucopareia*. Foot even smaller in proportion to tarsus than in that species, the middle toe and claw contained in the tarsus from 1·11 to 1·15, averaging 1·13 times. Weight taken from various sources, some our own weighings, but principally from figures on Iowa migrants furnished by R. M. Anderson, usually about 3½ pounds. Rarely as much as 5 pounds.

Distribution. Found breeding commonly and eggs collected on the Foxe Basin coast of southwestern Baffin island by Soper in 1929. Mr. S. G. Ford of the Hudson's Bay Company writing to Mr. F. H. Kennard from Coral harbour, Southampton island, under date of July 23, 1925, describes a small goose with black head and neck, white cheek patches meeting under the throat, and weighing 3¾ pounds, as breeding there. Specimen 6727 in the above list corroborates the identification. Richardson's type specimen was taken on Melville peninsula directly north of this island.

Inspector A. H. Joy of the Royal Canadian Mounted Police tells me he killed two "ducks that honked like geese" at Craig harbour, southern Ellesmere island, in the autumn of 1925. They were "scarcely half as large again as an eider and had fine white rings about their necks". An Eskimo accompanyng him stated that he had seen similar birds on the Humboldt glacier of Greenland. This is unmistakably this bird and suggests a high northern breeding limit. The migration route seems to be confined to the west side of Hudson bay and James bay. Mr. H. E. Bland (Hudson's Bay Company) mentions a "small grey goose" as well as the "Canada Goose" as occurring at Weenusk Post, and Mr. J. W. Anderson of Albany Post, describes a goose "the same as the Canada Goose in every way save that it is much smaller" and with a "note like some person rattling a large number of empty tin cans" as occurring in some numbers on migration on the shores between cape Henrietta Maria and Trout river. No reports referable to this form come from correspondents on the east side of Hudson bay. It is regular though not very numerous through southern Manitoba. We have several specimens from Whitewater lake and a convincing report of its rare occurrence on Shoal lake in that province. R. M. Anderson has furnished measurements and descriptions of a number of specimens hitherto identified as *minima*, but plainly referable to this subspecies, in the Museum of the University of Iowa, taken at Whiting, Wolf Creek, and Sloan, Iowa, and Platte and Wood rivers, Nebraska. In the United States National Museum there are migrant specimens from Andalusia, Illinois, and the "North Red River". In the Academy of Natural Science of Philadelphia are specimens from "Mississippi River", Illinois, and two from Sweetwater lake, North Dakota. Mr. J. H. Fleming informs me that a live pair in the Toronto Zoo, regarded as cackling geese but undoubtedly this bird, came from Kansas. Major Allan Brooks writes that he has secured one of these "dwarf geese" at Brownsville, Texas, and has information that it winters in Tamaulipas, Mexico. We can thus map out the whole range of the species in a fairly satisfactory manner.

Breeding in the eastern Arctics, it migrates down Hudson bay through southern Manitoba, Nebraska, Iowa, the Dakotas, and the Mississippi valley, wintering on the northern gulf coast of Mexico.

A number of records without this line of flight can probably be regarded as stragglers from the main route. A few have from time to time visited Jack Miner's sanctuary in southern Ontario. Manly Miner has described them several times as "not much larger than a green-head mallard drake.... but same markings as the Canada goose". In 1926 he reported that about one a year visited the sanctuary and that he had a "winged" bird permanently. In the autumn of 1927 a pair spent a short time and the following autumn eight came in. Of their voices he writes—"It does not honk but cackles or clucks like an old hen scolding". In another place he says—"their noise is K-r-r-r-r like an old hen telling her chicks to look out for a hawk or calling her young to feed—K-r-r-r a sort of trill". Elsewhere he calls it a "gurgle in the throat". Drawing and measurements taken by Prof. Wm. Rowan of a specimen taken at Sullivan lake, Alberta, suggest this subspecies. At least two have been taken in the autumns of 1926 and 1928 at cape Tourmente, near Quebec city. Through the courtesy of Mr. E. G. White of this city I have had the pleasure of examining both of these in the flesh. I have also examined winter specimens in the Academy

of Sciences of Philadelphia from Oracoke, North Carolina, and Bishop's Head, Dorchester county, Maryland, and January birds in the Museum of Comparative Zoology, Cambridge, Mass., from Pea island and Currituck sound, North Carolina.

Most of these little geese that have come to the attention of ornithologists have been referred to *minima* which they resemble in all but colour, but now as separate breeding and winter ranges can be shown for them and also as they never show the dark breasts or underparts of that race there can be no doubt as to their distinctness.

Richardson's account of *hutchinsi*, Soper's findings on Baffin island, and this suggestion from the winter range all point towards *hutchinsi* being a marine rather than a freshwater bird, which may account for the comparatively few and erratic numbers of Mississippi Valley records, the flocks passing over the freshwater interior with few or only accidental stop-overs, much as does the blue goose *(Chen caerulescens)* with a somewhat similar distribution and range.

Nomenclature. Branta canadensis hutchinsi is based on *Anser hutchinsi* Richardson, Fauna Boreali Americana II (1832), page 470, from a male bird taken on Melville peninsula, north of Hudson bay. In studying the measurements there given it is evident that a very small bird was in hand. In fact the describer plainly states that in form and size the new bird more nearly resembles the brant than the Canada goose. The measurements are with one exception consistently small, the feet and tarsi being extremely so, and much smaller than anything here presented. The culmen measurement, however (1 in. 8½ lines = 43·5 mm.), is much too large to agree with the other dimensions and taken literally makes the bird a monstrosity. I have tried to imagine the bill of No. 4496 *(leucopareia)* on one of the Baffin Island birds and the absurdity is apparent. Nor does the culmen figure harmonize with the other bill measurements. It is only one-half a line shorter than the figure given from tip of bill to the tip of the frontal angle and is 3½ lines longer than to rictus, whereas to agree with the *canadensis* type, it should be about equal to it. To any one who has measured many Canada goose bills the solution is apparent. The feathering on the fore crown was worn away and did not give the true exposed culmen line. Many birds show this wear and it takes considerable care in making this measurement to be certain that the real and not the apparent feather line is taken. With this correction and the direct statement that the newly described bird is the size of a brant there can be no doubt that it was this little goose that Richardson designated *hutchinsi* and not its much larger relative to which the name has hitherto been attached.

In order to avoid confusion with older references and to connect this bird with the man who first detected its distinctness I propose that it be known vernacularly as Richardson's goose.

General

The degree of relationship between these various forms of the genus *Branta* is difficult to arrive at. Though the breeding specimens under review show clear enough lines of demarcation between the groups, intermediates are said to (and probably do) occur. Whether these are true

intraspecific intergrades or extraspecific hybrids is not clear. That *minima* and *leucopareia* breed in comparative juxtaposition on the Bering sea coast without general mongrelization as described by Conover (The Auk, XLIII, 1926, 174), and that *hutchinsi* and *canadensis* do the same on Baffin island as determined by Soper in 1929, is strongly indicative if not finally determinative of specific distinction between these little geese and their larger relatives. That there is no indication or geographical opportunity for intergradation between *minima* and *hutchinsi* would equally separate them from each other. I, therefore, propose that they be treated as full and distinct species.

Though *occidentalis* is undoubtedly only a subspecies of *canadensis*, the status of *leucopaeria* is less evident. The difference between it and *canadensis* may possibly be much greater and more constant than specimens show or systematists suspect, but with our present lack of definite evidence it seems wisest to allow it only subspecific standing.

The group will then appear in our lists as follows:

Branta canadensis (Linnaeus), the Canada goose
Branta canadensis canadensis (Linnaeus), the honker or eastern Canada goose
Branta canadensis occidentalis (Baird), the western Canada goose
Branta canadensis leucopaeria (Brandt), the lesser Canada goose
Branta minima Ridgway, the cackling goose
Branta hutchinsi (Richardson), Richardson's goose

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FRESHWATER MOLLUSCA FROM CENTRAL ONTARIO

By F. C. Baker and A. R. Cahn[1]

Illustration

INTRODUCTION

The present paper is based on a large collection of freshwater mollusca made by the junior author during the summers of 1928 and 1929 in that part of Ontario between the International Boundary and Albany river. The complete itinerary is given later in this paper. The freshwater fauna of the region once known as Keewatin has been made historic by the writings of J. F. Whiteaves, Robert Bell, and George Dawson. Though portions of the territory have been studied and written upon, only one author has essayed to cover the entire area in a consideration of its molluscan aquatic fauna, Dall (1905) in his "Alaska Mollusks." Mozley has recently taken up the study of the Manitoba fauna, adding greatly to the number of species represented and bringing the nomenclature down to the present time. The important papers relating to this area are listed in the bibliography.

The region of central and northern Ontario is one of great interest to the student of geographic and ecologic variation. With its almost endless series of lakes, connected for the most part by rivers and sloughs, it affords the widest opportunity for the action of the laws of organic evolution upon the aquatic inhabitants. And that these laws have been in operation is evidenced by the varieties and species peculiar to this region.

Fifty species and races are represented in the collection, of which nineteen are new to the region, two of these representing apparently new varieties. This is the largest single collection reported upon from this area. There have been recorded from central and northern Ontario seventy species and varieties of freshwater mollusca; adding the nineteen species and races herein recorded for the first time from the area, there is a total of eighty-nine species and races known. About fifty-five additional species and races are known from Manitoba and adjacent territory, which should be found in Ontario, giving a grand total of one hundred and forty-four species and races of freshwater mollusca that should be found in central and western Ontario.

[1]Contribution from the Museum of Natural History, University of Illinois, No. 57. Contribution from the Zoological Laboratory, University of Illinois, No. 384.

It is interesting to note the distribution of the several families represented in this fauna, some groups increasing in species northward and others decreasing in this respect. The table below indicates this geographic distribution.

Southern fauna			Northern fauna		
—	Known	Probable	—	Known	Probable
Unionidae	6	7	Sphaeriidae	38	61
Viviparidae	1	1	Valvatidae	5	10
Amnicolidae	6	7	Lymnaeidae	15	25
Physidae	3	9	Planorbidae	13	19
Ancylidae	2	5			

It is also probable that species and varieties not at present known will be found in some of the lakes and streams, especially in the groups Sphaeriidae, Lymnaeidae, Planorbidae, and Physidae. The area as a whole may almost be considered virgin territory as far as the aquatic fauna is concerned. It is especially desirable that more material with the animal be collected, and that the habitat relations be accurately described, for it is now appreciated by biologists that differences in the animals are often coincident with differences in the physiographic relationships of the environment. The study of the fauna of the Canadian region is of great value in connexion with the geological history of North America, comparisons between the present fauna and that of the interglacial intervals showing clearly that great changes have taken place in the nature of the aquatic fauna since the last ice-sheet retreated to the north.

In the present paper comparative notes on each species represented are given more fully than is usual in local faunal papers, and in view of the inherent tendency to vary that is found in all organisms this becomes necessary to adequately understand the relationships of this fauna to that of other areas. Under each group other published records are included and comparisons are made with adjacent territory, Manitoba, Mackenzie river, etc., thus bringing together all of the information at present known concerning the fauna of central Canada. The nomenclature is brought down to date and is essentially that used by the senior author in his "Fresh Water Mollusca of Wisconsin," Bulletin 70 of the Wisconsin Geological and Natural History Survey.

ACKNOWLEDGMENTS

Dr. Victor Sterki has examined all of the Sphæriidæ and has made valuable notes on many species, these being indicated under each species. Mr. William J. Clench has examined the only species of Physa found by the party. The hearty co-operation of Mr. Jack T. Kemp is to be especially noted.

ITINERARY OF THE JOURNEY

By the Junior Author

During the summers of 1928 and 1929 the junior author headed a party of four on a six and ten weeks canoe trip through the central Canadian wilderness, with the intention of making a study of the birds, mammals, fish, and molluscs of the region. The second in command of the party was Mr. Jack T. Kemp, and the collections of molluscs herein discussed were made by Mr. Kemp and the junior author. Collections of living animals were made, and "wind rows" along the shorelines were carefully explored for washed up shells. In this way it is felt that a fairly representative collection of the forms living within the area traversed was assembled, though undoubtedly time will show that some species were missed. However, it is hoped that this report may stimulate collecting in this interesting area, for it is largely virgin territory. There are uncounted hundreds—if not indeed thousands—of lakes in this region that have never been studied; what treats they hold for the biologist, and especially for the conchologist, can not even be guessed at.

The 1928 trip started on the border waters at Ely, Minnesota, heading west and north through Basswood, Crooked, and Wicksteed lakes to lake La Croix; up Quetico river and through Beaverhouse, Quetico, Jean, Batchawana, and Flood, and so to Eva lake; then, turning south, through Pickerel, Sturgeon, Chatterton, Kahnipiminanikok, Saganagons, Saganaga, and Knife, and so back again to Basswood lake. The 1929 trip started from Sunstrum, 30 miles west of Sioux Lookout, and pushed northward through Rock lake into lac Seul, down English river to Pakwash lake, down Troutlake river to Trout lake; then back to the junction of Troutlake river with Woman river, and up the latter stream. Then followed dozens of lakes, including Woman, Shabumeni, Birch, Kapikik, to Cat lake, where the party turned south and east. Down Cat river through Zionz, Fawcett, Kezik, Bamaji, and Blackstone lakes to the west end of lake St. Joseph; down the entire 105-mile length of St. Joseph to and up Pashkokogan river entering at its eastern extremity; through Pashkokogan lake, followed by Hamilton, Fitchie, Hill, Armit, and Fairchild lakes, Marchington river, Schist, Kimmewin, Stranger, Marchington, Botsford, Abram, and Pelican lakes, and so to Sioux Lookout.

The region traversed during 1929 is rough and rocky in the extreme. It is very largely a granite country, covered with a heavy stand of excellent spruce *(Picea mariana)*, with large areas of muskeg swamps and their typical biota distributed throughout. Glacial action is everywhere in evidence and, particularly in the vicinity of Marchington river, great gravel moraines were encountered, together with many "dead" lake beds and old glacial river channels. The lakes, almost without exception, are large and relatively shallow. The shorelines are extremely irregular, and for the most part dangerously rocky. Sand beaches are rare, though more in evidence farther north than in the Quetico country. Many small lakes are mere puddles set in great muskeg swamps. These have a soft muck bottom and are full of aquatic vegetation, abounding in large Lymnæas and Bulimnea locally. The lakes being shallow, the shores are subjected to a terrific pounding by the waves, and in such exposed areas gasteropods

are very scarce. Pelecypods are numerous locally where bottom conditions afford them congenial footing. Sand beaches and the muck of the small lakes afforded excellent collecting grounds for Pisidium, Musculium, and Sphærium, but the Unios were few and far between. There are many muskrats *(Ondatra zibethica)* in the region, and it was found that they were feeding to a large extent upon Unios; hence the collectors profited by picking over the numerous shell piles which these accommodating animals left on the shore for them. Each collection was kept separately, and an effort was made to bring in a representative collection from the lakes and rivers traversed.

Family, UNIONIDAE

Anodonta grandis footiana Lea

Lakes Fitchie, Bamaji, Stranger, Kimmewin, Botsford, Cat, St. Joseph, Hill; Marchington and Pashkokogan rivers. Abundant only at the first three localities. This common and widely distributed variety of *Anodonta grandis* is undoubtedly a northern form in distribution as suggested by Ortmann. It is common in Michigan, Minnesota, Wisconsin, and northern New York in the United States, and has been seen from Georgian bay, and the northern part of Ontario in Canada. How much farther north it may extend is not known. The specimens collected by Dr. Cahn are like those from Winnebago lake, the type locality (*See* Baker, 1928, I, 157). Not recorded by Whiteaves (1905) from Keewatin.

Anodonta kennicottii Lea

Pashkokogan lake and river. Only three specimens of this characteristically northern Anodonta were found by the Cahn party. These are like those from Wisconsin. *Kennicottii* is known as far north as Great Slave lake. Recorded by Whiteaves (1905).

Anodonta marginata Say

Schist lake, one specimen. Typical in form and colouring. This species inhabits the Mississippi, St. Lawrence, and Hudson Bay drainages. Recorded by Whiteaves (1905).

Lampsilis superiorensis (Marsh)

Unio superiorensis Marsh, Nautilus, X, p. 103, Pl. 1, figs. 1, 2, 5, 1897.

This species appears to be the common Lampsilis of the north. The shell is much thinner than *siliquoidea*, the hinge much slighter, the cardinal teeth less developed, and the colour more yellowish with fainter rays. The hinge is more like that of *radiata*. The rays are more usually interrupted by the lines of growth than in the related species. The rest periods are strongly accentuated. In form the shell is always much higher behind the umbones than in front of these, a feature well shown in Marsh's figure. The Cahn specimens are much eroded about the umbones and the interior of the valves is in many cases discoloured with coppery stains, due to distomid parasitism.

Some measurements of this material indicate a larger size than that indicated by Marsh or Simpson (Desc. Cat., p. 62).

—	Length	Height	Diameter	—
	Mm.	Mm.	Mm.	
Lake Bamaji	82	46	28	Male
" "	72	43	26	Male
" "	73	48	27	Female
Hamilton lake	75	44	24	Male
" "	71	43	23	Male
Cat lake	75	44	25	Female
Marchington river	85	49	29	Male
" "	81	48	30	Male
" "	64	40	28	Female

Other localities are as follows: Hill, Schist, St. Joseph, Pashkokogan, Pelican, Stranger, and Shaubemini lakes; Marchington and Pashkokogan rivers. *Superiorensis* appears to be largely a species of lakes, as judged by the records. Published records of *superiorensis* are rare in Canadian literature. The type locality is Michipicoten river north of lake Superior, in southern Ontario. Whittaker (1924, page 8) found it in lake Kakiska and at the mouth of Hay river, both localities in the Mackenzie River basin. The specimens from the latter locality are somewhat heavier than those in the Cahn material. It is possible that some of the records of *Lampsilis luteola* from Keewatin and Ontario really belong under *superiorensis*. As for example Whiteaves' records from Ekwan river, mouth of Moose river, Albany river, Kawinogans river, and lake Abitibi. It is reported by Mozley from a number of places in Manitoba and western Ontario, bordering Manitoba. The known authentic records indicate a very wide distribution for this species, especially to the north.

The rarity of records of the river forms of the Naiades from this part of Ontario indicates clearly their general absence. Whittaker records *Strophitus edentulus* from the mouth of Hay river and Mozley lists it with the fauna of Manitoba and western Ontario. *Lasmigona complanata* is listed from Minaki, Winnipeg river. Dall (1905) records the following species of Naiades from parts of Ontario and Manitoba:

Lampsilis ventricosa (Barnes)[1]
Lampsilis luteola (Lam.)
Lampsilis radiata (Gmelin)
Lampsilis carinata (Barnes)
Ligumia ellipsiformis (Conrad)
Ligumia recta (Say)
Proptera alata (Say)
Leptodea fragilis Raf.
Anodonta implicata Say
Anodonta pepiniana Lea
Anodontoides ferussacianus (Lea)
Lasmigona costata Raf.
Lasmigona complanata (Barnes)
Amblema costata Raf.
Megalonaias gigantea (Barnes)
Quadrula quadrula Raf.
Fusconaia flava (Raf.)[1]

Just how many of the species listed inhabit the Hudson Bay drainage is not certain. None of the usual river mussels was obtained by the Cahn party and few are recorded by other observers from this drainage and it is quite possible that many of those listed are not found outside of the Mississippi drainage.

[1] For the nomenclature of the Unionidae of this region see Baker, Moll. Wis., vol. I.

Sphaerium sulcatum (Lam.)

Botsford lake, one valve is referred to this species by Dr. Sterki. Recorded by Whiteaves from Knee lake, and by Mozley from Rainy lake, near Wade, Ontario, as well as from parts of Manitoba.

Sphaerium fallax Sterki

Fitchie, Cat, Hill, Bamaji, Hamilton, and Botsford lakes; Marchington river. A rather variable Sphaerium distinct from *sulcatum* and apparently the dominant large member of this genus in the north. Some of the material listed as *simile* by Whiteaves and others may be of this species.

Sphaerium acuminatum (Prime)

Lakes St. Joseph and Bamaji, more common in the latter. Not noted by Whiteaves.

Sphaerium vermontanum (Prime)

Botsford lake. Recorded from Mills lake, Mackenzie River district, by Whittaker.

Sphaerium emarginatum (Prime)

Hamilton lake. Recorded by Whiteaves from Attawapiskat river and from Knee lake on Hayes river.

Sphaerium tenue (Prime)

Bamaji lake. Recorded by Whittaker from several places in Mackenzie River district.

Sphaerium sp. indet.

Several Sphaeria not at present determinable were collected in lakes Kimmewin, Bamaji, Hill, and Fitchie. Much of this material is beach debris, rather worn.

Other species of Sphaerium have been recorded from this area by Whiteaves and these are listed below for completeness.

Sphaerium walkeri Sterki—Attawapiskat river
Sphaerium stamineum (Conrad)—Kawinogans river, Abitibi lake
Sphaerium flavum (Prime)—Root river, lac Seul, English river above lac Seul
Sphaerium striatinum (Lam.)—Lake Abitibi, Ontario side
Sphaerium rhomboideum (Say)—Lake St. Joseph, Albany river

Mozley records the following species from the boundary between Manitoba and Ontario:

Sphaerium crassum Sterki
Sphaerium solidulum (Prime)
Sphaerium striatinum (Lam.)
Sphaerium occidentale Prime

Musculium rosaceum (Prime)

St. Joseph, Botsford, Hamilton, Kimmewin, Kapikik, and Pashkokogan lakes. Found by Whittaker in Mills lake, Mackenzie River district, indicating a wide northward distribution. Published references to this species from Ontario and other parts of western Canada are rare.

Musculium truncatum (Linsley)

Hamilton lake, rather common. Sterki says of this Musculium: "A form markedly different from all seen. It may be a species if sustained by additional material." The name *quadrulum* is given to it by Dr. Sterki, tentatively. Typical *truncatum* is recorded by Mozley from Skunk lake, near Minaki, Ontario.

Musculium securis (Prime)

Fitchie lake. Reported by Whiteaves from Kawinogans river and by Mozley from Alice lake, between Minaki and Wade.

Musculium sp. indet.

Questionable forms of Musculium were found in Fitchie and Kimmewin lakes. Small and uncharacteristic specimens.

Musculium partumeium (Say) is recorded by Whiteaves from Kawinogans river.

Pisidium compressum Prime

Pashkokogan and Botsford lakes. Reported by Whiteaves from Ozhiski lake and from Attawapiskat, Kawinogans, and Winisk rivers. Recorded by Whittaker from Mills lake, Mackenzie River district, and by Mozley from places in Manitoba. The Ontario shells are not the typical creek and small river forms, but one of the lake varieties, either *pellucidum* or *limnicolum* Sterki (*See* Baker, Moll. Wis., I, p. 372).

Pisidium variabile Prime

Botsford lake. Reported by Whiteaves from Kawinogans river and lake St. Joseph. Widely distributed in Manitoba.

Pisidium ferrugineum Prime

Hamilton lake, one specimen. As far as known not before reported from central Ontario.

Pisidium rotundatum Prime

Hamilton and Kimmewin lakes. Recorded by Whiteaves from lake St. Joseph. Sterki gives the distribution as Ontario and Manitoba in Canada. Apparently rare in Canada.

Pisidium punctatum Sterki

Hamilton lake. Apparently not before reported from Ontario or Canada.

Pisidium adamsi Prime

Cat and Fitchie lakes. As *Pisidium affine* Sterki reported from Kawinogans river by Whiteaves (*See* Baker, Moll. Wis., I, p. 385).

Pisidium minusculum Sterki

Kimmewin lake, common. Apparently not before reported from Canada.

Pisidium scutellatum Sterki

Bamaji, Hamilton, Pashkokogan, and Kimmewin lakes. Reported from Kawinogans river and Ozhiski lake by Whiteaves. Mackenzie river and Yukon territory (Whiteaves and Whittaker). Rarely recorded from Canadian localities. Dr. Sterki has shown that his *scutellatum* is probably the same as the European *lilljeborgi* of Clessin, but as the varieties of that species in Europe are little known it appears best, as suggested by Sterki, to use the American name for our own species. The Canadian forms are somewhat different from the species as known farther south.

Pisidium sp. indet.

Some material from Bamaji and Botsford lakes is at present indeterminable. Dr. Sterki says that the Keewatin (northern Ontario) material contains a number of peculiar forms and suggests that future collecting may bring to light many additional peculiar varieties and species. This area should be almost virgin territory for students of the Sphaeriidae.

Many species of Pisidium not collected by the Cahn party are recorded from this territory. Whiteaves has listed the following:

Pisidium fallax septentrionale Sterki (= *errans* Sterki)—Ozhiski lake, Knee lake, Hayes river
Pisidium sargenti Sterki—Kawinogans river
Pisidium splendidulum Sterki—Ozhiski lake; lake St. Joseph
Pisidium politum Sterki—Ozhiski lake; Root river
Pisidium mainense Sterki—Root river
Pisidium abditum Hald.—Albany river
Pisidium roperi Sterki—Albany river
Pisidium pauperculum crystallense Sterki—Root river
Pisidium vesiculare Sterki—Head of lake St. Joseph
Pisidium milium Hald.—Head of lake St. Joseph
Pisidium walkeri Sterki—Attawapiskat river

From Manitoba the following species are known, any or all of which are likely to be found in northern Ontario:

Pisidium medianum Sterki
Pisidium ventricosum Prime
Pisidium noveboracense Prime
Pisidium pauperculum Sterki
Pisidium tenuissimum Sterki
Pisidium subrotundum Sterki

Family, VALVATIDAE

Valvata tricarinata (Say)

Outlet of lake Bamaji; Fitchie, Kimmewin, Botsford, and Cat lakes. Mostly strongly carinate and hence typical. The material from Cat lake has a much depressed spire and is sharply tricarinate. It would be of interest to know how general this variation is among the Valvatidae of the northern lakes. This species is reported by Whiteaves from Sutton lake, lake St. Joseph, Kawinogans and Attawapiskat rivers, and Albany river. Dall records it from Moose Factory and the variety *simplex* Gould from English river. It is abundant in Manitoba and Whittaker found it in Mackenzie River district.

Valvata tricarinata perconfusa Walker

Outlet Bamaji lake, abundant and very variable as regards distinctness of the two carinæ. This variation has not generally been recognized by Canadian writers. Mackenzie River material examined was all referable to the typical form.

Valvata lewisi helicoidea Dall

Kimmewin lake, rare. The immature shell of two whorls has the same fine sculpture as typical *lewisi* which changes to the coarse, rib-like sculpture of *helicoidea* between the second and third whorls. One specimen is markedly discoidal, the last whorl separated from the one preceding and distinctly descending. This variety of *lewisi* is reported from Mackenzie region by Whittaker. It is not specifically noted by Whiteaves, but it is probable that the record of *Valvata sincera* from Kawinogans river, which is said to be small and partly uncoiled, may be the same as the specimen obtained by Dr. Cahn. Also the *Valvata sincera* from lake St. Joseph might have been this form of *lewisi* (*See* Walker, 1906, p. 26, for descriptions and figures of the true *sincera* and its relationship to *lewisi*).

Valvata lewisi Currier is recorded from Manitoba by Mozley and others and doubtless inhabits central Ontario as it does the southern part of this province. Whiteaves records *Valvata sincera* from Sutton lake, Keewatin, but whether this is the true *sincera* or a variety of *lewisi* cannot be ascertained without an examination of the specimens.

Family, VIVIPARIDAE

Campeloma milesii (Lea)

Hamilton lake, one immature specimen. This is referred to *milesii* rather than to *decisum*. Campeloma is not listed by Whiteaves or others from northern Ontario and our knowledge of the distribution of this genus in Canada is very imperfect. Dall (1905, p. 125) lists *decisum* only and this from doubtful sources, for the most part. Hanham records *decisum* as from Lake of the Woods, rare. This may possibly have been *milesii*, which is largely a lake species. Campeloma is evidently rare in central and northern Canada and special search should be carried on for it by exploring parties.

Family, AMNICOLIDAE

Amnicola limosa porata (Say)

Pashkokogan, Hamilton, Kapikik, Cat, Botsford, and Kimmewin lakes. Apparently common in all lakes. Recorded by Whiteaves as *Amnicola limosa* var. from Kawinogans river and lake St. Joseph, and from Knee lake as *Amnicola limosa*. No specimens from the rivers are at hand for comparison, but the form of rivers may be typical. All lake material is referable to *porata*. Recorded by Mozley and others from Manitoba.

Amnicola (Marstonia) lustrica decepta F. C. Baker

Botsford lake, common. The specimens are large with widely open umbilicus. Females are most abundant. This lake form of *lustrica* appears to be widely distributed in the glaciated region of central North America and is very uniform in characteristics. As far as has been ascertained, *Amnicola lustrica* has not been reported from Keewatin or adjacent regions It is not listed by Dall or Whiteaves. (*See* the Wis. Mon., I, p. 108, for the original description and notes on this ecological variety.)

Amnicola (Marstonia) walkeri Pilsbry

Kimmewin lake. *Amnicola walkeri* appears to be rare or absent from most of the Canadian territory, excepting lower Ontario. The only record observed is that of Mozley from Victoria Beach, Manitoba. It is not noted by Dall. The present record indicates a wide distribution in central Canada.

The specimens from Kimmewin lake show considerable variation, from the typical *walkeri* form to that with the spire depressed and the first two whorls coiled in the same plane, forming a somewhat decollated spire. As intergrading individuals occur it is to be classed as simply an individual variation, but if the variations became permanent and included all of the material it would constitute an environmental or ecological variety.

Cincinnatia cincinnatiensis judayi (F. C. Baker)

Hamilton lake, common. The *cincinnatiensis* from northern Ontario, or Keewatin, appear to be referable to the variety first recorded from Winnebago lake, Wisconsin. The individuals are somewhat larger but are otherwise the same. This is the lake manifestation of the typical river form so abundant southward. Dall (1905, p. 118) records the species from Moose Factory, Hudson bay. These may have been the variety *judayi*, which appears to be the northern form of the species. No other record has been seen.

Vancleaveia emarginata (Küster)

This species has been recorded from Moose Factory by Dall, from Manitoba in several places by Whiteaves and Hanham, and from Mackenzie River district by Whittaker. The *emarginata* of Mackenzie region has been differentiated as variety *canadensis* F. C. Baker (*See* Moll. Wis., I, p. 130), and it is probable that the other northern references are based on the same large form with open umbilicus.

Amnicolidae, so abundant in species in the southern part of the United States, appears to be poorly represented in species in the north. *Amnicola pallida* Hald. is recorded by Dall and Hanham from Manitoba and *Pomatiopsis lapidaria* (Say) is recorded by Dall from Moose Factory, Hudson bay. These species should be found in northern and central Ontario.

Family, LYMNAEIDAE

Lymnaea stagnalis jugularis Say

Marchington river, abundant. The specimens from this river show some variation in the arching of the upper part of the outer lip, but are otherwise typical. Recorded by Whiteaves from several places in Keewatin and other parts of Canada. It is recorded from many places in Manitoba, in Mackenzie River district, and in Alaska. It is probably generally distributed over the boreal region.

Lymnaea stagnalis lillianae F. C. Baker

Hill, Blackstone, St. Joseph, Bamaji, Fitchie, Abram, and Cat lakes; Bamaji Lake outlet, on rocks in the rapids. Recorded by Mozley from Manitoba. It is probable that the *stagnalis appressa* recorded by Whiteaves from lake St. Joseph and other lakes in eastern Keewatin really belong to the variety *lillianae*, which was not differentiated when the

Stagnicola catascopium kempi var. nov., *Helisoma antrosa royalensis*, and *H. campanulata canadensis* var. nov.

UPPER ROW. *Helisoma campanulata canadensis* Baker and Cahn. Left figure, type; others, paratypes. Mus. Nat. Hist., Univ. Ill., No. Z30721. Bamaji lake.

SECOND ROW. *Helisoma antrosa royalensis* (Walker). Bamaji lake. Mus. Nat. Hist., Univ. Ill., No. Z30720.

LOWER TWO ROWS. *Stagnicola catascopium kempi* Baker and Cahn. Third row, left, type; others, paratypes. Mus. Nat. Hist., Univ. Ill., Z30719.

All figures enlarged two diameters.

papers on this region were published. The material collected by Dr. Cahn is in most respects like that from the original locality in Tomahawk lake, Wis. Some of the shells have a longer spire than is typical in this race, but they have the same general regularity of the aperture and body whorl characteristic of this lake race. The largest specimen measures: length 50, width 24; aperture length 28·5, width 13·5 mm. They are like Figure 9, Plate XII, of Baker's Wisconsin Monograph. The variety is probably widely distributed in central and northern Canada. All of the shells of the *stagnalis* group, as well as of most of the species in the Keewatin material, are very thin and brittle, as would be expected to be the case with animals living in waters surrounded by igneous rocks.

Stagnicola exilis (Lea)

Cat, Pashkokogan, and Bamaji lakes, and Bamaji Lake outlet. Not common. The individuals are rather smaller and narrower, as well as thinner, than the same species as it occurs in Wisconsin. Not recorded before from Keewatin or other parts of central Canada. Dall (1905) has confused this species with *lanceata* and *kirtlandiana*, all quite distinct species.

Stagnicola palustris alpenensis (F. C. Baker)

Bamaji lake, common. Excepting for the smaller size and very thin shell, due to lack of lime in the water, the Bamaji shells are like the Lake Michigan form of *alpenensis*. It is apparently an ecological variety induced by lake conditions. Much the same form was found in Mills lake, Mackenzie River district, by Whittaker. Some of the material recorded by Dall and others as *palustris* from York Factory, Moose Factory, English river, as well as localities in Mackenzie River region, may include this variety. Typical *Stagnicola palustris elodes* was not found by the Cahn party.

Stagnicola catascopium kempi var. nov. Plate II, two lower rows.

Type locality: Bamaji Lake outlet on rocks in rapids; other localities: lake St. Joseph; Pashkokogan river, in rapid water. Types: Museum of Natural History, Univ. Ill., No. Z30719; Cotypes, National Museum, Canada, Molluscs, No. 4377.

Shell differing from that of typical *catascopium* in being much larger, with a larger, wider, in many cases a patulous, aperture, a wider columellar callus, a more distinct columellar plait, and usually wider spire whorls. The spiral sculpture is more distinct. The umbilicus may be a small, shallow chink or it may be tightly closed.

Length 25·0;	Diam. 15·5;	Aperture length 14·0;	Diam. 10·0 mm.	Type
Length 24·0;	Diam. 15·0;	Aperture length 14·0;	Diam. 9·0 mm.	Paratype
Length 21·0;	Diam. 14·0;	Aperture length 13·0;	Diam. 7·9 mm.	Paratype
Length 19·5;	Diam. 13·5;	Aperture length 12·5;	Diam. 8·0 mm.	Paratype
Length 22·7;	Diam. 16·5;	Aperture length 15·5;	Diam. 10·5 mm.	Paratype

This variety of *catascopium* is a product of the environment, the large patulous aperture being a response to the nature of the habitat, where the animal lives on rocks in rapids and a larger foot is necessary for the animal to retain its hold on the rock to prevent being swept off by the rapidly flowing water. It is very distinct from the graceful, long-spired shell of the more quietly flowing waters of the southern rivers. The shells

also resemble *emarginata* and some individuals might, alone, be referred to that species. It lacks the peculiar texture of that species as well as the wide spire at the shoulder, and the aperture and columellar region are, for the most part, different. As far as shell form is concerned, the two species in the north approach each other very closely in many respects. The new variety is very abundant in the localities cited and the material includes all ages, the smallest being 2·5 mm. in length and having barely two whorls. The large aperture appears to develop at an early period in the life of the snail. The variety is named in honour of Mr. Jack T. Kemp, a companion of the junior author on his Canadian trips.

This is probably the form recorded as *catascopium* by Whiteaves from Mistassin, Ozhiski, and Sutton lakes, Attawapiskat, Kawinogans, and Winisk rivers. It may also include some material from Manitoba listed as *emarginata*. Dall records *emarginata* from English river, and this may also be founded in the new form of *catascopium*. No material like the typical *emarginata* from Maine has been seen from northern Ontario. Mozley records *emarginata* from Manitoba and as typical *emarginata* occurs in northern Wisconsin it probably has a wide northward range. There are several ecological races of this species that should be found in the lakes of northern Ontario and Manitoba.

Fossaria obrussa decampi (Streng)

Bamaji, Hamilton, Cat, Pashkokogan lakes, and outlet of Kapikik lake. All of the specimens are small and immature, but without doubt referable to this race of *obrussa*. Recorded from Manitoba but not from northern Ontario, so far as known. It is highly probable that the material recorded by Whiteaves as *Limnaea galbana* (Say) (not Haldeman) from Kawinogans, Attawapiskat, Kanuchuan, and Winisk rivers and Ozhiski and Wapikopa lakes is all referable to *decampi*, which is the common small lymnaeid of the north, both recent and in post-Glacial deposits. The form called *galbana* (Say) is rare, occurring so far as known as a fossil only in the eastern part of the United States. The living representative of the genus, variety *sayi*, is somewhat different from the fossil form and occurs only, so far as recorded, in the area of the Great Lakes.

Fossaria exigua (Lea)

Bamaji Lake outlet. Rather longer-spired than the typical form of the species, but referable to it without doubt. Not before recorded from central Ontario. Listed from Manitoba by Mozley.

Bulimnea megasoma (Say)

Marchington river, very abundant; Bamaji lake, not common; Cat and Hill lakes, rare. Recorded from lake St. Joseph by Whiteaves and from Manitoba by Mozley. This monotypic group is distributed from northern Ohio (Stark county) to Echinamish lake in latitude 57 degrees, and is apparently most abundant in the northern part of the United States and southern Canada. It is the most abundant shell obtained by the Cahn party. The individuals are large and fine in colour, the size of a majority of the specimens being between 45 and 50 mm. in length. The young and immature shells are very thin.

There should be many more species of the Lymnaeidae found in northern and central Ontario than have been recorded. The following species and varieties are known from adjacent territory and several have been recorded from the vicinity of Hudson bay:

Lymnaea stagnalis sanctaemariae Walker—Manitoba (Mozley)
Stagnicola emarginata canadensis (Sowb.)—Minaki, Winnipeg river, Ont. (Mozley)
Stagnicola emarginata angulata (Sowb.)—Manitoba (Mozley)
Stagnicola lanceata (Gould)—Manitoba (Mozley)
Stagnicola palustris elodes (Say)—Manitoba (as *palustris*, Mozley)
Stagnicola preblei (Dall)—Knee lake, Keewatin (Dall)
Stagnicola vahlii (Beck' Möller)—Hannah bay, near Moose Factory Hudson bay (Dall); Manitoba (Mozley)
Stagnicola arctica (Lea)—Moose river, Hudson bay (Drexler) Harricanaw river, Hannah bay (Whiteaves)
Stagnicola umbrosa (Say)—Rainy lake and Seine river, Ont. (Say)
Stagnicola caperata (Say)—Moose Factory (Dall); Manitoba (Mozley). This species should be found rather abundantly in northern Ontario
Stagnicola walkeriana F. C. Baker—English river, near junction with Winnipeg river; Lost lake, near Minaki, Ontario (Mozley). This is recorded as *apicina* Lea, but it is not that species. Lake of the Woods (Kennicott). (*See* Baker, Wis. Moll., I, p. 247.)
Fossaria modicella (Say)—Manitoba (Mozley)
Fossaria parva (Lea), var.—Manitoba (Mozley)
Fossaria parva sterkii (F. C. Baker)—Manitoba (Mozley)
Fossaria dalli (F. C. Baker)—Manitoba (Mozley)
Fossaria umbilicata (C. B. Adams)—Manitoba (Mozley)
Pseudosuccinea columella (Say)—Manitoba (Dall)
Pseudosuccinea columella casta (Lea)—Manitoba (Mozley)

Family, PLANORBIDAE

Helisoma antrosa royalensis (Walker). Plate II, second row.

Bamaji, St. Joseph, Hamilton, Cat, and Botsford lakes; outlet of Bamaji lake on rocks in rapid water. Most abundant in lake Bamaji.

All of the *antrosa*-like shells of the collection are referable to this race, first described from Siskowit lake, isle Royale, lake Superior, and previously known only from the type locality. The peculiar sculpture mentioned by Walker, the more or less regular rib-like vertical sculpture, is markedly developed on the Keewatin specimens, and is even more regular than on some of the Isle Royale specimens, closely resembling that of *Helisoma corpulenta*, as mentioned by Walker. There is considerable variation in the form of the aperture, in some individuals the form being decidedly triangular, the upper part of the aperture raised above the dorsal margin of the body whorl, in others this area is almost in a line with the body whorl.

It is probable that some of the records of *Planorbis bicarinatus* published by Whiteaves are referable to this variety. That from lake St. Joseph is certainly the same and the Kawinogans River record may be the same. The Albany River material is uncertain, but the Knee Lake specimens are probably referable to *royalensis*. Dall's Moose Factory record is probably one of the lake varieties and not the typical *antrosus* of rivers.

The species once called *Planorbis bicarinatus* Say, and now known as *Helisoma antrosa* (Conrad), though fairly uniform in the rivers and creeks of the central and southern part of the United States, becomes, in the lakes of the north, beyond the terminal moraines of the late Wisconsin

glaciation, split up into many varieties, more or less distinct, reflecting the influence of the diverse lake environments. Mozley records variety *striatus* F. C. Baker from several places in Manitoba, but this is rather the form recently differentiated as variety *sayi* F. C. Baker, the modern descendant of the fossil *striatus*. (*See* Moll. Wis., I, p. 322, for the reasons for this change.) No typical *striata* have been seen from the recent fauna. Whether the typical form is found in the rivers of Canada is not definitely known to the authors, no such material having been seen from the area under consideration. Several of the northern varieties—*percarinata* Walker, *shellensis* F. C. Baker, *cahni* F. C. Baker—should be found in some one of the many lakes of northern Ontario.

Helisoma (Pierosoma) trivolvis (Say)

Pashkokogan, Cat, and Bamaji lakes; outlet of lake Bamaji.

The specimens of *trivolvis* from this area are large, fine examples of the species, showing some variation, however, in sculpture as well as in relative axial height of the body whorl. The material from the outlet of Bamaji lake, living on rocks in rapid water, shows a tendency to increase the axial height as in the race *pilsbryi*, but it is without doubt referable to *trivolvis*. True *pilsbryi* is apparently rare in northern Canada.

Whiteaves records *trivolvis* from 2 miles above mouth of Harricanaw river, Hannah bay, from Ozhiski, Machawaian, and Wapikopa lakes, Attawapiskat and Winisk rivers, Ontario. Dall cites English river and Moose Factory. Mozley cites many localities in Manitoba. The species is known to extend geographically as far north as Great Slave lake and it doubtless exists still farther to the north.

Helisoma (Pierosoma) trivolvis pilsbryi (F. C. Baker)

Planorbis binneyi Authors, not Tryon.

Marchington river; Sturgeon lake, Rainy River district.

Specimens from these localities are referable to *pilsbryi*, which appears to be rare in Canada. Some of the material recorded as either *trivolvis* or *corpulenta* may have been of this race. The *Planorbis binneyi* recorded by Mozley from Manitoba is referable to *pilsbryi*, *binneyi* being restricted to the Pacific Coast region.

Helisoma (Pierosoma) corpulenta (Say)

St. Joseph, Birch, Hill, Bamaji, Abram, and Blackstone lakes; Marchington river. Trout lake near International Boundary, Rainy River district; Knife lake, St. Louis county, Minn.

One of the rarest of freshwater species and practically unknown until recently, this fine planorbid is now known to be one of the most abundant species of the northern fauna, widely distributed from the International Boundary to Athabaska, in latitude 56° 30′. It is unknown at present outside of the Hudson Bay drainage and in the United States has not been reported authentically south of northern Minnesota near the International Boundary. The records of this species, as far as known, are as follows: Minnitaki lake and lac Seul; Root and English rivers; English river below Manitou fall; Knee lake (Whiteaves); Knee lake, Isle La Crosse lake, English lake, Rat portage (Dall, Walker); lake Simcoe to Rainy lake, Lake of the Woods, Winnipeg river and lake, to Vermilion lake, Athabaska

(Dall); Winnipeck river (possibly meaning Winnipeg river) and lake, Rainy lake, Lake of the Woods (Say); Minaki, Winnipeg river, Sand lake, Winnipeg river, White Dog, Winnipeg river, Sword lake, near Minaki, Fox lake near Wade, all Ontario (Mozley).

Corpulentus is at once known by the rather sharp dorsal and ventral carina and peculiar rib-like spaced sculpture of the body whorl. The radula is different from that of *trivolvis* as are also the carinated whorls and sculpture. Both species, also, occur in the same lake area, as noted in Bamaji and St. Joseph lakes. There is some variation in the sculpture and in the axial height of the body whorl, but all of the material examined agrees in the carinated and flat-sided whorls so characteristic of the species. The race *vermilionensis* F. C. Baker, at present known only from lake Vermilion, northern Minnesota, appears not to be represented among any of the Canadian specimens. It differs from typical *corpulenta* in its greater axial height and in the flatter, even concave body whorl, and in the flatness of both spire and base whorls (*See* Baker, 1929a, p. 131).

Helisoma (Planorbella) campanulata canadensis var. nov. Plate II, top row

Shell resembling that of *Helisoma campanulata wisconsinensis* (Winslow), but always much smaller. There are 5½ whorls, slightly carinated above, rounded below; umbilicus deep, showing three full whorls; spire elevated above the general plane; sculpture coarse, rib-like; aperture as in *wisconsinensis*.

Height 6·0; Gr. diam. 11·5; Les. diam. 9·2; Aper. height 4·1; Diam. 3·0 mm. Type.
Height 5·2; Gr. diam. 10·5; Les. diam. 8·5; Aper. height 4·0; Diam. 2·8 mm. Paratype.

Type locality: Bamaji lake, northern Ontario. Types: Mus. Nat. Hist. Univ. Ill., Z30721; Cotypes, National Museum, Canada, Molluscs, No. 4378.

This form of *campanulata* is another of the almost endless variations of these northern planorbes. It appears to be a miniature *wisconsinensis* and might be referred to this variety but for its uniformly smaller size, the Wisconsin form measuring 8 mm. in height and 16 mm. in diameter in its most common form. Smaller individuals occur among the specimens from the type locality (Little Arbor Vitae lake, Vilas county, Wis.), but these are invariably associated with the larger form. The largest examples of *wisconsinensis* are found in Tomahawk lake, Oneida county, Wis.

The small form herein called *canadensis* appears to be characteristic of the lakes of northern Ontario, only one specimen in a series of 35 from this region even approaching *wisconsinensis* in size. This specimen measures: height 6, greater diameter 12·8 mm. It was found in Hamilton lake. The collection includes material from the following localities: Hamilton, Cat, Bamaji, Kimmewin, Kapikik, and St. Joseph lakes. On the previous trip (1928) the same form was found in Trout lake, near the International Line, Ontario, and in lake La Croix, Rainy River district.

Previous records of *campanulata* from Keewatin and other parts of central and northern Canada probably include this variety, if they were not founded entirely upon it. Such are Whiteaves' records from lac Seul, Kawinogans, Elbow, and Attawapiskat rivers, lake St. Joseph, and Winisk river. Some of Dall's records from English river, Moose Factory, Great

Slave lake, Lake of the Woods, etc., may also include this variety. This small form must not be confused with *Helisoma campanulata minor* (Dunker), a small variety associated with the large typical *campanulata*, which is quite different in form and sculpture. Many of the variations of *campanulata* appear to be dimorphic, having a large and a small manifestation of each.

Several other varieties of *campanulata* have been recorded from northern Ontario or adjacent territory. *Helisoma campanulata rudentis* (Dall), a large form very characteristic, has thus far been found only in the type locality, Knee lake, on Hayes river, Keewatin. The specimens listed by Whiteaves from Knee lake are probably the same (Dall, 1905, page 90). The specimens from Michigan referred to this variety by Dall and others are not *rudentis* but represent another variety (*See* Baker, 1927, page 49). *Helisoma campanulata wisconsinensis* (Winslow) is listed by Mozley from the following localities: Minaka, Winnipeg river; White Dog, Winnipeg river; Star lake, near Reddit; Alice and Onion lakes, near Minaki; English river, near junction with Winnipeg river, Ontario; Indian Bay station, Falcon bay, Manitoba. It is also recorded from Saskatchewan (Mozley). *Helisoma campanulata davisi* (Winslow) is listed by Mozley from Douglas lake, near Onah, Manitoba, thus placing it in the Hudson Bay drainage, but it has not yet been reported from northern Ontario (*See* Winslow, 1926, page 8). As in other groups, *campanulata* exhibits greater variation in its northern range within the Wisconsin drift sheet area than in the areas south of this region.

Planorbula armigera (Say)

There appear to be two varieties of this common species represented in the Keewatin material. One, from lakes Bamaji, Cat, and St. Joseph, has rounded basal whorls, the umbilicus rather shallow. This form is more generally found in sloughs and swamps. The other, from lakes Botsford, Hamilton, and Fitchie, has rather sharply carinated basal whorls and the umbilicus is regularly, widely funnel-shaped. Whether this is an ecological variety cannot be definitely determined at present for lack of enough material specifically noted as to habitat. A large part of the Keewatin Planorbula is beach material and the original habitats cannot be determined. Say especially mentions the basal carina which reaches the aperture and this must be taken as the typical form. The type locality, also, is western: "Inhabits Upper Missouri" (Say). Typical material is represented by specimens from Thief River falls, Minn., collected by L. E. Daniels. The swamp or pond form is well represented by material from a pond at Camp Colfax, near La Porte, Ind., also collected by L. E. Daniels. These specimens have the basal whorls rounded, not carinated, and the umbilicus is not funnel-shaped, the penultimate whorl forming a raised coil within the umbilicus. The pond and swamp variety may be called variety *palustris*, with the Camp Colfax specimens as types and type locality. This form appears to be more abundant toward the east.

Whiteaves records *armigera* from Kawinogans river and Dall lists the species from Moose Factory, James bay, and Vermilion lake. Mozley records it from Manitoba. *Planorbula crassilabris* Walker is listed from Manitoba by Mozley. This species should be found in northern and central Ontario. *Planorbula christyi* Dall was described from High Bluff, Manitoba, and is listed by Mozley from other localities. This large species with rounded whorls should be found in Ontario also.

Menetus exacuous (Say)

Cat, Bamaji, and Kimmewin lakes. Typical of the species. Recorded by Whiteaves from Knee lake; by Dall from Moose Factory, Hudson bay; by Mozley from Minaki, Winnipeg river. It is known from various places in Manitoba and adjacent territory.

Menetus exacuous megas (Dall)

Cat and Fitchie lakes. Recorded by Dall from Birtle, Man., its type locality. The "pinched" character of the periphery, a diagnostic feature, is well shown in the Keewatin specimens.

Gyraulus deflectus obliquus (De Kay)

Cat, St. Joseph, Kimmewin, and Bamaji lakes; Knife lake in swale. It is probable that some of the references by Whiteaves and others from Keewatin and other parts of central Canada are referable to this race of *deflectus* rather than to *hirsutus*, under which name they are listed. Whiteaves' records of *Planorbis albus (hirsutus)* from lakes St. Joseph and Wapikopa, Kawinogans and Attawapiskat rivers, and mouth of Albany river near Fort Albany may include or refer to *obliquus*, the rounded periphery easily confusing it with *hirsutus*. Mozley lists *deflectus* from Manitoba and also *hirsutus* from the same region. The distribution of *hirsutus* in Canada is imperfectly known. Whittaker's record for Mackenzie river appears authentic, specimens having been examined.

Gyraulus arcticus ('Beck' Möller)

Kimmewin, Bamaji, Cat, St. Joseph, Hamilton, Kapikik, Pashkokogan, and Fitchie lakes.

Gyraulus arcticus appears to be the common small planorbe of the northern part of the United States and of Canada. All of the material in the collection is referable to this form which has been correlated with the Greenland species described by Mörch in the Journal of Conchology (*See also* Baker, Moll. Wis., I, p. 230). It differs from *parvus* in its rounded basal whorls, which are not excavated. *Arcticus* is cited by Dall from Ungava and Labrador. Whittaker collected the species at five places along Mackenzie river (specimens examined). References to *parvus* from the north must be viewed with suspicion, in view of the number of small planorbes related to this species but now known to be distinct from it. Some of the records by Dall, Whiteaves, Taylor, Mozley, and others, may include *arcticus* as well as other forms of these small planorbes. Mozley records *parvus* from Minaki, Winnipeg river, Alice and Lost lakes near Minaki, and Malachi lake near Malachi. Also from many places in Manitoba. Some of these probably include *arcticus*. No true *parvus* has been seen personally from the area under consideration.

The references to *parvus* by Whittaker (1924, p. 11) are founded on a variation of *arcticus*, specimens of these having been examined by the writer. A form of *arcticus* occurs in Georgian bay, lake Simcoe, and probably in other places, which has been referred to *altissimus* F. C. Baker. None of these is to be classed with this Pleistocene species, but as a variety of *arcticus*, characterized by a flattening of the upper part of the body whorl and a somewhat "reamed out" appearance of the umbilicus. The specimens from these lakes are much smaller than the Pleistocene fossil and do not conform to the characteristics of that species (*See* Rawson, Toronto Studies, 31, p. 94).

Gyraulus circumstriatus (Tryon)

Several specimens of a small planorbe submitted for indentification by Professor C. H. O'Donoghue, of the University of Manitoba, appear to be referable to this species, which is widely distributed in the United States and should be found abundantly in Canada. Specimens from Winnipeg river, received from Judge F. R. Latchford, are also this species, which has probably been listed as *parvus* by previous writers. (*See* the Wis. Mon., I, p. 378, for description and figures of this species.)

The small planorbes are very perplexing, and, as is the case with other species, have their maximum degree of variation within the area of the late Wisconsin drift sheet, where the physiography is characterized by a multitude of lakes, large and small. Of the Torquis group of the family, four species occur in Canada in the recent fauna—*parvus, arcticus, circumstriatus,* and *umbilicatellus; altissimus,* a Pleistocene fossil, also occurs in various deposits of late Wisconsin age. *Arcticus* and *circumstriatus* are apparently descendants of *altissimus,* which is the only member of the family known from early and middle Pleistocene time, extending from the earliest interval (Aftonian) to late Wisconsin time. Among both *arcticus* and *circumstriatus* there are individuals which approach the ancestral form, as would be expected. Such are the forms of *arcticus* living in Georgian bay and lake Simcoe, and a large form of *circumstriatus* from Douglas lake, Michigan (*See* Moll. Wis., I, p. 378). *Gyraulus umbilicatellus* has been listed by Mozley from Manitoba, but none has been seen from central Ontario, where it should certainly be found. The little species known as *Gyraulus (Armiger) crista* (Linn.) has been recorded by Whiteaves from a lake west of Pine creek, northeast of Carberry, Manitoba, and it should be found widely distributed in Canada. Its small size (about 1·8 mm.) has doubtless caused it to be overlooked.

Family, ANCYLIDAE

Ferrissia parallela (Say)

Pashkokogan lake. Recorded by Whiteaves from Root river, Ontario, and by Mozley from several places in Manitoba.

Ferrissia fusca (C. B. Adams)

Bamaji lake, rare. Not before recorded from this area.

Several Ancylidae have been listed from adjacent territory which should occur in western Ontario. *Ferrissia rivularis* (Say) and F. *tarda* (Say) have been listed from Manitoba and Assiniboia. The Canadian distribution of the family is not well known owing, doubtless, to the fragile nature of the shells, which are rarely preserved in beach debris and must be collected from their natural habitat, on rocks, shells, or vegetation.

Family, PHYSIDAE

In the writer's "Mollusca of Wisconsin," the American species of the family were restricted in a group separate from the European typical Physa on account of the differences in the digitation of the mantle. In the European type of the genus, *Physa fontinalis,* the mantle nearly covers

the outside of the shell when the animal is extended, whereas in the American forms only the digitate edge is partly reflected over the columellar and parietal regions. The name chosen for the American group was Haldeman's Physella founded on a small species, *globosa*, living in the Nolichucky river in Tennessee.

In a recent paper (1930, page 305) Mr. William J. Clench, who is making a special study of this family, questions the use of Haldeman's Physella for the American Physas. Its type, *globosa*, is a small species, although adult, and its peculiar environment suggests that it may be different from all the other American species and may be closely related to Pilsbry's *Petrophysa zionis* (Pilsbry, 1925) in which there are no mantle digitations. Should this prove to be the case, Physella would constitute another monotypic group like Petrophysa. The writer has contended that, should Physella be found untenable as a name for the American forms, *Physodon* Haldeman would be available. This provision was mentioned in the Wisconsin Monograph. Clench does not believe that this name is tenable because the original diagnosis is based on a character, the tuberculate columella, which is not uniformly represented in the type species, *microstoma*, and is not found in the other species included in the genus. But this objection is not valid and is not sustained by the International Code. If we were to adhere to such a rule we would have to reject about half of the ancient genera and subgenera which have been amended by later authors, Pilsbry, Dall, Walker, etc., and are received without question by modern taxonomists. Most ancient group names have departed a long way from the characters given in the original diagnosis. Therefore, as Physodon is the earliest name given to a group of American Physas its use either as a genus or subgenus name is perfectly regular under the code and was properly chosen as a group name by me in the Wisconsin Monograph.

As to the use of Alampetis v. Martens, 1898, this is open to the same objections as Physodon, as noted by Clench himself, the characters assigned being a smooth and not a glossy shell, characters found in several forms of American Physas in the same species, and the group name is no more tenable than Physodon. Alampetis may be found to cover peculiarities of some of the southern species, *Physa osculans* being the first species mentioned by v. Martens, who cited no type. *Physa ancillaria* and *P. heterostropha* are mentioned as belonging to the group.

Whether the American species should be separated from the European Physa as a genus or as a subgenus depends wholly on the viewpoint of the individual student using the group. The senior author has favoured the separation into distinct genera, but it may be best to use these names as subgenera, at least until more is known about the genitalia of the European species, which, as in the case of Planorbis, may show very definite generic characters when more carefully examined.

The names proposed for the American species of Physa may, therefore, be tabulated as follows:

Physa Deep, 1801. Type: *Bulla fontinalis* Linn.
Subgenus Physodon Haldeman, 1843. Type: *Physa microstoma* Hald.
Synonymn: Alampetis v. Martens, 1898. Type: *Physa osculans* Hald.
Subgenus Physella Hald., 1843. Type: *Physa globosa* Hald.
Subgenus Petrophysa Pilsbry, 1925. Type: *Physa zionis* Pilsbry.

Physa (Physodon) gyrina (Say)

Bamaji, Botsford, Hamilton, Pashkokogan, Cat, Fitchie, Kimmewin, and St. Joseph lakes.

A few physae, all beach shells, are referred to *gyrina* by Mr. Clench. They all have very thin shells, due to the absence of limestone rocks surrounding these lakes. Mr. Clench says of these shells "The specimen sent has the sculpture and general shape of *gyrina*, lacking only the thickness of the shell, a very variable character in this genus."

This is evidently the species recorded as *heterostropha* by Whiteaves from lake St. Joseph, lac Seul, Machawaian lake, Attawapiskat river, Wapikopa lake, and Winisk river. Also Albany river and Knee lake. *Gyrina* is listed from several places in Manitoba by Mozley. The reference to *heterostropha* is probably founded upon some other species, as this is an eastern form, not authentically recorded from the central states. *Physa integra* Hald. and *Aplexa hypnorum* (Linn.) are listed by Mozley from Manitoba. Dall's records all need revision since they are founded on the old lists of Whiteaves and others and also on a misconception of the species. *Aplexa hypnorum* is listed by Whiteaves from Harricanaw river near Hannah bay and by Dall from York Factory. The physoid fauna of Ontario and adjacent territory is greatly in need of revision based on our modern conception of the family. The many lakes should contain some of the varieties recorded from Wisconsin, Michigan, and Minnesota, as well as others not yet recorded.

Land Mollusca

A few land molluscs, mostly from beach debris associated with freshwater species, were collected by the Cahn party. These are listed below.

Gonyodiscus anthonyi (Pilsbry)

Shore of lakes St. Joseph and Botsford. Living under rock in spruce forest bordering Kogik lake. It is interesting to note that these are typical *anthonyi* and not the carinated form *catskillensis*, characteristic of high latitudes.

Retinella hammonis (Ström.)

Under rock in spruce forest bordering Kogik lake.

Zonitoides arborea (Say)

Beach debris on lake St. Joseph.

Succinea retusa Lea

Beach debris on lakes Bamaji and Kapikik.

Succinea avara Say

Beach debris on lakes Kapikik, Bamaji, and Pashkokogan.

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DISTINGUISHING CHARACTERISTICS OF ALGONKIAN AND IROQUOIAN CULTURES

By W. J. Wintemberg

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PREFACE

The early immigrants from France who colonized eastern Canada in the sixteenth and seventeenth centuries found the country inhabited by Indians who spoke two entirely different languages. The tribes in the Maritime Provinces, and throughout Ontario and Quebec north of St. Lawrence river with the exception of the peninsula south and west of lake Simcoe, all spoke dialects of the Algonkian language. The Huron Indians around lake Simcoe, the Tionontati or Tobacco Indians southwest of them, and the Neutral Indians on both sides of lake St. Clair, together with two neighbouring tribes in the United States, the Erie and the Andaste or Conestoga, spoke dialects of the same language, Iroquoian, as the Iroquois or Five Nations (Seneca, Cayuga, Onondaga, Oneida, and Mohawk) who controlled the country south of the St. Lawrence from lake Ontario to Maine. Even before the destruction of the Hurons, Tionontati, and Neutrals by their Iroquois brethren in the seventeenth century, during the struggle between the English and the French, there had been many

conflicts and tribal changes in the basin of the St. Lawrence. The Algonkians left traces of their camps in districts that were occupied by Hurons or other Iroquoians during historical times; conversely the Iroquoian tribes built villages and buried their tribal dead within what was later Algonkian territory. Occasionally, too, one finds in Ontario objects similar to those unearthed in the great mounds and earthworks erected by Indian tribes in Ohio and other states of Mississippi valley. In the following paper Mr. Wintemberg distinguishes these various remains, to guide both the professional archæologist and the amateur who collects Indian 'curios' in his own neighbourhood.

INTRODUCTION

We have archæological evidence of the presence of Algonkian, mound-building Indians and Iroquoian people in Ontario and Quebec.

The Algonkian were probably the earliest and most widely distributed inhabitants of eastern Canada, but, in most cases, there are only their artifacts to show that they had inhabited certain areas. Our knowledge of their culture is derived almost entirely from a study of material collected from the surface of sites; only one site has so far been excavated. There appear to have been two periods of Algonkian occupation; one, seemingly the earliest, and, apparently, a pre-ceramic culture; and the other, later and more widely distributed. Intensive explorations of selected sites may show that the last should be divided into two or more different periods as in New York state.[1]

It is not known if the mound-building Indian occupation was contemporary with or later than the Algonkian. There is ample evidence in the shape of mounds and graves, containing material like that in Ohio mounds,[2] to show that such a people once occupied Ontario and the south-western part of Quebec.

Indians of the Iroquoian stock were the dominant people in eastern Canada when Europeans arrived, their country extending from near Quebec to Detroit river and from lake Erie north to Georgian bay. The archæological evidence so far discovered suggests that the Neutrals, who occupied the western part of southern Ontario, belonged to what is called the "Western Group",[3] which, in addition to the Neutral, included the Erie, Seneca, Cayuga, and Conestoga or Andaste, and that the Tionontati or Tobacco Nation Indians, Huron, Mohawk, and Onondaga form another group, known as the "Eastern Group". The culture of the last group is of the late pre-European and post-European stages of development; none of the sites is known to show evidence of earlier stages. The culture of the Neutral is the only one that shows what seem to the writer to be successive stages or periods of development, viz.: archaic, transitional, and late pre-European. After the dispersion of the Tionontati, Hurons, and Neutrals by the Five Nations, bands of the confederated tribes settled in Ontario, establishing villages along the north shore of lake Ontario and perhaps as far west as Grand river; these are referred to as Iroquois in this article.

[1] *See* Parker, A. C.: "The Archæological History of New York," Part I, New York State Mus. Bull., Nos. 235, 236, pp. 48–50. (Albany, 1922.)

[2] *See* Wintemberg, W. J.: "Artifacts from Ancient Graves and Mounds in Ontario"; Trans. Roy. Soc., Canada, 3rd ser., vol. XXII, sec. II, pp. 175–202, and 32 ills. (1928).

[3] *See* Skinner, Alanson: Notes on Iroquois Archæology, Indian Notes and Monographs, Museum of the American Indian, Heye Foundation, New York, 1921, p. 30 *et seq.*

In Canada no attempt was made to distinguish the artifacts of one culture from another until 1900 when the writer pointed out certain differences between artifacts found on sites of what he called a pre-Neutral people and those from sites of undoubted Neutral-Iroquoian occupation.[1] Since then Parker,[2] Houghton,[3] and Skinner[4] have published articles on the characteristics of Algonkian and Iroquoian cultures in New York. In spite of all that has been written on the subject, however, Algonkian artifacts are still being classed as Iroquoian, because they were found in territory known to have been occupied by that people. Some have attempted to identify the culture of a site from the shape and disposition of the so-called ash-beds (refuse deposits), classing those sites with groups of small, round deposits clustered around a central larger one as Algonkian, and those with long, narrow deposits as Huron, but without considering the character of the material found on each kind of site, which is often the same on sites with both kinds of deposits. After excavating several Iroquoian sites the writer has come to the conclusion that refuse deposits are not always located on the site of a dwelling; that long or oblong deposits do not necessarily indicate where a long-house stood, or that round cabins stood on small, round deposits. The kinds of artifacts found on a site, especially pipes and pottery, as will be pointed out in this article, are the most reliable criteria for identifying the culture.

There is still much to be learned respecting the Algonkian and Iroquoian cultures, and such questions as the effect of Algonkian influence on Iroquoian culture and vice versa, the relations of both with mound-building Indians and Eskimo, what differences there are between the earliest and latest Algonkian and the various groups of Iroquoian people, in addition to those mentioned in this article, and whether or not the Huron, Tionontati, Mohawk, and Onondaga, with their highly developed culture, were originally part of the Neutral nation, whose culture alone shows what seem to be earlier stages of development, await solution.

This paper will deal only with the differences between the cultures of the Algonkian and Iroquoian inhabitants of Ontario and Quebec. For convenience the artifacts of the two cultures are grouped under the various materials of which they are made, including stone, copper, earthenware, bone, antler, and shell.

CHARACTERISTICS OF ALGONKIAN AND IROQUOIAN SITES

Algonkian sites are located on the banks of streams and lakes, usually on the north or west banks, in many cases below a hill where they are sheltered from north and west winds. The Algonkian shunned clay soils, even preferring to camp on an unprotected, sandy south shore if the north shore happened to be clay. Temporary camps in many cases are located

[1] *See* "Indian Village Sites in the Counties of Oxford and Waterloo"; Archæological Report, 1900, being Appendix to the Report of the Minister of Education, Ontario, Toronto, 1901, pp. 37–39.

[2] *See* his "The Origin of the Iroquois as Suggested by their Archæology"; Am. Anthropologist, N.S., vol. 18, pp. 479–507 (1916)". The Archæological History of New York"; op. cit., pp. 46–79 and 98–151. "Aboriginal Culture and Chronology of the Genessee Country"; Proc., Rochester Acad. of Sci., vol. 6, No. 8 (1929).

[3] Houghton, Frederick: "The Characteristics of Iroquoian Village Sites of Western New York"; Am. Anthropologist, vol. 18, pp. 508–520 (1916).

[4] Skinner: "Notes on Iroquois Archæology"; op. cit.; "General Archæological Criteria of Early Algonkian Culture"; Researches and Transactions of the New York State Archæological Association, Morgan Chapter, Rochester, N.Y., 1923, pp. 1–48.

at the foot of rapids. The refuse deposits of most camps are shallow and not more than 8 inches deep, and are only a few feet in diameter. In the western part of southern Ontario deep, black deposits, which contain no artifacts, occur at sites where artifacts of Algonkian type are abundant.[1]

The Iroquoian peoples were more particular than the Algonkians in the selection of sites for their semi-permanent villages, in many cases choosing a flat-topped, peninsula-like sandhill, the surrounding land also being sandy and suitable for the raising of corn and other vegetal foods. In low, flat areas where sandhills were not available, but the soil was suitable, it was necessary to build circular or oval earthworks (in one case double) to support the posts of the palisade that surrounded many Iroquoian villages. Only sites of the post-European period are located on clayey soils. The villages were generally located as far as possible from large, navigable streams.

The refuse deposits are either in heaps or fill deep hollows and are from a few inches to 4 or more feet deep, and from 6 to 100 feet in diameter. In these are found fragments of pottery, pipes, implements, and ornaments of stone, shell, and bone, carbonized corn cobs, kernels, beans, sunflower seeds, plum pits, nuts, and animal bones.

No sites with superimposed Algonkian and Iroquoian cultural deposits; that is, Algonkian material at the bottom and Iroquoian material at the top, have been found in Ontario but are known to occur in New York.

STONE WORK

The stone artifacts from Algonkian and Iroquoian sites consist of chipped, ground, and polished specimens. The Algonkian were preeminently stone workers and their artifacts of this material exceed in numbers, variety, and uses those of the Iroquois, whose stone work, especially chipped, was less fully developed than that in other materials.

Chipped Stone Artifacts

Artifacts chipped from stone from Algonkian sites consist of points for arrows, spears, and knives, axes, points for drills, and scraper blades; points for arrows and drills, knives, and scraper blades are found on Iroquoian sites.

Most of the Algonkian artifacts are chipped from chert, many others are chipped from quartzite, and a few are of quartz, quartz crystal, jasper, chalcedony, and felsite. Chert and opaque chalcedony are the principal materials used by the Iroquois, very little jasper, quartz, and quartzite being used.

Points for Arrows, Spears, and Knives

The points for arrows from Algonkian sites, very few of which are very small, are of the following types: leaf-shaped (Plate III, figures 1 and 5); triangular (figures 2-4), pentagonal (figure 28); shouldered but not barbed (figures 8 and 21), notched (figures 9-17, 23, and 24), and barbed and stemmed (figures 18-20, 22, and 25-27). A few have serrated edges (figures 13 and 22) and others have both edges bevelled, giving the

[1] *See* the writer's "Indian Village Sites in the Counties of Oxford and Waterloo"; Archæological Report, 1899, p. 86, Toronto, 1900; and "The Archæology of Blandford Township, Oxford county, Ontario"; Victoria Memorial Museum, Bull. No. 1, pp. 198–9 (1913).

point a rhomboidal cross-section (figures 16 and 21). Some have a bifurcate base, especially those with somewhat broadly triangular blades (figures 5, 13, 14, 18, 25, and 26). Most of the points are notched.[1] The triangular points are mostly large, in a few cases thick, and are either concaved on all edges or have convex edges and a straight or concave base. Only a few are very thin, but many are delicately chipped.

Arrow points are less common on Iroquoian than on Algonkian sites. Some are of the same types as Algonkian points, but the types illustrated on Plate III, figures 5, 6, 11, 14, 20, 21, 25, and 26, are lacking. Arrow points are commoner on Neutral than on other Iroquoian sites. The triangular type is the most common and it seems to be as common on post-European as on pre-European sites; in one instance, seventeen small, thin specimens, nearly uniform in size, being found in a grave. Some have convex edges (Plate XII, figures 1 and 2); others are slightly incurved on the edges and base. Most of them, especially those of the late pre-European and post-European periods, are small, thin, and delicately chipped to a sharp edge all around. There are very few pentagonal points, and those of the stemmed or shouldered but not barbed, notched, and notched and barbed types are less common than on Algonkian sites. One kind of notched point, with a narrow neck and nearly square-tanged stem, which is more common on Neutral than on other sites, was produced from a thin, triangular point by deeply notching both edges near the base (Plate XII, figures 3 and 4). Very few points have serrated edges and very few, also, have bevelled edges like those occasionally found on Algonkian sites, but most of them are much smaller; in fact, notched points generally are smaller and more delicate than most of those of the Algonkian.

Spear points from Algonkian sites, which are mostly of the same types as the arrow points (*See* Plate IV, figures 1-4), are common on Algonkian sites, but only a few large points come from Iroquoian sites, one from a Mohawk-Onondaga site being 6 inches long; others, but smaller, have been discovered on other sites of the same culture. These, however, were probably used as knives and may have been obtained from Algonkians, because the Iroquois are not known to have used spears.[2]

Leaf-shaped (Plate IV, figures 14-16) and asymmetric blades (Plate IV, figure 5), in some cases with only one sharp edge, abundant on Algonkian sites, and occasionally found *en cache*, may either have been knives or unfinished spear points. Only a few small, leaf-shaped blades have been found on Iroquoian sites, one being a chert oblanceolate blade from an ossuary at a Neutral site of the transitional period.

Ax Blades

A few ax blades chipped from chert, with the broad end ground to a sharp cutting edge, have been found on Algonkian sites; they do not occur on Iroquoian sites.

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[1]Three hundred and seventy-two, or 92 per cent, out of four hundred points, collected by Mr. C. E. Kelson on his farm in Grantham tp., Lincoln co., Ont., and presented by him to the National Museum, are notched and stemmed.

[2]Cartier's vocabulary does not include a word for spear, although there are words for bow and arrow. (*See* "The Voyages of Jacques Cartier"; published from the originals with translations, notes, and appendices, by H. P. Biggar, Publications of the Public Archives of Canada, No. 11, Ottawa, 1924, p. 81).

Drill Points

Drill points, which are rarer than other chipped stone objects on Algonkian sites, are mostly of chert, only a few being of quartzite or quartz. They present the following different types: crude, with broad, leaf-shaped base, long and slender with wedge (Plate IV, figure 6) or club-shaped base, double pointed, T-shaped (Plate IV, figure 7), and notched and stemmed (Plate IV, figure 8). Drill points have been found at several Neutral-Iroquoian sites (as many as five being from one site), at an early Huron site, and at a post-European Iroquois site. They are entirely absent from other Iroquoian sites in the eastern part of southern Ontario and western Quebec, and are rare in New York.[1] In a few cases they are made of arrow heads, the attenuated tips of which were found suitable for drilling; a few are double pointed, but none of them is of the T-shaped type found on Algonkian sites.

Scraper Blades

Scrapers of five different types are common on Algonkian sites. The most simple specimens are crude, plano- and concavo-convex chips of chert (Plate IV, figure 9), in a few cases with one end pointed for insertion in a handle; a few are leaf-shaped (Plate IV, figure 10); many are stemmed (Plate IV, figure 13), or notched (Plate IV, figure 11), being probably broken arrow heads with the broken end trimmed off round for use; and others are shaped like a saddler's knife (Plate IV, figure 12). The stemmed forms are the most common, as many as seventy-four coming from one site. Only specimens of the plano- and concavo-convex types are found on Iroquoian sites of all periods, being more abundant than arrow points at some sites. A few of those from post-European Tionontati and Iroquois sites have serrated edges (Plate XII, figure 5), but this may have been suggested by whites, for none of the specimens from early sites has this feature.

Ground and Polished Stone Artifacts

There is a greater variety of ground and polished than of chipped stone artifacts on Algonkian and Iroquoian sites. Algonkian ground stone artifacts, of all kinds, however, are less common than those of chipped stone; on Iroquoian sites, on the other hand, they are more abundant than chipped artifacts. Artifacts of this class are mostly utilitarian, and include points for arrows and knives, bayonet slates, dishes, pestles, mullers, mortars, adzes, chisels, gouges, ungrooved and grooved axes, knife-like tools, grooved stone mauls, beads, pendants, disks, pipes, plummets, a spool-shaped object, gorgets, boat stones, bar and bird amulets, banner stones, and tubes, the last eight being of unknown use.

Ground Slate Points for Arrows and Knives

Ground slate arrow and knife points of various sizes, with leaf-shaped or triangular blades, elliptical or diamond-shaped in cross-section, have been found at several Algonkian sites in Ontario and Quebec. Most of them have stems, which are either long and slender, in some cases with rounded edges (Plate V, figures 2 and 8); broad, with the edges squared

[1]Parker, Archæological History, op. cit., p. 107.

or rounded (Plate V, figure 3), in one instance with one edge notched (Plate V, figure 1); with both edges notched and the base tanged; short and broad with both edges notched (Plate V, figure 4); or broad and tapering to the base with notches on both edges (Plate V, figure 5). Other methods of fastening are suggested by the shapes of the bases of the points on Plate V, figures 6 and 7. A few specimens are barbed (Plate V, figures 3-5). All these points, especially those like the one in figure 5, Parker thinks,[1] probably belong to an Eskimo-like culture; the writer, however, has seen specimens that were found on sites yielding pottery of Algonkian type. They are not known to occur on Iroquoian sites.

Bayonet Slates

These are long and slender, pointed, highly polished specimens with sharp edges, diamond-shaped in cross-section; the base wedge-shape for insertion in a handle or spear shaft (*See* Plate V, figure 9). They have been found in three different localities in Ontario and one in Quebec, but none has been found on an Iroquoian site.

Semilunar Knives

Slate knives of this type having a curved cutting edge and either a dull-edged, straight back (Plate V, figure 10), or a thickened, flange-like grip, corresponding to the handles of wood, bone, or ivory seen on some Eskimo specimens, have been found on a few Algonkian sites in Ontario. The largest specimen of the simple type is $7\frac{3}{16}$ inches long and $2\frac{7}{8}$ inches deep; one of those with a grip is about 9 inches long. This type of knife suggests Eskimo contact. None is found on Iroquoian sites.

Dishes

A steatite dish, $9\frac{1}{2}$ inches long, $6\frac{1}{4}$ wide, and 3 inches high, with lugs or handles at each end, is the only specimen of the kind from Ontario.[2] This was found in Hastings county, near Trent river, a well-known water route from lake Ontario to Georgian bay, and was probably brought here by some Algonkian hunting or trading party from south of lake Ontario.

Roller Pestles

Cylindrical specimens from about 1 foot to 20 inches or more in length and from $1\frac{3}{4}$ to 3 inches in diameter, in most cases nearly uniform in diameter throughout, and mostly with the grinding face at one end only, have been found on a few Algonkian sites in Ontario and Quebec; they do not occur on Iroquoian sites.

Mullers

Round or oval cobbles with one or two sides flattened, and in many cases pitted on one or both sides, which were used as the upper millstones in grinding corn, are common on Iroquoian sites, but the writer has not seen any from Algonkian sites.

[1] *See* Parker, Arch. Hist. of N.Y., op. cit., p. 79.
[2] *See* Smith, Harlan I.: "An Album of Prehistoric Canadian Art"; Victoria Memorial Museum, Bull. No. 37, Plate XLV, figure 8 (Ottawa, 1923).

Mortars

A few small stone mortars, one of them hollowed on both sides, have been found on Algonkian sites. They are more abundant on Iroquoian sites, ranging from small, portable ones to others in the tops of large, stationary boulders.

Adzes

Adzes, which have flat backs and are asymmetric as viewed from the narrow sides, are common at most Algonkian sites. Many of them are not distinguishable from some of those found on sites of other cultures. One type, however, is distinctive (Plate VI, figure 2), consisting of long, in some cases slender, flat-backed blades, convex from end to end on the front, on both narrow sides, and from side to side, the last making the blade half-round in cross-section. The cutting edge, which is mostly convex, is narrower than the middle of the adze, but in most cases slightly wider than the poll. Specimens from Tadoussac, Quebec, are narrower but of the same general type, although a few have a triangular cross-section. Specimens of another type are widest at the cutting end, whence they taper to the poll, and have all the angles rounded. A few have a cutting edge at each end; others are slightly grooved, one being unique in having another groove in line with the longer axis of the blade; one is fluted; and another has three knobs on the front, like some of those from the Maritime Provinces and New England states.

Adzes are found on all Iroquoian sites and are as abundant as at Algonkian sites, as many as one hundred being from one site.[1] In many cases they cannot be distinguished from Algonkian specimens. Some are double-bitted, a few are grooved, but none is fluted or knobbed.

Small, Chisel-like Specimens

Very few small, narrow, chisel-like specimens, with flat back and sharp cutting edge at one end, are found on Algonkian sites, but they are common on Iroquoian sites.

Gouges

Gouges resemble adzes, but have the back partly (Plate VI, figure 3) or entirely hollowed (Plate VI, figure 4), the latter being less common than the first type. Some of them are so slightly hollowed that it is difficult to distinguish them from adzes. Many of them decrease slightly in width and thickness toward the poll; others bulge in the middle. The poll is mostly narrower than the cutting edge; one is slightly flaring. The cutting edges are mostly convex, a few only being straight. They are from $2\frac{1}{2}$ to 15 inches long, but only a few of the long ones are very slender. They are half-round, triangular, quadrangular, and trapezoidal in cross-section. A few are grooved, some of them across the front, and one is provided with a seat for the attachment of a handle. The precise use of gouges is unknown; their shape suggests that they were used to hollow out wooden utensils, for which the curved cutting edges are adapted. They do not seem fitted for smoothing plane surfaces.

[1]Parker: Arch. Hist., N.Y., op. cit., p. 249, says adzes are less common than celts (ungrooved axes) on Iroquoian sites in New York state.

Gouges are not found on all Algonkian sites; the writer has collected only one specimen during the many years he has been doing archæological work. They are more common in the central and eastern portions of Ontario than in the west. None is found on Iroquoian sites, except intrusively on those of the post-European period.

Combined Gouge and Adzes

Implements hollowed at one end like a gouge and with a straight cutting edge at the other end are occasionally found on Algonkian sites.

Ungrooved Axes

Ungrooved stone axes, usually called "celts," which are bilaterally symmetrical as viewed from the narrowest side, are less common than adzes. They are mostly of medium size (from about 3 to 5 inches) and most of them are oval in cross-section. As both faces are rounded they are not so easily hafted as the flat-backed adzes, and so were probably mostly mortised into the handles. One slightly grooved on both edges is seen on Plate VI, figure 1. They are rare on Algonkian, and rarer still on Iroquoian, sites. Very few Iroquoian axes have the angles rounded as on Algonkian specimens.

Grooved Axes

Grooved axes are wider, more massive, and bulbous than the ungrooved specimens and have a groove at right angles to the longer diameter. They are of two types: in the one the groove extends only partly round the poll, a narrow side being usually left straight to permit a wedge to be driven between the withe handle to tighten it (Plate VI, figure 5); in the other more common type the groove extends entirely around the poll (Plate VI, figure 6). A few specimens of the first type have the straight side slightly grooved from end to end. They are mostly oval in cross-section. Only a few specimens have more than one groove, and the writer has seen only one with an oblique groove as on specimens from the United States, but this oblique grooving may not have been intentional. The grooves vary in width and depth; a few are bordered by low ridges. Some specimens are polished all over; others retain marks of the pecking process, especially in the grooves. They are from about 3½ to 11 inches long, 2 to 4½ inches wide, and from 1½ to 2⅛ inches thick. The cutting edge is usually narrower than the upper portion of the implement, in one case being only about 1½ inches wide.

Grooved axes are not common on Algonkian sites and they are also not found at every site. There are records in the archæological files of the National Museum of only one hundred and fourteen specimens from Ontario and Quebec. They decrease in number toward the east, fewer specimens being found in the eastern part of southern Ontario and Quebec than in the western part, where one county (Middlesex) alone yielded more than twenty specimens. A few specimens have been found intrusively in post-European Iroquois graves,[1] but none has been found at an early Iroquoian site.

[1] *See* Wintemberg: "Foreign Aboriginal Artifacts from post-European Iroquoian sites in Ontario"; Trans. Roy. Soc., Canada, third series, vol. XX, sec. II, pp. 40-41 (1926).

Grooved Stone Mauls

Mauls are grooved, oval (in some cases nearly round) stones which are either round or oval in cross-section. A few have a flattened striking-face at one end. They vary in size, one of the largest being $6\frac{1}{2}$ inches long and $3\frac{5}{8}$ inches in diameter. One specimen is unusual in having a pit on one side, in which respect it is like some mauls from the Oregon and Washington coasts.

Mauls are rare on Algonkian sites, and only one has been reported from an Iroquoian site.

Knife-like Tools

Several thin, knife-like objects, made of schistose slate and hornblende schist, with one of the long edges sharpened and a sharp edge at one or both ends, have been discovered on a few Neutral and Mohawk-Onondaga sites of the pre-European period, but none has been found at an Algonkian site.

Dagger-like Object

A long, slender, dagger-like object, polished, with a blade like a bayonet and the handle carved to represent the head of a bird was found on a post-European Tionontati site. The specimen is unique.

Pendants

Pendants made of small, flat pebbles, round, oval, or pear-shaped and in some cases decorated (Plate XII, figure 6), have been found on Neutral-Iroquoian sites of all periods. They are not found on Algonkian sites. A few specimens, including circular disks and others carved to represent certain animals, made of a reddish stone resembling catlinite, have been found on post-European Tionontati sites (Plate XII, figure 7); these, also, do not occur on Algonkian sites.

Beads

Many discoidal (Plate XII, figure 9) and a few cylindrical beads made of stone (Plate XII, figure 10), chiefly soapstone and slate, have been found on pre-European Huron, Tionontati, and Mohawk-Onondaga sites, but do not occur on Algonkian sites.

Disks

Disks consisting of pieces of limestone or shale, with the edges smoothed and rounded and in some cases polished, perforated, or with markings on one or both faces, are found on late pre-European Huron and Mohawk-Onondaga and post-European Tionontati and Huron sites (Plate XII, figures 11 and 12), but are not found on Algonkian sites.

Plummet-like Objects

What are known as plummets are more or less pyriform objects with a groove around the smaller end, in one case with a hole in addition to the groove. They are of unknown use. Only one specimen known to the writer is polished, although others may have been polished, their present

rough appearance being perhaps due to the attrition of sand, all but a few having been found on the surface of wind-swept, sandy sites. Some are round in cross-section, others are oval, and a few are of an irregular shape. That on Plate VI, figure 7, is probably one of the smallest from Ontario. An unfinished specimen from Tadoussac is $4\frac{3}{8}$ inches long, and $2\frac{5}{8}$ inches in diameter. None of them has a groove at right angles to the encircling one as on some specimens from New York.

Plummets are rare and found on Algonkian sites only, none being from Iroquoian sites. The writer has records of only twenty-eight specimens from Ontario and Quebec; they seem more plentiful in New Brunswick, Newfoundland, the New England states, and perhaps Labrador.

Spool-shaped Object

The only specimen of this class from Ontario is seen on Plate VI, figure 8. Its use is unknown. Similar objects are found on Algonkian sites in New York, but they do not occur on Iroquoian sites.

Gorgets

Gorgets are thin, flattened, and polished pieces of stone, principally of slate, with from one to five holes, mostly biconical; specimens with two holes being the most common. They are of many different shapes (Plate VII). In those with only one hole the perforation may be at the narrowest end, in the middle, or near the widest end; those with the hole at the smallest end probably having been used as pendants.

These one-holed gorgets are either pointed at both ends; reniform; triangular, with convex edges (Plate VII, figure 3); rectangular; with convex edges and straight ends (Plate VII, figures 4 and 6); with the long edges converging to a point at one end and a straight edge at the other end; trapezoidal (Plate VII, figure 2); half-round; or pentagonal (Plate VII, figure 5). One specimen is flanged at the lower end; another is spud-like; and one specimen is bifurcate at the widest end and pointed at the other. Most of them are rectangular or oblong in cross-section. A few have the broad end sharpened (Plate VII, figure 1); others, the narrow end. Several have a row of notches at one or both ends (Plate VII, figure 4); a few others are deeply notched.

Specimens with two or more holes are of several different types, the most common being like the one seen on Plate VII, figure 7. There are other types besides those seen in that plate, including: rectangular; rectangular with one end indented; with incurved edges and straight ends; with curved edges, one end straight and the other indented; with straight edges and indented ends; hexagonal; and a type like the specimen on Plate VII, figure 9, but with both ends flaring. Those of a pyramidal shape (Plate VII, figure 11) are rare, the writer having records of only five specimens from Ontario. A few specimens are ridged on one side. Two specimens shaped like boat-stones have a knob on the ridged side. The cross-section varies, being either rectangular, elliptical, lenticular, or pentagonal. A few specimens are decorated on the sides (Plate VII, figure 10) and a few have notched decoration on the long edges and ends.

Gorgets are common at most Algonkian sites, the writer having records of six hundred and seventy-five specimens from Ontario, the largest number coming from the western part of southern Ontario. Specimens with two holes have been found on archaic and late pre-European Neutral sites, on a late pre-European Mohawk-Onondaga site, and on a few post-European Iroquois sites. Some may have been obtained from Algonkians, but the discovery of a few unfinished specimens suggests that others may have been made by the Iroquois. They are not found on Iroquois sites in New York state.[1]

Boat Stones

The so-called boat stones (Plate VII, figure 12) are rarely found, there being records of only ten specimens from Ontario. One side of these objects is somewhat pyramidal and the flat side is deeply hollowed, the outline of the top of the hollow being lenticular. The flat side of most of them is rectangular, only one that the writer has seen being oval. They are from about $2\frac{5}{8}$ to $4\frac{3}{4}$ inches long, about 1 to $1\frac{3}{16}$ inches wide, and about $1\frac{1}{4}$ inches from front to back. One has a knob on the ridged side, and another is grooved in line with the holes and has a large hole through one side. All specimens are pierced with two holes. They are mostly made of beautifully veined slates and are all finely finished and as a rule polished. Boat stones are found on Algonkian sites in Ontario, but do not occur on Iroquoian sites.

Bar Amulets

Two types of slate bar amulets (so called from their shape, although their use as amulets is purely conjectural), one being imperforate and the other perforated, are found on Algonkian sites. Specimens of the first type (Plate VIII, figure 2) are rare, only ten being known from Ontario; they are from $6\frac{1}{8}$ to $9\frac{3}{4}$ inches long, half-round in cross-section, higher and wider in the middle than at the ends (which are either straight or slanting), and almost perfectly flat at the base. The perforated specimens (Plate VIII, figure 1), which are more common than the others, are mostly long and slender, with more or less parallel sides, flat base, in many cases a slight hump in the middle of the back, and mostly flaring at the ends. One specimen, with one side flattened, is formed of a roughly oval slate pebble; another, knobbed and in some respects like a boat stone, has holes drilled diagonally through the corners on opposite sides. A few specimens have a diagonal hole through one end and another through the top at the other end. Bar amulets are not found on Iroquoian sites.

Bird Amulets

Bird amulets, which in some cases look more like turtles and mammals than birds, are found on Algonkian sites, but not on all sites. They are of several different types, including, besides those seen on Plate VIII, figures 3-10, one with a flat, oval base and the holes drilled through from top to base; one with an oval projection on top of the head, and one without the beak seen on most other specimens. The base is mostly flat and in most specimens there are diagonal holes through the lower corners of each end. The very squat forms in some cases are so low as to make it impossible to

[1] *See* Parker: Arch. Hist. N.Y., op. cit., p. 401.

produce the basal holes, one or both holes having to be drilled through the top as in the amulet on Plate VIII, figure 9. In many cases the holes are drilled through flange-like basal projections. Two specimens have a head at each end, and a few have the edges of the tail and the angles of the base and back decorated with notches. Specimens with the eyes indicated by large knobs or spool-like projections (Plate VIII, figures 4 and 6-9) are more common than those of the type seen on Plate VIII, figure 3.

About two hundred specimens have been found in Ontario, but there is only one doubtful record of their occurrence in Quebec. Most of them come from the western part of southern Ontario, as many as forty specimens being from one county (Middlesex).

No bird amulets are found on Iroquoian sites.

Banner Stones

Several types of banner stones made of soapstone or slate, the latter material seemingly specially selected on account of the beautiful venation, are found on Algonkian sites. They include pick-like; lunate, some with knobs on the ends and others bulged in the middle (Plate IX, figure 1); bilunate; geniculate, with oblong holes (Plate IX, figure 8); and several different kinds of bipennate or winged forms (Plate IX, figures 2 to 7). The winged forms are the most usual. With the exception of gorgets, banner stones are more common than the other kinds of so-called ceremonial objects. About two hundred and sixty specimens are known to have been found in Ontario and Quebec, but they are more abundant in the western part of southern Ontario, where one county alone produced sixty specimens. They are not found on Iroquoian sites.

Tubes

Tubes, mostly of veined slates, in only a few cases of limestone and sandstone, are either long, slender objects round or polygonal in cross-section (Plate IX, figure 9), quadrangular in cross-section (Plate IX, figure 12), cigar-shaped, or barrel-shaped, with oval cross-section (Plate IX, figure 10). The hole, which is mostly parallel-sided and of uniform diameter throughout, runs from end to end. One end is usually smaller than the other and in a few cases is rounded off, possibly to serve as a mouthpiece; on others the smaller end flares. One specimen is unique in having a curved, hook-like projection at one end. Eighty-six specimens are known to have been found in Ontario, but fewer in the eastern part of southern Ontario than in the western part, where all but nine of the specimens were discovered. Most of the tubes are found on Algonkian sites; a few others are from mound-building Indian sites, but none has been discovered on Iroquoian sites.

Perforated Ball-like Objects

Perforated ball-like objects, with a groove on one side parallel with the hole, like that on Plate IX, figure 11, are related to the tubes, but their use is unknown. Only six specimens have been found in Ontario and their distribution is more restricted than that of tubes, being confined to a small area in the western part of southern Ontario. They are found on Algonkian sites only.

Pipes

The writer has never found stone pipes on an Algonkian site. Most of those occurring sporadically in Ontario, and which are not referable to Iroquoian inhabitants, may belong to either mound-building Indians or Algonkians. The only type of which we can be reasonably sure are the so-called Micmac pipes (Plate XII, figure 15), but most of these are comparatively recent. The well-known monitor type of pipe with prow-like extension in front of the bowl (Plate XII, figure 16), of which several specimens have been found here and there throughout Ontario and in one locality in Quebec, if used by the Algonkians, may have been obtained by them from mound-building Indians; at least they are mostly found in mounds in the United States. Another type of monitor, which has been found, not on definitely located sites, but in regions where artifacts of almost exclusively Algonkian origin occurred, has a handle-like projection on the base; Parker, however, seems to consider this to be of mound-builder origin.[1] The sub-type of monitor, with stem and bowl at an obtuse angle, also occurs, but here again there is no definite information to help us, because none has been found on a site in association with Algonkian artifacts. The provenience of a curved-base mound pipe, found in Ontario, is also uncertain.

Stone pipes from Iroquoian sites are of many different types. Those from Neutral sites of the archaic period consist of a type of monitor of the same type as some of those from mound-builder and Algonkian sites. Specimens of the same type have been found on sites of the transitional period. Pipes from Neutral sites of the late pre-European period show greater variety, the simplest being a detachable or stemless vasiform bowl, and another stemless type, high-bowled, with rectangular cross-section, in some cases with incised and other decoration.[2] Other stemless pipes are carved to represent birds, the bowl cavity and the hole for the reception of the stem being in the back. The stemmed pipes are mostly of the simple elbow type, some of them plain and others with human faces carved on the bowl, two of them having, in addition, a lizard-like creature winding around the stem.[3] Pipes from late pre-European Huron and Tionontati sites are of several different types, most of them being stemless, which are either conoidal and vasiform, or carved to represent birds and mammals. The stemmed pipes are mostly plain. Stone pipes are scarce on Mohawk-Onondaga sites of the late pre-European period, consisting mainly of a few stemmed specimens; one specimen of the same type as that on Plate XII, figure 26, has a human form carved on the front of the bowl, one is carved to represent a bear-like animal, and another represents a bird. The number of stone pipes greatly increases on post-European Neutral, Huron, Tionontati, and Iroquois sites; there is an appreciable increase of stemmed specimens, and there is also a greater variety of forms, including more pipes with representations of birds (Plate XII, figure 21), mammals and human forms (Plate XII, figure 23). Some of the stemmed pipes and a few stemless specimens have animal forms represented as climbing up the front of the bowl, the tail extending along the bottom of the stem or around the base of the bowl (Plate XII, figures 22, 24, and 25).

[1] *See* Parker: Arch. Hist. N.Y., op. cit., pipe in lower left corner, Plate 21.
[2] *See* Boyle: Archæological Report, 1898, Toronto, 1898, figs. 5–8.
[3] *See* Laidlaw, George E.: Effigy Pipes in Stone, sixth paper, Thirty-fourth Annual Archæological Report, 1923, Toronto, 1924, fig. 3.

A few stemless bowls are simple, with only incised ornamentation (Plate XII, figure 19). The type of vasiform pipe seen on Plate XII, figure 20, is common on most post-European Iroquois sites, as many as five specimens being from one place.

COPPER ARTIFACTS

Artifacts made of native copper are found in many different localities in Ontario and Quebec, but in most cases not on camp sites yielding Algonkian pottery or other artifacts characteristic of that culture, and many of them were probably left by mound-building Indians.[1] Very few copper artifacts are found on Iroquoian sites, most of them being from sites of the earliest periods.

Most of the artifacts are utilitarian, and consist of points for arrows and spears, fish-hooks, knives, spuds, adzes, axes, gouges, long, double-pointed objects, scraper-like objects, and beads.

Arrow and Spear Points

Arrow and spear points are more common than the other artifacts made of copper, although we have a record of less than one hundred from the two provinces. Only a few of the points are small enough to be classed as arrow points. The simplest consists of a long, slender, triangular point with a wedge-shaped base for insertion in the cleft end of the arrow shaft (Plate X, figure 5). A few specimens are hollow, cone-shaped objects (Plate X, figure 6); one has both edges near the base concave like the chert arrow or spear point on Plate IV, figure 1; and a few others are stemmed. The spear points, of which there are records of eighty, have leaf-shaped blades, are sharp on both edges, and lenticular, triangular, or diamond-shaped in cross-section. The stems are either long, slender, pointed and more or less round in cross-section (Plate X, figure 1), in two cases with small barb-like projections at the base of the blade (Plate X, figure 2); broad and short, and in a few cases flattened on both faces, one of them notched on one edge (Plate X, figure 3); or with a half-open socket formed by bending both edges inward (Plate X, figure 4). They are more common in the eastern and central portions of southern Ontario than in the western part, twenty-seven specimens having been found in Renfrew county alone.

A few spear points have been found on Neutral-Iroquoian sites of the archaic period, but these were probably obtained from Algonkians or mound-building Indians.

Fish-hooks and Gaffs

Thirty-two of the thirty-four copper hooks from Ontario and Quebec, of which the writer has any record, are from localities along the north shore of lake Superior (as many as twenty-seven being from one locality). Only one specimen comes from central Ontario and what is probably another was found on a site near Batiscan, Champlain county, Quebec.

[1]Parker (Arch. Hist. N.Y., op. cit., p. 76) thinks the copper implements found in New York are not all "Algonkian by any means," and that "those they had were probably acquired from extra-limital sources through trade or otherwise. They are probably of mound culture origin."

Six of the specimens are probably fish-hooks. One of the smaller ones is roughly square in cross-section and about $2\frac{1}{4}$ inches long, with a knob at the end of the shank for the attachment of a line.[1] The one seen on Plate X, figure 8, is round in cross-section and the end of the shank is bent over to form a loop for the line. The largest specimen of what was probably a fish-hook, as is suggested by the loop for the attachment of a line, is $6\frac{5}{16}$ inches long and 3 inches wide; Plate X, figure 7, shows a smaller one of the same type from the same locality. The specimen from the central part of southern Ontario is about the same size as the one in figure 7 but is not so angular, and the one from Batiscan, Quebec, is of the same type (Plate X, figure 9). Two extremely large specimens, one 12 inches and the other 17 inches long, from Lake Superior region,[2] were probably used as gaffs.

Knives

Knives differ from spear points in having either curved or leaf-shaped blades, in some cases with only one sharp edge. Generally they have tangs for insertion in handles (Plate X, figure 10), only a few being perforated. They are less common than spear points on Algonkian sites. One specimen has been reported from a Neutral-Iroquoian site of the archaic period, but it was probably obtained from Algonkians.

Adzes, Chisels, and Axes

Adzes, chisels, and axes of copper are seldom found, the writer having a record of only thirty specimens from Ontario and Quebec, most of them coming from the eastern part of southern Ontario and the western part of northern Ontario. The cutting edge of most specimens is curved and in many cases the lower part of the blade flares. Those with one side flatter than the other were probably used as adzes and chisels (Plate X, figure 14), and those that are symmetrical as viewed from the narrow sides may have been axes (Plate X, figure 17). They are either rectangular, triangular, or pentagonal in cross-section. The poll is usually narrower than the cutting edge. Copper specimens of these types are not found on Iroquoian sites.

Spuds

Spuds are adze-like tools with a socket formed by bending the edges of the upper half of the blade inward, but their precise use is unknown (Plate X, figure 13). They are rare, the writer having records of only four specimens, all but one being from north of lakes Huron and Superior. All of them are probably from Algonkian sites.

Gouges

A few copper gouges (Plate X, figure 16) have been found on Algonkian sites but do not occur on Iroquoian sites.

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[1] *See* Boyle, D.: Annual Archæological Report, 1903, fig. 57.
[2] *See* Orr, R. B.: Thirty-sixth Annual Archæological Report, 1928, pp. 51 and 54.

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[1] *See* Boyle, D.: Annual Archæological Report, 1903, fig. 57.
[2] *See* Orr, R. B.: Thirty-sixth Annual Archæological Report, 1928, pp. 51 and 54.

Pikes or Poniards

Nine long copper objects of unknown use, all except two of which taper to a point at each end, have been found in Ontario. The largest specimen (from Sebastopol township, Renfrew county, Ontario) is 19½ inches long, ⅞-inch in diameter, and weighs more than 2 pounds.[1] These specimens are probably all from Algonkian sites; none has been found on an Iroquoian site.

Scraper-like Tools

Three copper scraper-like objects, generally known as "crescents," two of them with a tang at each end for insertion in a handle, have been found in three different localities in the central portion of southern Ontario,[2] and one of another type, thicker, on a site in Quebec (Plate X, figure 11). No objects of this type occur on Iroquoian sites.

Awl-like Tools

Copper awls, roughly square in cross-section and pointed at both ends, are rarely found on Algonkian sites; they are mostly from graves of the mound-building Indian culture. The object on Plate X, figure 15, may have been an awl, the wider end perhaps serving for a handle. Awls of this material are said to have been found on a Neutral site of the late pre-European period, in Oxford county, Ontario, but this is the only record of their occurrence on an Iroquoian site.

Beads

Beads made of copper are rarely found on Algonkian sites and were probably not in general use as among mound-building Indians. The only one ever found by the writer (Plate X, figure 12) is made of thin sheet copper. They are not found on Iroquoian sites in Canada.

EARTHENWARE

Earthenware from Algonkian and Iroquoian sites in Ontario and Quebec consists mostly of pottery fragments, a few nearly whole pots, and a few pipes. Iroquoian earthenware includes also beads and disks.

Pottery

Pottery is one of the most important criteria in identifying cultures. Algonkian pottery is distinctive and can easily be recognized, even when found intrusively on Iroquoian sites. The pots are usually globular, although the bases of a few vessels appear to have been almost pointed.

[1] This is by no means the longest specimen of this type. One found in Wisconsin is 29 inches long, and another, in the Field Museum of Natural History, Chicago, is 40 inches.

[2] *See* Boyle, D.: Annual Archæological Report, 1904, figs. 75 and 76 (Toronto, 1905).

They are mostly slightly constricted at the top (*See* Figure 2, *a* and *b*), the walls in only a few cases being straight, but in some cases the mouth is decidedly flaring; a few have scalloped tops. The texture of the ware is mostly coarse, and much of it is rather friable, the paste consisting largely of coarse stone tempering. Generally the ware is decidedly inferior to even the coarsest Iroquoian pottery. Some of it was made by the coil process. The colour of most of the ware is reddish or yellowish buff, only a small proportion of it being grey or black; and the fractured edges are mostly of a uniform colour. The plain parts of the pots are either smooth or show the marks left by malleating paddles, in some cases making the

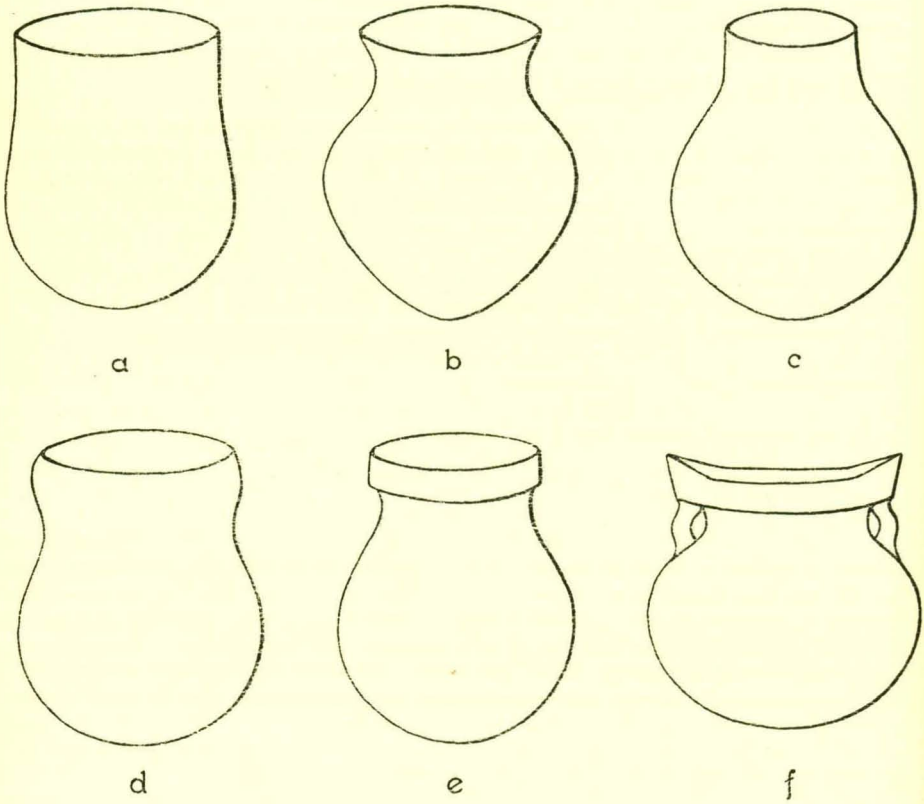

FIGURE 2. Outlines of Algonkian and Iroquoian pots.

surface uneven, in others leaving a surface resembling that made with a cord- or fabric-wound paddle. Other surface markings were made with a paddle with a chequered surface (Plate XI, figure 4). A few pieces are scarified on the outside (Plate XI, figure 3) and many others show this kind of marking on the inside, as on pottery from Nova Scotia.[1] Most of the pottery is decorated; some of it apparently all over (Plate XI, figure 7).

[1]*See* Smith and Wintemberg: "Shell-heaps of Nova Scotia"; National Museum of Canada, Bull. 47, Pl. VIII, fig. 12, and Pl. XXV, figs. 3 and 6.

The rim margins are also invariably decorated (Plate XI, figures 12 and 17), the decoration on the inner edge being in some cases quite extensive (Plate XI, figure 5), although generally of the same pattern as that on the outside. The simplest decoration consists of roundish, oval, triangular, and squarish depressions, made with blunt markers (Plate XI, figures 19 and 21). Markings of various kinds made with a rocking stamp (Plate XI, figures 12 and 17), some of it zigzag (Plate XI, figure 7), are the most common kinds of decoration. There is also a certain amount of decoration with what seem to have been cord-, splint-, or sinew-wound twigs (Plate XI, figures 6, 8, and 9), and possibly fabrics (Plate XI, figure 2). Other decoration consists of a series of parallel meanders, each separately stamped with a piece of wood with alternate notches cut on the stamping end (Plate XI, figure 14). One rim fragment bears a pinnate or herring-bone design. A few zigzag impressions look as if they had been made with the edge of a cockle or scallop shell (Plate XI, figure 3). Another design, composed of zigzags, is seen on the rim fragment on Plate XI, figure 5, but it is not certain how it was made. There is very little trailed and incised line decoration. A few lines were produced by drawing the marker with a jerky motion across the surface, resulting in a broken or interrupted line. A few specimens bear rows of short, linear markings, placed end to end, at short intervals apart. The lines made with rocking stamps in some cases form rectilinear patterns (Plate XI, figure 17). A few reticulate designs are composed of stamped (Plate XI, figure 1) and others of trailed lines. It is uncertain how other markings were made (Plate XI, figures 10, 11, 13, 15, 18, and 20). In many cases two and three different decorative techniques can be seen on the same pots. A few pots have holes punched from the inside of the rim, producing rounded eminences on the outside (Plate XI, figure 6), and in a few cases there are two rows of holes and bosses; other pots had the holes punched from the outside (Plate XI, figures 2, 9, and 12). Only one rim fragment seen by the writer has ornamentation in relief.

What differentiates most Iroquoian pottery from Algonkian ware is the overhanging rim (*See* Figure 2, *c* and *f*, page 82), although it is by no means an exclusively Iroquoian feature, being found on pottery from sites of Mound-building Indians in Ohio and Virginia. Iroquoian ware is also superior and more highly developed in several other respects. Fragments of pottery are abundant at most Iroquoian sites; a few whole but mostly small vessels come from refuse deposits, and large specimens are found occasionally in graves, ossuaries, and crevices in rocks. The ware of the different groups varied slightly and more marked differences are noted in the wares from Neutral Indian sites of different periods.

The most common type of pot from Neutral sites of the archaic period has a round-bottomed globular body, slightly constricted neck, and flaring mouth (*See* Figure 2, *b*, page 82, except that the bottom is more rounded) in many cases with a slightly incurved, or rolled rim (Figure 2, *d*). A few, mostly small and crude, have more or less straight walls, in a few cases slightly incurved, in others slightly everted; one has the rim smaller in circumference than the body and rising more or less vertically from the shoulder (*See* Figure 2, *c*). Very few had overhanging collared rims, deeply constricted necks, and none had

handles. A few had pitcher-like lips, and the tops of others are scalloped. The surface of many pots shows scarifying and chequered markings. The exterior decoration is confined to the rim and neck, and the inside is more extensively decorated than Iroquoian ware generally, in which respect it is like some Algonkian ware. The decoration is mostly geometrical and is both rectilinear and curvilinear, most of it consisting of simple elements, which were stamped, punched, or made with the finger nails. Some of the impressions appear to have been made with cord-wound twigs, but the ware bearing this kind of decoration was probably either obtained from Algonkians or was made by Algonkian captives. Another kind of decoration consists of rounded nodes on the outside of the rims, which were produced by punching holes from the inside of the pots while still plastic. This, too, seems to have been an Algonkian suggestion, except that the holes on most Algonkian pots are punched from the outside and the nodes are on the inside. About half of the lines occurring on pottery were what might be called interrupted or broken (Plate XIV, figure 1), in some cases looking like cord impressions. There are a few curved lines. Some of the patterns produced by combinations of different decorative elements are a pinnate or herring-bone design, which was common (Plate XIV, figure 2); a few reticulate designs; and an unusual rectilinear pattern resembling a Greek fret; there were no chevrons. Stamped circles and oval depressions in a triangle were probably intended to represent a human face. Pottery from Neutral sites of the transitional period retains certain features of that of the early period, including the simple form with everted rim; the scarification, chequering, and textile texturing of the outside surface; interrupted lines, cord-impressed decoration, and embossed nodes; but there are more vessels with overhanging collars, and one has a pedestal base. No ware of this period shows evidence of Algonkian decorative technique like that seen on ware of the archaic period. The groups of one kind of simple decorative elements have been superseded by more elaborate complex designs, composed of several different elements; and a simple kind of chevron appears. The decoration of the inside of the rim becomes less extensive, and that on the outside in many cases extends to the shoulder of the pot. There is not much change in the pottery from Neutral sites of the late pre-European period, except that there are many more pots with overhanging collars; more with angular lips, and one with an octagonal top. Very little shows scarifying and none shows textile texturing. There are no interrupted lines, but one or two show roulette decoration. A common kind of decoration consists of a row of vertical lines around the rim. There is a profusion of complex patterns including chevrons. A few pots are decorated on both rim and neck (Plate XIV, figure 12). Only one pot has the triangular group of circles seen on a few pots of the archaic period.

The most common decoration on Tionontati ware of the late pre-European period consists of short vertical lines around the collar; there are also a few chevron designs. Several pots have projecting angular lips, and there are a few with crude handles. Some of the ware shows textile texturing on the body of the pot. Chevrons are common on Huron ware of the same period, there are many pieces with stamped circles, and many of the collars have the lower angle decorated with notches of various kinds.

The most highly developed ware comes from Mohawk-Onondaga sites of the late pre-European period in the eastern part of southern Ontario and in western Quebec (*See* Figure 2, *f*, page 82). The rims are highly elaborated and decorated with a few simple kinds of decoration (Plate XIV, figure 3) and a variety of complex patterns, the most common being chevrons of several different kinds, composed of triangular, rhomboidal, and trapezoidal plats filled with vertical, diagonal, or horizontal lines (Plate XIV, figures 6, 7, 9, and 10). One of the distinctive designs, known as the "corn-ear pattern," consists of vertical ridges surrounding the rim, the kernels being indicated by short, transverse incisions. There is a more extensive use of stamped circles (Plate XIV, figures 9 and 10) which occur in combination with other decorative elements in many patterns. Many of the pots are decorated on the outside, inside, and edge of the rim, in the neck, and on the shoulders. Most of the ware is harder and firmer than that from other groups, especially that of the Neutrals; and it is mostly smooth, except when the surface is covered with chequered paddle-marking or textile texturing. There are more pots with overhanging collars, angular lips, and polygonal rims, more with loop handles, and more with carinated shoulders than at other Iroquoian sites. Only a few of the pots are of the type with flaring rim like that in Figure 2, *b*.

Pottery from Huron, Tionontati, Neutral, and Iroquois sites of the post-European period, except that which had survived from pre-European times, is mostly smaller than that from earlier sites, and there is a tendency to narrow the rims and restrict the decoration to mere notches on the edge of the rim. A few have handles (Plate XIV, figure 14), but these have mostly become mere ornamental features, apparently no longer functioning as handles. A few pots from Tionontati sites have all-over decoration (Plate XIV, figure 13) and one is decorated with impressions made with cord-wound twigs (Plate XIV, figure 4). A reticulate design, which also occurs on ware of the earlier periods, is seen on Plate XIV, figure 5.

Pipes

Only three fragmentary pipes are known to have been found at Algonkian sites in Ontario (Plate XII, figures 17 and 18). The stem of the one in figure 18, part of which is missing, is mixtilinear-triangular in cross-section. The two other specimens are crude stems of broken pipes, both bearing decoration apparently made with cord-wound twigs; the one in figure 17 being of an unusual shape, and the other lenticular in cross-section.

Pipes from Iroquoian sites are of several different types. Those from Neutral sites of the archaic period are mostly modified monitors (Plate XIII, figure 1), but only one is of the typical form. All but a few have simple, cylindrical bowls, and the short stems are round, oval, triangular, and diamond-shaped in cross-section; very few are decorated.

During the transitional period pipes were more extensively used and a few new types were evolved; there was a general improvement in technique, and a greater degree of ornamentation. The modified monitor of the archaic period persists, but others, mostly decorated, appear, including those with bowls having a barrel-shape (Plate XIII, figure 6); barrel-shape with cylindrical top (Plate XIII, figure 2); urn-shape; ovoid; inverted cone shape (Plate XIII, figure 3); trumpet shape (Plate XIII, figure 7); and a type between a cone and trumpet. The type of earthenware pipe

most peculiar to sites of this period, has a cone-shaped bowl, which in many cases is massive, with thick walls, and a very short, thick, stubby stem; the bowls are mostly decorated with a chevron design (Plate XIII, figure 3). A few pipes have a lizard-like form on the bowl, the tail extending along the base of the stem (Plate XIII, figure 5); these, of earthenware at least, occur only at sites of this period. The stems of most pipes with trumpet and barrel-shaped bowls have long and more or less slender stems. Others have stems of medium length, which taper rapidly from where they join the bowl to the tip.

Most of the pipes of the late pre-European period of the Neutral culture are similar to those from sites of the transitional period. The new types consist of one with a simple bowl and stem almost on the same plane; one with a ringed, ovoid bowl; one with a low bowl shaped like a truncated cone; one with both bowl and stem square in cross-section; and one with a barrel-shaped bowl with collared top. A few have bird heads and human faces on the bowl and three others have a human figure sitting on the stem with the back to the bowl.

The pipe bowls of the Huron and Tionontati of this period are of various shapes, including: trumpet; trumpet with bulging sides; barrel-shaped; cylindrical; inverted, truncated cone decorated with pits or vertical oblong depressions (Plate XIII, figure 9); cylindrical collar with funnel-shaped top; collared, in some cases overhanging and decorated; ovoid, with pentagonal and square tops; and types with human, mammal, and bird heads on the bowl and a few with snake forms coiled around the bowl and stem. A few of the stems are square in cross-section, and others are elaborately decorated. Only one bowl is of the detachable, stemless type; it is cone-shaped.

The pipes from Mohawk-Onondaga sites of the late pre-European period, present some unusual features not seen on Neutral, Huron, and Tionontati pipes. Among others is a type with a semi-lunar shield on the bowl, on which is a raised, semi-circular figure, with a row of rectangular depressions; and in one case, a row of little human faces in relief, across the front of the shield. Another, from the site of Hochelaga, has the whole front of the shield covered with rectangular depressions and there is a human face on one edge. A fragment of another specimen has three triangular figures above three little human faces in relief.

The most characteristic features of pipes of the post-European period of Neutral, Huron, Tionontati, and late Iroquois cultures are: that they are mostly of glossy black ware; that the tops of most stems are fluted, the ridges between the flutings being decorated; that a new human-form type of pipe known as the "blowing face" was evolved (Plate XIII, figure 15); that the trumpet pipes have become less graceful, and have thick lips instead of the thin, gracefully curved, flaring lips of the earlier pipes of this type; that a type between cylindrical and inverted cone type, with encircling lines, appears and is common on Iroquois sites (Plate XIII, figure 8); that pipes are relatively more numerous and that a greater number are decorated with bird (Plate XIII, figures 12 and 13), animal, and human forms (Plate XIII, figure 16) than at earlier sites. The square-mouthed type of the late pre-European period persists and is found on Tionontati, Huron, and Iroquois sites (Plate XIII, figure 11). There are also a few snake forms (Plate XIII, figure 14), but they are not as common as on earlier sites.

Beads

Several earthenware beads (Plate XII, figure 8) have been found on widely separated sites in southern Ontario, a few being from Tionontati sites, a few from Huron sites near Orillia and in Victoria county, others from Mohawk-Onondaga sites in eastern Ontario and from the site of Hochelaga, one from the last-mentioned having a crenated edge. They do not occur on Algonkian sites.

Disks

A few disks of modelled earthenware and many made from potsherds have been found on late pre-European Mohawk-Onondaga sites. Potsherd disks are common on early Huron sites in the central part of southern Ontario (Plate XII, figure 13). A few imperforate disks of potsherds, and some with a median perforation (Plate XII, figure 14), have been found at Neutral sites of the archaic and transitional periods. They are not found on Algonkian sites.

BONE, ANTLER, TEETH, AND SHELL ARTIFACTS

The bone work of the pre-European Algonkian of Ontario and Quebec was poorly developed. Only two bone awls,[1] and no artifacts of antler, teeth, and shell, have been found on their sites; and one of the awls may have been left by Iroquois, because fragments of Iroquoian pottery were found in the same locality. The Iroquoian peoples, on the other hand, were expert bone workers, bone and antler artifacts being more abundant than those of stone. Artifacts of teeth and shell are also common on Iroquoian sites.

Bone and Antler

Bone and antler were made into the following artifacts.

Arrow Points

The arrow points are either solid, pointed pieces of bone with wedge-shaped, tapering (Plate XV, figure 1), or notched bases; a few have both faces near the base grooved for insertion in the cleft end of the arrow shaft, or else they are hollow pieces of bone and antler, in some cases with barbed bases (Plate XV, figure 2, and Plate XVI, figures 2 and 3); specimens of the second kind are less common at Tionontati, Huron, and Neutral sites than on Mohawk-Onondaga sites.

Harpoon Points

Harpoon points are of two types. One type, made of bone and antler, is unilaterally barbed, having from one to four barbs on one edge only (Plate XVI, figure 1); the other is bilaterally barbed (Plate XV, figure 3), having from one to five barbs on both edges, in a few cases more on one edge than on the other. Points of the second type are mostly more slender than points of the first. Only the unilaterally barbed points are perforated.

[1]Bone and antler artifacts are more common on Algonkian sites in the Maritime Provinces, New England states, and New York.

Both types are found on the same sites, mostly those of the pre-European period. The bilaterally barbed specimens are the commoner at sites of this period; those barbed on one edge only are commoner at later sites. Only one barbed unilaterally comes from a Neutral site of the archaic period. The writer has not seen any specimens of either type from an Algonkian site in Ontario or Quebec, but they are found in the Maritime Provinces.

Antler Toggle-head Harpoon Points

A few hollowed antler tines, with a hole at right angles to the longer diameter, and one or two spurs at the base,[1] which were probably toggle-head points for harpoons, have been found at late pre-European Huron and post-European Iroquois sites.

Fish-hooks

Bone fish-hooks are rare, only ten complete specimens being known, five of which come from late pre-European Huron sites.[2] Several specimens, two of them perfect, others broken, and others in process of manufacture, were found at Mohawk-Onondaga sites in the eastern part of southern Ontario (Roebuck site) and the site of Hochelaga; all but the one from Hochelaga are barbed; of the others all except one, which is perforated, have the end of the shank notched for the attachment of the line. They have not been found on Neutral sites, and none has been reported from an Algonkian site.

Spoons

Several spoons, one of which is of bone and others of antler, have been found on Iroquois sites of the post-European period;[3] they do not occur on earlier Iroquoian or on Algonkian sites.

Knife-like Objects

Several knife-like bone objects from Neutral sites of the transitional (Plate XV, figure 10) and late pre-European periods resemble knife blades, but their exact use is not known.

Antler Mattock-like Tools

Several large mattock-like tools made of antler of unknown use, have been found on Huron and Mohawk-Onondaga sites of the late pre-European period. Only one is pointed, the rest being more or less blunt, and only a few specimens show signs of use. One side of the upper end is flattened, apparently to facilitate attachment to a handle. In one specimen the shaft is grooved, in another perforated.

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[1] *See* the author's "Bone and Horn Harpoon Heads of the Ontario Indians"; Ann. Arch. Rept., 1905 (Toronto, 1906).

[2] *See* Boyle, D.: Arch. Rept., Ann. Rept., of the Canadian Institute, Session, 1888–9, fig. 20 (Toronto, 1889), and Arch. Rept., 1900, fig. 29 (Toronto, 1901).

[3] *See* Boyle, D.: Ann. Arch. Rept., 1902, fig. 6; Orr, R. B.: Thirtieth Ann. Arch. Rept., 1918, p. 38, and Skinner, A.: "Two Antler Spoons from Ontario"; Indian Notes and Monographs, Museum of the American Indian, Heye Foundation, New York, 1920, Pl. I.

Antler Chisel- and Adze-like Tools

Some antler objects, mostly of tines, found at most sites of the late pre-European period, have the smaller end ground down to a chisel edge, but whether for use as chisels or as wedges is unknown (Plate XVI, figure 4). The larger end in some cases shows the effects of hammer blows. One or two specimens of another kind, made from broad, thin pieces of antler (Plate XVI, figure 5), have been found at post-European Iroquois sites; but their purpose, also, is uncertain.

Chipping Tools

Small punch-like objects of three different kinds, made of antler, have been found on Neutral sites of the archaic, transitional, and late pre-European periods, late pre-European Huron and Tionontati sites, and on post-European Iroquois sites. Those from the early sites are mostly oblong in cross-section (Plate XVI, figure 7), whereas those from post-European Iroquois sites are round and most commonly somewhat club-shaped (Plate XVI, figure 6).

Arrow-straighteners

Several antler objects with a large hole drilled through the wide part where the antler branches, which are called arrow-straighteners by local collectors, have been found at post-European Tionontati (Plate XVI, figure 12), Huron, and Iroquois sites; their use as arrow straighteners, however, is purely conjectural.

Handles

Several different types of handles have been found at a Mohawk-Onondaga site of the late pre-European period. One kind, made of an antler tine, has a socket in one end. Another has a deep, narrow cleft in one side of the smaller end for the reception of a stone blade. A third, and larger kind, has a deep socket and a hole at right angles to it, as for a pin to hold the blade in place. A fourth has a curved groove on one side, apparently to hold a beaver incisor chisel or knife.

Awls

The most common implements from Iroquoian sites consist of awl-like tools of various kinds, including those retaining for a handle the joint of the bone from which they are derived (Plate XV, figures 4-6), those retaining only a few vestiges of the original form of the bone, those made of splinters, and those that have been worked over completely and are smoothly finished, and polished (Plate XV, figure 7). A few specimens of the last class have carved, notched ends (Plate XV, figure 8); and others bear incised decoration, among other designs, chevrons. A few awl-like tools of antler, from Neutral sites of the late pre-European period, retain part of the beam of the antler as a handle; they were probably used gimlet fashion. Awls are found on Neutral sites of all periods, on Huron, Tionontati, Mohawk, and Onondaga sites of the late pre-European period, and on most sites of the post-European period. They are the only bone artifacts found on Algonkian sites, one, perforated, being from a site in Camden township, Lennox county, and another, imperforate, from a site on the shore of Rideau lake, Lanark county, Ontario.

Needles

Needles are of two types, the one slender, with the eye near one end, the other wide, in many cases curved from end to end, and with an eye (mostly oval) near the centre (Plate XV, figure 9); the latter were probably used in weaving the mesh of snowshoes, as they are like the needles used by modern Indians for this purpose. Two specimens of the first type were found at the site of Hochelaga. Specimens of the second type are common on Neutral sites of the archaic and late pre-European periods, on Huron and Mohawk-Onondaga sites of the late pre-European period, and on Tionontati, Huron, and Iroquois sites of the post-European period.

Spatulate Objects

A few highly polished spatulate or paddle-shaped objects, of unknown use, were found on a Mohawk-Onondaga site, but do not seem to occur on other Iroquoian sites in Canada.

Beaming Tools

Fragments of four beaming tools, or draw-shave scrapers, used in tanning, have been found on a Neutral-Iroquoian site of the archaic period. They are rare at Iroquois sites, only one in New York state having yielded implements of the same kind; but they are abundant in mound culture sites in Ohio.

Fleshers

A few chisel-like tools made from tibiæ and a femur of a large mammal, perhaps deer, in some cases with the edge toothed, have been found at a few Huron sites of the late pre-European period in Simcoe[1] and Victoria counties, and at post-European Tionontati sites in Simcoe county. Their use was probably suggested by Algonkian neighbours of the Hurons and Tionontati, as they resemble the tools used by the Plains Indians for fleshing hides.

Combs

A few combs made of bone and antler have been found at archaic Neutral and late pre-European Neutral and Huron sites; many others come from post-European sites. All those from early sites, seen by the writer, have three and five teeth, and a few bear incised decoration[2] (Plate XVI, figure 8); others have large holes cut through the top. A few of those from post-European sites also have holes through the top, but most of them have more teeth than those from early sites (Plate XVI, figure 9). The tops of most of the combs of this period are carved to represent human and animal forms.[3]

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[1] *See* Boyle: Report for 1902, op. cit., fig. 8.
[2] *See* Boyle: Ann. Arch. Rept., 1904, fig. 47 (Toronto, 1905).
[3] *See* Boyle: Annual Archæological Report and Canadian Institute (Session 1891), Toronto, 1892, fig. 62; Report for 1903, figs. 48–50; and Report for 1904, fig. 52; and Orr, Thirty-third Annual Archæological Report, 1921–22, two lower figures on p. 119.

Pendants

A few bone pendants have been found on Neutral sites of the archaic and late pre-European periods. One is made from a portion of the carapace of a painted turtle;[1] another from part of the plastron of the same species.[2] A few specimens made by perforating the ball joints of deer femora are found on Neutral sites of the late pre-European period.[3]

Beads

Beads made of bone are found on Neutral sites of all periods; and on Huron, Tionontati, Onondaga, and later Iroquois sites. A few discoidal specimens have been found on late pre-European Neutral sites, but most of them, from all sites, are made of hollow bird and mammal bones, and are of various lengths and degrees of finish (Plate XV, figures 18 and 19); a few bear incised decoration,[4] and others are carved.[5] A square type, derived from the distal joint of the proximal phalanx of the deer, is common on late pre-European Neutral sites. A few of the pearly "jewel" bones from the head of the sheepshead, a fish common in Ontario waters, were perforated for use as beads (Plate XV, figure 20); and in a few cases perforated vertebræ of other large species of fish were used for the same purpose (Plate XV, figure 17).

Armlets

A few thin bone and antler objects from about $\frac{1}{2}$ to $2\frac{3}{4}$ inches wide, bent into a circle, and with holes through the converging ends, have been found on Iroquoian sites of at least three different periods in Ontario. What appears to be part of such an object was found on a Neutral site of the archaic period;[6] a specimen decorated with small, round depressions comes from a Neutral site of the late pre-European period, and a second, much broader, and decorated with incised designs, from another site of the same period; one from another Neutral site is seen on Plate XVI, figure 10; a plain fragment comes from a site, possibly Huron, near Toronto; a narrow specimen decorated with a meander design was found on another Huron site of the late pre-European period; and another, with decoration of the same kind, comes from a Mohawk-Onondaga site (Plate XVI, figure 11). Only one specimen comes from a late or post-European Iroquois site.

Gorgets

Perforated circular gorgets made from pieces of human skull, usually the parietals (Plate XV, figure 21), have been found on several Neutral, Huron, and Mohawk-Onondaga sites of the pre-European period, as many as ten from one site. They mostly have seven perforations; only a few are decorated.

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[1] *See* Boyle: 1904 Report, op. cit., fig. 69.
[2] *See* the author's "Uren Prehistoric Village Site, Oxford County, Ontario"; National Museum, Canada, Bull. 51, Pl. XXII, fig. 12.
[3] *See* Boyle: Archæological Report, 1894–5, figs. 65 and 66.
[4] *See* Boyle: 1902 Report, op. cit., fig. 7.
[5] *See* Boyle: 1904 Report, fig. 43.
[6] *See* Wintemberg, W. J.: Nat. Mus., Canada, Bull. 51, Pl. XXII, fig. 10.

Units for Cup and Pin Game

Objects made by drilling a large hole through the proximal end and a smaller hole through the distal extremity, or by cutting off the proximal end and drilling the distal end, of proximal phalanges of the deer (Plate XV, figure 13), are found on most Iroquoian sites. A few are made of middle phalanges, and others have additional holes through the wall at the lower end. These objects were probably units for the well-known cup and pin game.

Flattened Deer Phalanges

Phalanges of the deer, flattened on the front and back (Plate XV, figure 14), in some cases slanting from the middle to both ends, some of them looking like whistles, and others having a triangular transverse diameter, many of them showing incised and burnt markings and pits, have been found on Iroquoian sites of the late pre-European period, most of them being from Huron and Mohawk-Onondaga sites. Their use is unknown, but the markings suggest that they were used in a game similar to dice.

Turtle-shell Rattles

A few perforated fragments of painted turtle shells, mostly of the plastron, have been found at Iroquoian sites of the late pre-European period. They may be parts of rattles. Whole shells of the southern box turtle, with several perforations, which may have been either knee or hand rattles (Plate XV, figure 22), have been discovered at post-European Iroquois sites.

Tubes

A few large tubes, of unknown use, made from leg bones of a large mammal, have been found at Neutral sites of the archaic[1] and transitional periods (Plate XV, figure 11), and one, the only decorated specimen, on a Huron site of the late pre-European period.[2] Other tubes, but smaller and chiefly made from deer radii, dog tibiæ and femora, also a few tubes of bird bones with notches on the more prominent angles, called "tally bones" by local collectors, have been found at several Iroquois sites of the post-European period. Many of them are highly polished and others, in addition to the notches, bear incised decoration (Plate XV, figure 12). They are all too large for beads and their precise use is unknown.

Pipes

A pipe made from the proximal phalanx of a wapiti by removing the proximal end and making a hole through the distal articular facet for the reception of the stem, was found on a Neutral site of the late pre-European period. Several made from deer scapulæ were found on a Mohawk-Onondaga site, and on a Neutral site in Brant county. Only one pipe made of antler has been found; it is from a post-European Iroquois site.[3]

[1] *See* Wintemberg: Uren, Pl. XXIII, fig. 16.
[2] *See* Boyle: Archæological Report, Fourth Annual Report of the Canadian Institute (Session of 1890-91), fig. 132.
[3] *See* Boyle: 1891 Report, op. cit., fig. 71.

Faces and Figurines

A few small, perforated, concavo-convex pieces of bone, carved to represent human faces, have been found at Huron sites of the post-European period in Simcoe county.[1] A small human figurine of bone, with a perforation for suspension through the neck,[2] comes from a post-European Iroquois site, and another of antler, from a Tionontati site of the same period.

Artifacts made of Teeth

Artifacts made of teeth consist mainly of chisels, knives, pendants, and beads.

Chisels made of beaver incisors are common at most sites. Those that show artificial modification had the root cut off, or the inner, curved wall of the tooth removed. In a few cases the root end was worked to a bevel to correspond with the unworked natural cutting end.

Knife blades were made of beaver, porcupine, and woodchuck incisors, either by breaking the tooth in two lengthwise, and grinding the broken edge smooth, or by grinding the tooth to the desired thickness, thus producing a sharp cutting edge on the concave edge of the tooth. Knives made from bear canines have been found on Huron and Mohawk-Onondaga sites of the late pre-European period.

Pendants were made by either notching or perforating the root end of bear (Plate XV, figure 16), wapiti, wolf, and raccoon canines, and deer incisors (Plate XV, figure 15).

Only one tooth, the canine of a dog, which seems to have been used as a bead, has both ends removed, exposing the longitudinal neural cavity, through which the string could be passed.

Artifacts of Shell

No artifacts of shell are found on Algonkian sites in Ontario and Quebec, but they occur on most Iroquoian sites.

With the exception of shells of freshwater clams, which in many cases are adapted for several uses without artificial modification, Neutral sites of the archaic period, and Neutral, Huron, Tionontati, and Mohawk-Onondaga sites of the late pre-European period yield very few articles of shell. A few pendants made from shells of freshwater clams have been found on sites of the late pre-European period,[3] and a few come from post-European Neutral or Iroquois sites.[4] Others, made from pieces of marine shells, chiefly *Fulgur perversum*, of several different kinds, including crude, curved, narrow strips, oval pieces (Plate XVII, figure 12), and irregularly shaped pieces, with a hole through one end, and a few carved to represent animal forms[5] and human faces, are common on post-European Huron,

[1] *See* Boyle: Archæological Report, Annual Report of the Canadian Institute, Session 1886–87, fig. 105.
[2] Ibid., fig. 106.
[3] *See* the author's "The Use of Shells by the Ontario Indians"; Annual Archæological Report, 1907, Pl. XI, fig. *b* (Toronto, 1908).
[4] Ibid., Pl. X, figs. *a*, *b*, *g*, and *h*.
[5] Ibid., Pl. XIX, fig. *g*.

Tionontati, and Iroquois sites. Small, whole shells of *F. perversum*[1] and *F. pyrum*[2] have the rostrum either perforated or notched for suspension, and a small species of *Strombus* has a hole through the lip.[3] Several small specimens, shaped like ducks, with a hole through the neck and decorated with incised lines and pits, have been found at two late seventeenth century Iroquois sites;[4] others are shaped like claws. What are known as shell pins (Plate XVII, figure 15), but are more likely to have been pendant ornaments, found at a few post-European Tionontati sites, probably were obtained from Indians of other cultures south of the Great Lakes. There are other shell ornaments from post-European Huron, Tionontati, and Iroquois sites that consist of curved elliptical pieces of shell with two perforations; they are known as crescents (Plate XVII, figures 13 and 14). One specimen, perhaps a bead, is shaped like a flat-headed rivet;[5] others are like large beads, but have holes drilled straight[6] or diagonally through each end;[7] a concavo-convex piece, with holes drilled diagonally through one edge, is seen on Plate XVII, figure 16. Another ornament consists of a flat, circular disk, with incised decoration on one or both sides,[8] and holes drilled through the disk from edge to edge; some of these, however, may be of European origin. A few shell ornaments from late pre-European Neutral sites are carved to represent fish.[9]

A few beads, some perforated, made from freshwater snails, including *Goniobasis livescens* (Plate XVII, figure 1), *Limnaea catascopium, Pleurocera subulare, Campeloma decisum* (Plate XVII, figure 2), and a small marine species, *Marginella apicina* (Plate XVII, figures 3 and 4), a few discoidal specimens made from pieces of freshwater clams and marine shell, and cylindrical specimens made from columellæ of marine shells (Plate XVII, figure 5), have been found on pre-European Neutral, Tionontati, Huron, and Mohawk-Onondaga sites. Many of these different kinds of shell beads, including specimens like those in figures 7-9, continued in use after the arrival of Europeans, but the supply was augmented to an extent probably undreamed of by the earlier Indians, thousands having been found in ossuaries and village sites. Some of the beads are larger than those from the earlier sites (Plate XVII, figures 6, 10, and 11).

Many shell gorgets have been found in ossuaries at post-European Iroquois sites and a few come from ossuaries at Tionontati sites of the same period; they are not found on early sites. They are of three different kinds, one being oval with three perforations for suspension near the edge; another round with from two to ten perforations (Plate XVII, figure 17); and the third pear-shaped, mostly with two holes, but, in some cases, with three (Plate XVII, figure 18).

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[1]Ibid., Pl. XII, figs. *a* and *b*.
[2]Ibid., Pl. XII, fig. *c*.
[3]Ibid., Pl. XII, fig. *d*.
[4]Ibid., Pl. XIX, fig. *j*.; and Orr, 1921-22 Report, op. cit., illustration on p. 122. Cf. Skinner, "Notes on Iroquois Archæology," op. cit., fig. 28.
[5]Wintemberg: "Use of Shell"; op. cit., Pl. XI, fig. *c*.
[6]Ibid., Pl. IX, fig. *h*.
[7]Ibid., Pl. IX, fig. *g*.
[8]Ibid., Pl. IX, fig. *m*, and Pl. X, fig. *e*.
[9]Ibid., Pl. XIX, fig. *b*.

BURIALS

There is very little archæological information respecting graves of the Algonkian Indians. Only a few have been discovered, mostly in the course of ploughing and road and railway construction in Ontario, and very little is known about them beyond the fact of their occurrence and that they contained no artifacts. It is possible, however, that some of the graves containing copper beads, awls, axes, shell ornaments, and in some cases powdered hematite or limonite, which are considered to be those of mound-building Indians,[1] are really Algonkian.

Single graves have been discovered at several Neutral sites of the archaic period, but it is not known if the bodies had been buried full-length or in a flexed position, or if there were accompanying artifacts. Sir Francis Knowles excavated an ossuary at a Neutral site of the transitional period, which contained many human bones, a cremated burial, a few chipped stone artifacts, a cylindrical, hollow bone bead, and a few small discoidal shell beads. Single burials seem to be the rule at Neutral sites of the late pre-European period, but in a few cases the graves contained a pile of leg and other bones, with the skulls piled on top or around them.

The mortuary customs of the Hurons differed from those of most of the earlier Iroquoian peoples in Ontario. They are known to have practised scaffold burial, but many single graves are known to occur at their village sites, from which the bones were periodically removed and reburied, in some cases as many as a thousand skeletons, in a single pit. The ossuaries of the early period do not seem to have contained anything besides the bones, but, after the arrival of Europeans, stone and earthenware pipes, earthenware pots, shell, brass, porcelain, and glass beads, shell ornaments, large ocean shells, brass kettles, and iron axes were buried in them. Very few ossuaries occur at pre-European sites, the most easterly ones being in Durham county, Ontario.

The early Tionontati appear to have buried their dead in single graves, and this seems also to have been the practice at sites of the post-European period; in the latter case, however, the remains were periodically exhumed and reburied in ossuaries. Over thirty ossuaries, containing, besides the bones, articles of native and European origin, occur in the area known to have been occupied by these people.

Most of the graves at Mohawk-Onondaga sites are single, but occasionally two and, in a few cases, three, skeletons have been found in the same grave. In only one instance was anything buried with the dead.

There are both single graves and ossuaries at Iroquois sites of the post-European period, all containing human bones and associated objects similar to those from post-European Huron and Tionontati ossuaries.

[1] *See* Artifacts from Ancient Graves, etc., op. cit.

PLATE III

Arrow heads chipped from stone

($\frac{1}{2}$ natural size)

FIGURE 1. Leaf-shaped, chipped from chert. From near Batiscan, Champlain co., Que., Cat. No. VIII-E-203.

FIGURES 2, 3, and 4. Triangular, chipped from chert. From lot 20, con. I, Grantham tp., Lincoln co., Ont. Cat. Nos. VIII-F-19052 to VIII-F-19054.

FIGURE 5. Leaf-shaped, indented base. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5390.

FIGURE 6. Stemmed. From Houghton tp., Norfolk co., Ont. Cat. No. VIII-F-4166.

FIGURE 7. Notched. From Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-5592.

FIGURE 8. Shouldered but not barbed. From lot 31, con. I, S., North Cayuga tp., Haldimand co., Ont. Cat. No. VIII-F-15713.

FIGURE 9. Notched. From Bayham tp., Elgin co., Ont. Cat. No. VIII-F-1651.

FIGURE 10. Notched. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3932.

FIGURE 11. Thick, notched. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5242.

FIGURE 12. Notched. From Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-422.

FIGURE 13. Serrated edge, notched. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1558.

FIGURE 14. Notched, indented base. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4240.

FIGURE 15. Notched. From lot 20, con. I, Grantham tp., Lincoln co., Ont. Cat. No. VIII-F-19055.

FIGURE 16. Tip bevelled and rhomboidal in cross-section. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3002.

FIGURE 17. Quartz notched. From Renfrew co., Ont. Cat. No. VIII-F-17764*b*.

FIGURE 18. Indented base, barbed. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-2924.

FIGURE 19. Barbed. From lot 20, con. I, Grantham tp., Lincoln co., Ont. Cat. No. VIII-F-19056.

FIGURE 20. Jasper, barbed. From near Dalmeny, Osgoode tp., Carleton co., Ont. Cat. No. VIII-F-14675.

FIGURE 21. Thick. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3886.

FIGURE 22. Serrated edge, barbed. From South Dorchester tp., Elgin co., Ont. Cat. No. VIII-F-723.

FIGURE 23. Convex base. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3225.

FIGURE 24. Ridged. From Timiskaming co., Que. Cat. No. VIII-E-151.

FIGURE 25. Indented base. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-6216.

FIGURE 26. Indented base. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-300.

FIGURE 27. Unusual type. From lot 20, con. I, Grantham tp., Lincoln co., Ont. Cat. No. VIII-F-19057.

FIGURE 28. Pentagonal. From same locality as figure 27. Cat. No. VIII-F-19058.

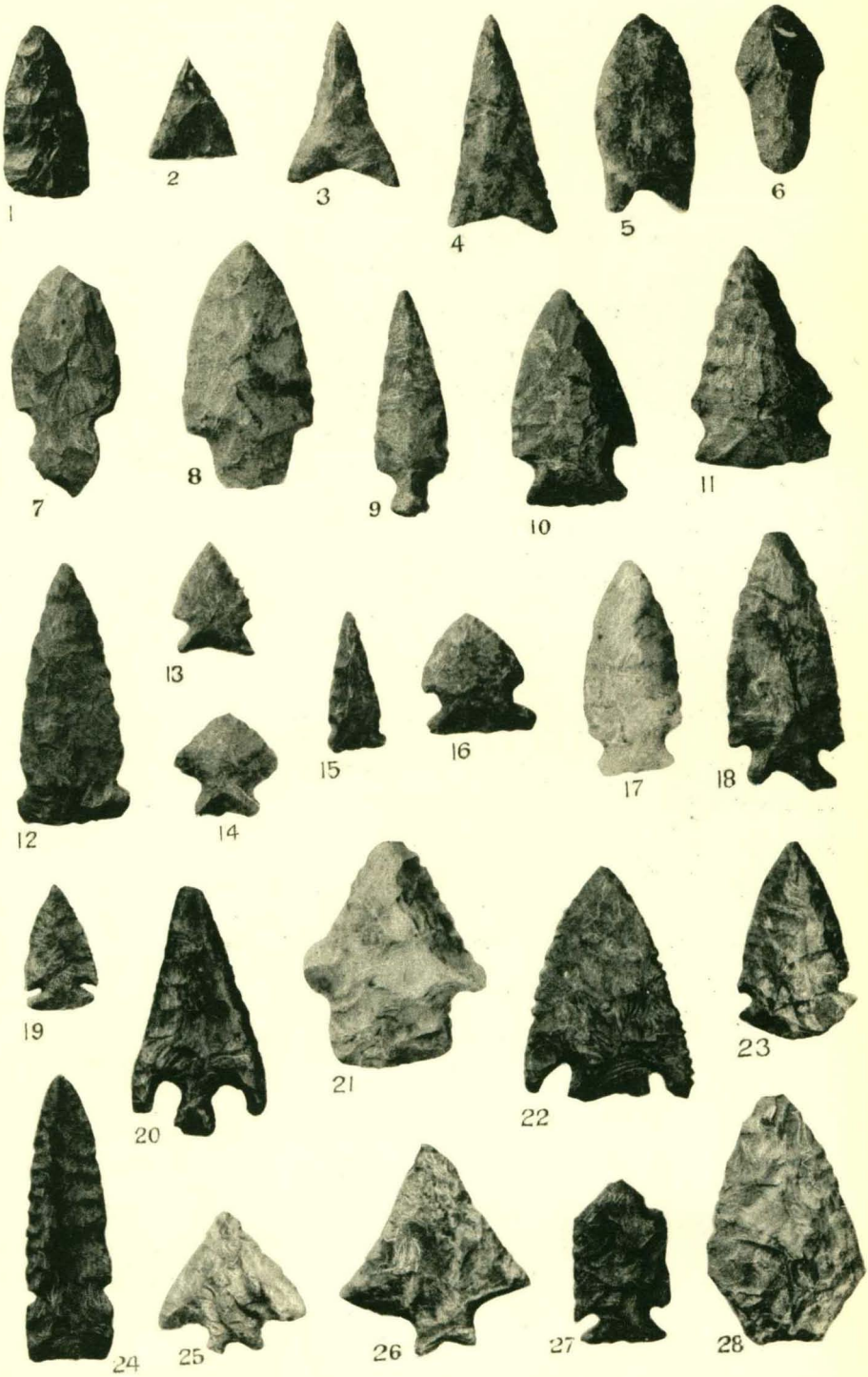
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Plate IV

Chipped stone artifacts from Algonkian sites

($\frac{1}{2}$ natural size)

Figure 1. Notched arrow or spear point chipped from grey chert. From Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-3155.

Figure 2. Stemmed and shouldered spear point chipped from grey chert. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3358.

Figure 3. Notched and shouldered spear point chipped from grey chert. From near Aylmer, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4684.

Figure 4. Stemmed and shouldered point for spear chipped from pinkish chert. From lot 1, con. IX, Euphrasia tp., Grey co., Ont. Cat. No. VIII-F-15095.

Figure 5. Chert blade, perhaps knife. From Bayham tp., Elgin co., Ont. Cat. No. VIII-F-4972.

Figure 6. Chert drill point. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5429.

Figure 7. T-shaped chert drill point. From Brant co., Ont. Cat. No. VIII-F-15219*a*.

Figure 8. Notched chert drill point. From near Agincourt, Scarborough tp., York co., Ont. Cat. No. VIII-F-14988.

Figure 9. Crude plano-convex scraper chipped from grey chert. From site on lot 28, con. I, S., North Cayuga tp., Haldimand co., Ont. Cat. No. VIII-F-15737.

Figure 10. Leaf-shaped, plano-convex chert scraper. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4703.

Figures 11 and 12. Notched chert scrapers. From Malahide tp., Elgin co., Ont. Cat. Nos. VIII-F-4691 and VIII-F-935.

Figure 13. Stemmed chert scraper. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4194.

Figure 14. Chalcedony blade, perhaps knife. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5007.

Figure 15. Large chert blade. From near Strathroy, Middlesex co., Ont. Cat. No. VIII-F-4687.

Figure 16. Chert blade, perhaps knife. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1501.

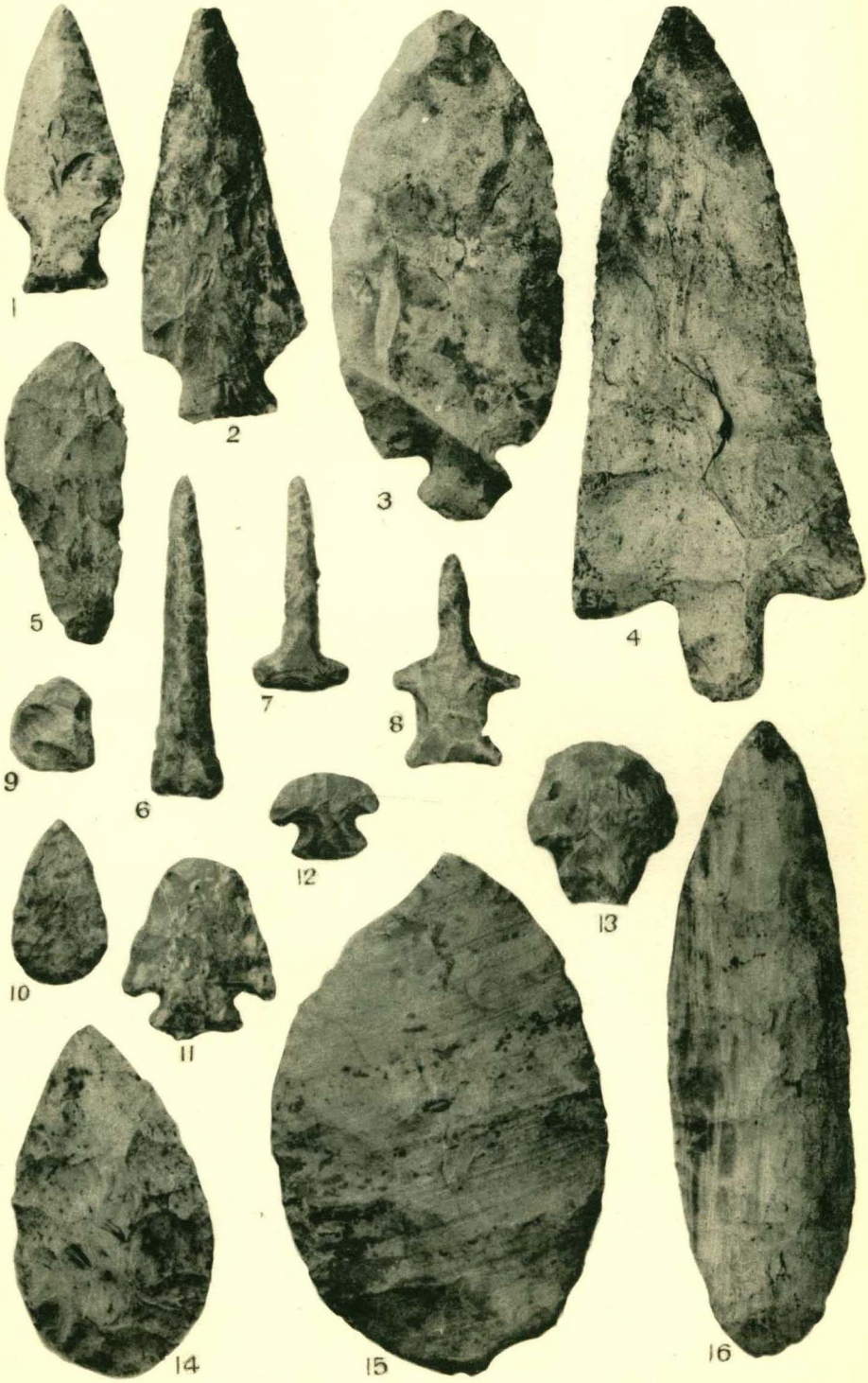
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PLATE V

Ground slate points

(½ natural size)

FIGURE 1. Arrow point, stem notched on one edge only. From lot 11, east range, Allumette island, Pontiac co., Que. Cat. No. VIII-E-37.

FIGURE 2. Red slate arrow point. From lot 5, range I, Onslow tp., Pontiac co., Que. Cat. No. VIII-E-160.

FIGURE 3. Point for spear or knife, both faces slightly ridged. From near Trenton, Ont. Cat. No. VIII-F-15233.

FIGURE 4. Point for spear or knife, both faces slightly ridged. From lot 25, con. X, Fitzroy tp., Carleton co., Ont. Cat. No. VIII-F-15665.

FIGURE 5. Thin point for spear or knife. From southwestern Ontario. Cat. No. VIII-F-5127.

FIGURE 6. Point for spear or knife, lenticular in cross-section. From Scarborough tp., York co., Ont. Cat. No. VIII-F-15232.

FIGURE 7. Point for spear or knife, lenticular in cross-section. From Houghton tp., Norfolk co., Ont. Cat. No. VIII-F-3320.

FIGURE 8. Point for spear or knife, lenticular in cross-section. From west half lot 25, con. VI, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9082.

FIGURE 9. Bayonet slate, diamond-shaped in cross-section. From lot 20 or 21, con. XIV, Wilberforce tp., Renfrew co., Ont. Cat. No. VIII-F-17494.

FIGURE 10. Semilunar knife. From Georgina tp., York co., Ont. Cat. No. VIII-F-14799.

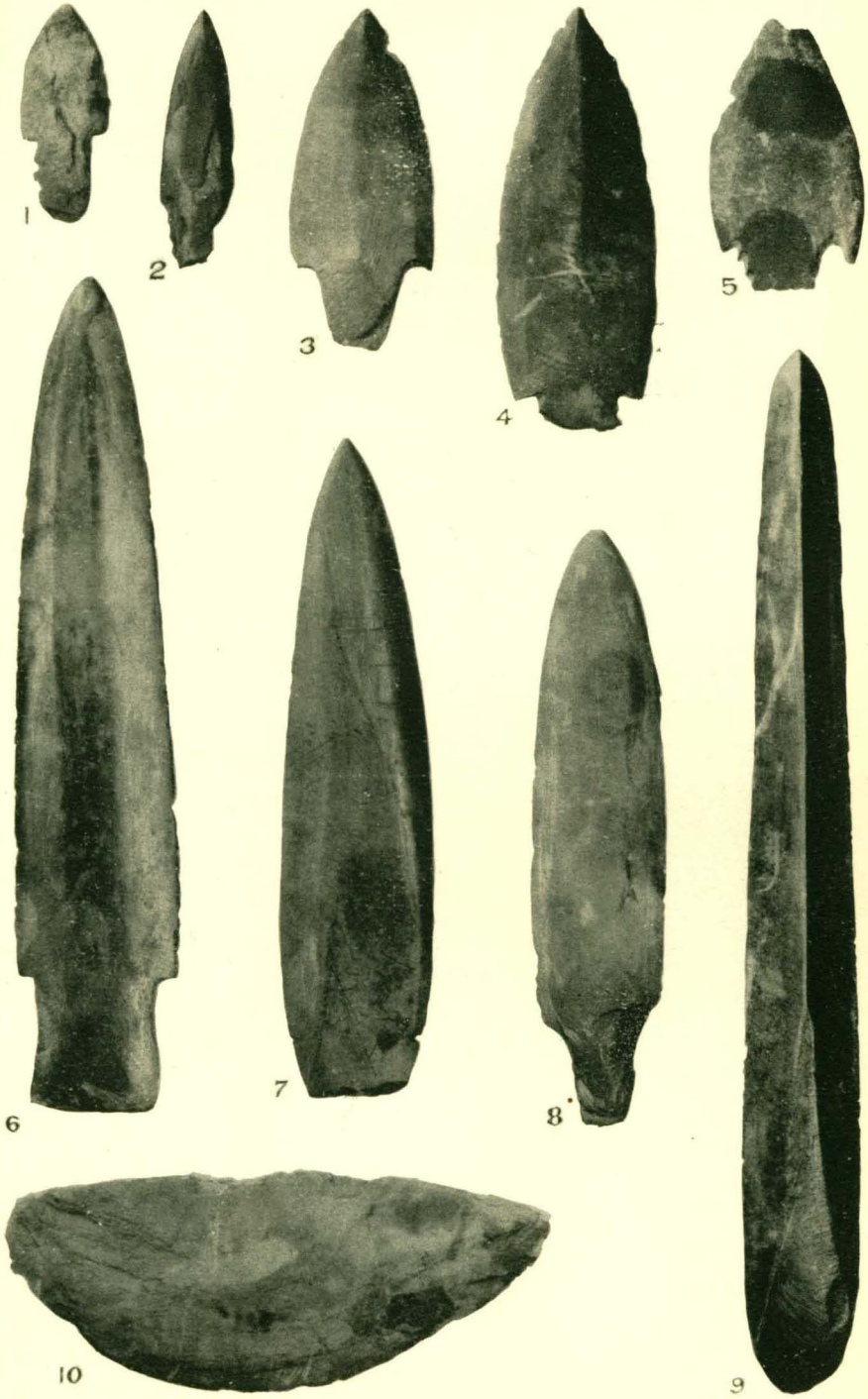
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PLATE VI

Ground stone artifacts from Algonkian sites

(½ natural size)

FIGURE 1. Ax grooved on edges only and pitted on both faces. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-6145.

FIGURE 2. Stone adze. From Tuckersmith tp., Huron co., Ont. Cat. No. VIII-F-14473.

FIGURE 3. Small slate gouge. Only partly hollowed. From con. III, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4349.

FIGURE 4. Gouge hollowed from end to end. From lot 20, con. IX, Fitzroy tp., Carleton co., Ont. Cat. No. VIII-F-15664.

FIGURE 5. Grooved ax. From Mariposa tp., Victoria co., Ont. Cat. No. VIII-F-8982.

FIGURE 6. Grooved ax. From Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-8986.

FIGURE 7. Soapstone plummet. From near Ottawa, Carleton co., Ont. Cat. No. VIII-F-14790.

FIGURE 8. Spool-shaped object. From Houghton tp., Norfolk co., Ont. Cat. No. VIII-F-1407.

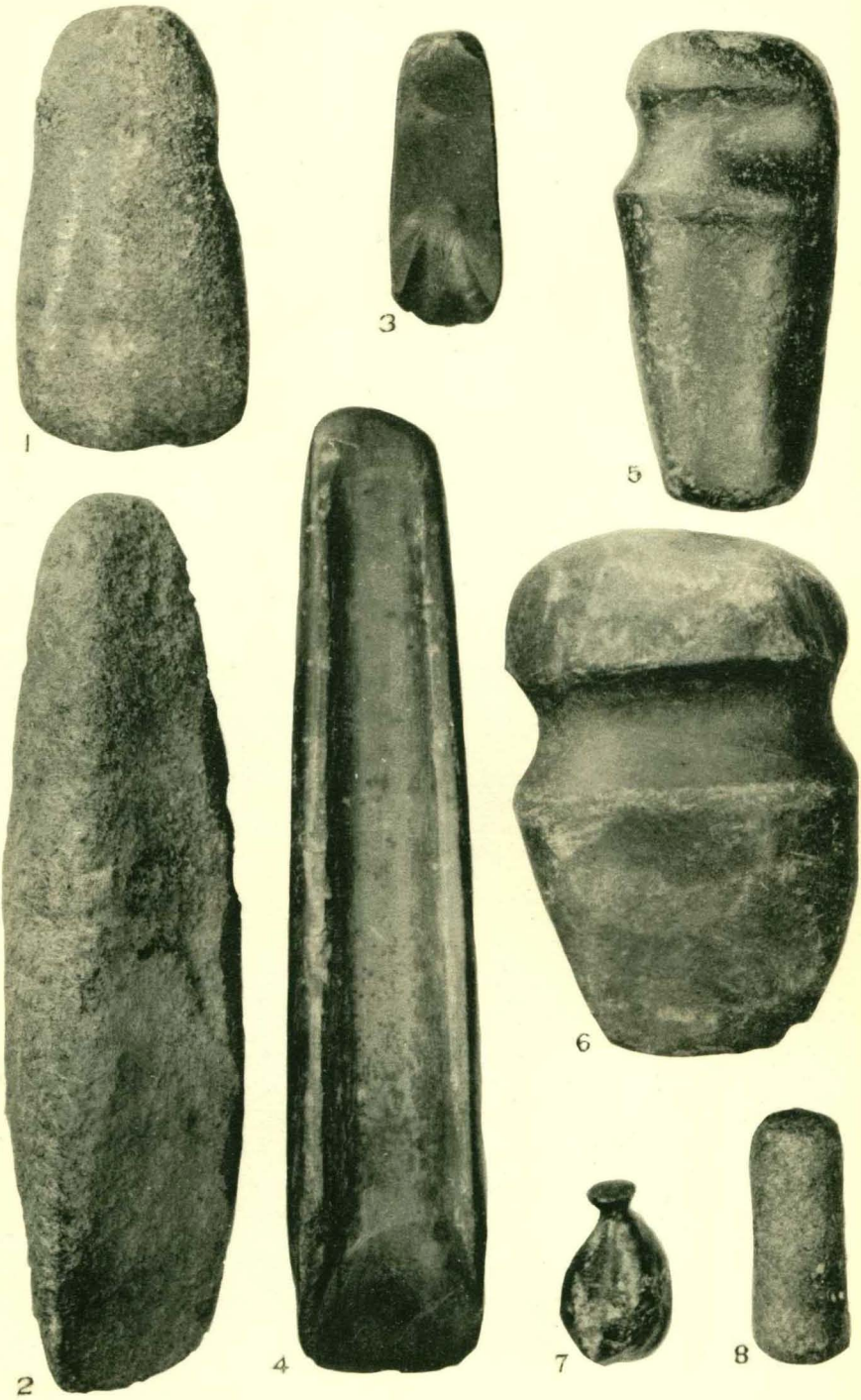
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Plate VII

Slate gorgets and pendants

(½ natural size)

Figure 1. Pendant-like object with chisel edge. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5879.

Figure 2. Thick, pendant-like object with biconical hole. From Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-3186.

Figure 3. Pendant. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5880.

Figure 4. Red slate gorget with ends notched. From Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-5839.

Figure 5. Pentagonal gorget of brownish slate. From Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-5828.

Figure 6. Gorget of reddish slate. From Dereham tp., Oxford co., Ont. Cat. No. VIII-F-5862.

Figure 7. Gorget of veined grey slate. From con. V, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-3313.

Figure 8. Reel-shaped gorget made of grey slate. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5271.

Figure 9. Thin gorget with flaring end, made of veined grey slate. From con. VIII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-196.

Figure 10. Decorated gorget of grey slate. From Middlesex co., Ont. Cat. No. VIII-F-5826.

Figure 11. Pyramidal type of gorget, made of grey slate. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5878.

Figure 12. Boat stone made of bluish grey, veined slate. From lot 28, con. VII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-187.

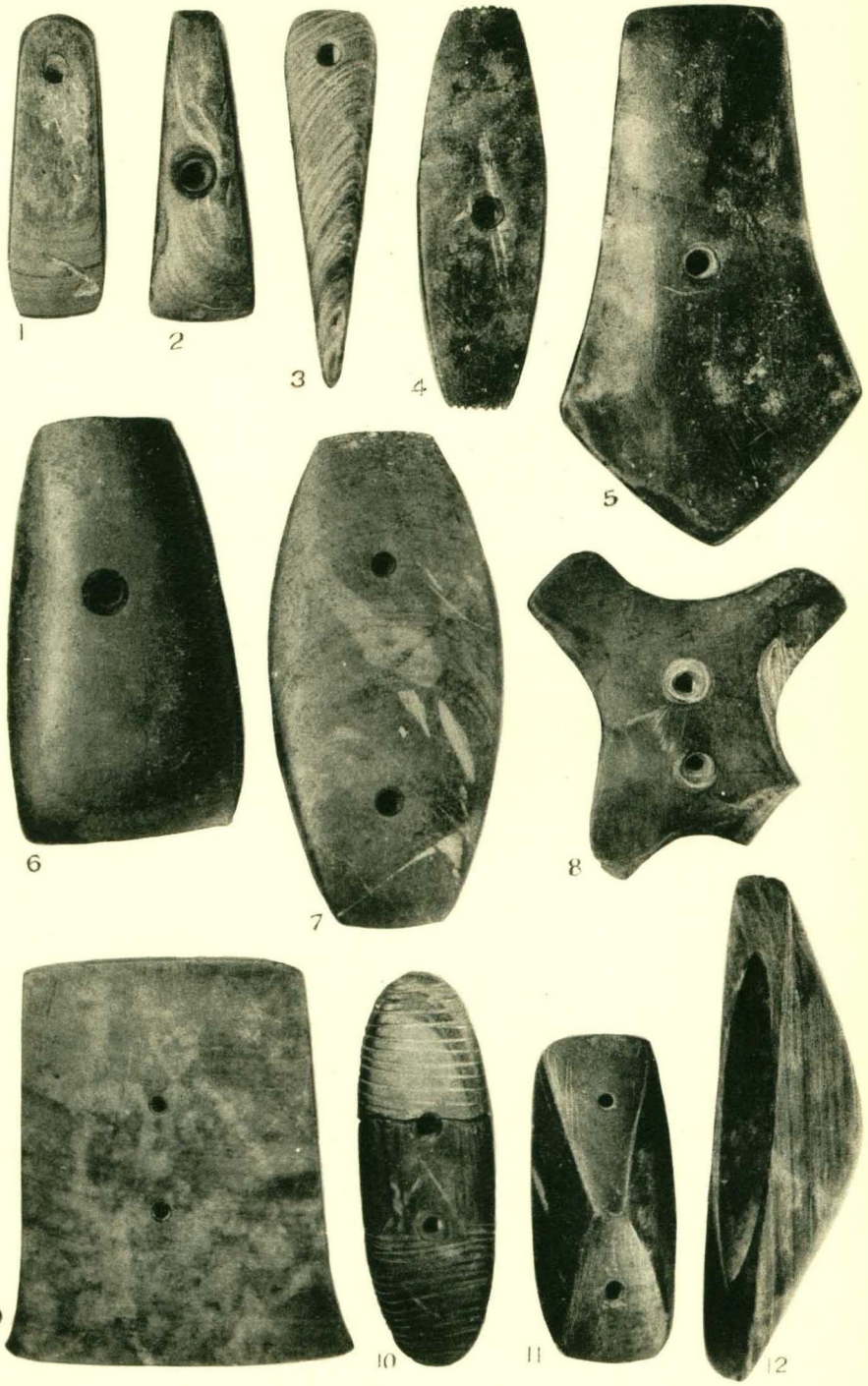
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PLATE VIII

Bar and bird amulets

($\frac{1}{2}$ natural size)

FIGURE 1. Cast of a bar amulet; original made of veined grey slate. From lot 2, con. VIII, Blandford tp., Oxford co., Ont. Cat. No. VIII-F-8307.

FIGURE 2. Imperforate bar amulet made of red slate. From lot 8, con. III, Huntley tp., Carleton co., Ont. Cat. No. VIII-F-8383.

FIGURE 3. Simple type of bird amulet, made of veined, greenish grey slate. From Prince Edward co., Ont. Cat. No. VIII-F-8317.

FIGURE 4. Squat type of bird amulet, made of veined grey slate. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1263.

FIGURE 5. Cast of small, rabbit-like amulet. Original of grey slate and probably from Middlesex co., Ont. Cat. No. VIII-F-19031.

FIGURE 6. Bird amulet made of veined reddish slate; knobs on head. From Barton tp., Wentworth co., Ont. Cat. No. VIII-F-8318.

FIGURE 7. Part of bird amulet with spool-shaped knobs on head, made of veined grey slate. From near Delhi, Norfolk co., Ont. Cat. No. VIII-F-3014.

FIGURE 8. Unpolished bird amulet of veined grey slate. From Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-3335.

FIGURE 9. Bird amulet of veined greenish grey slate, with hole through top of tail. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5940.

FIGURE 10. Bird amulet of veined, greenish grey slate. From lot 19, con. XIV, Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-5928.

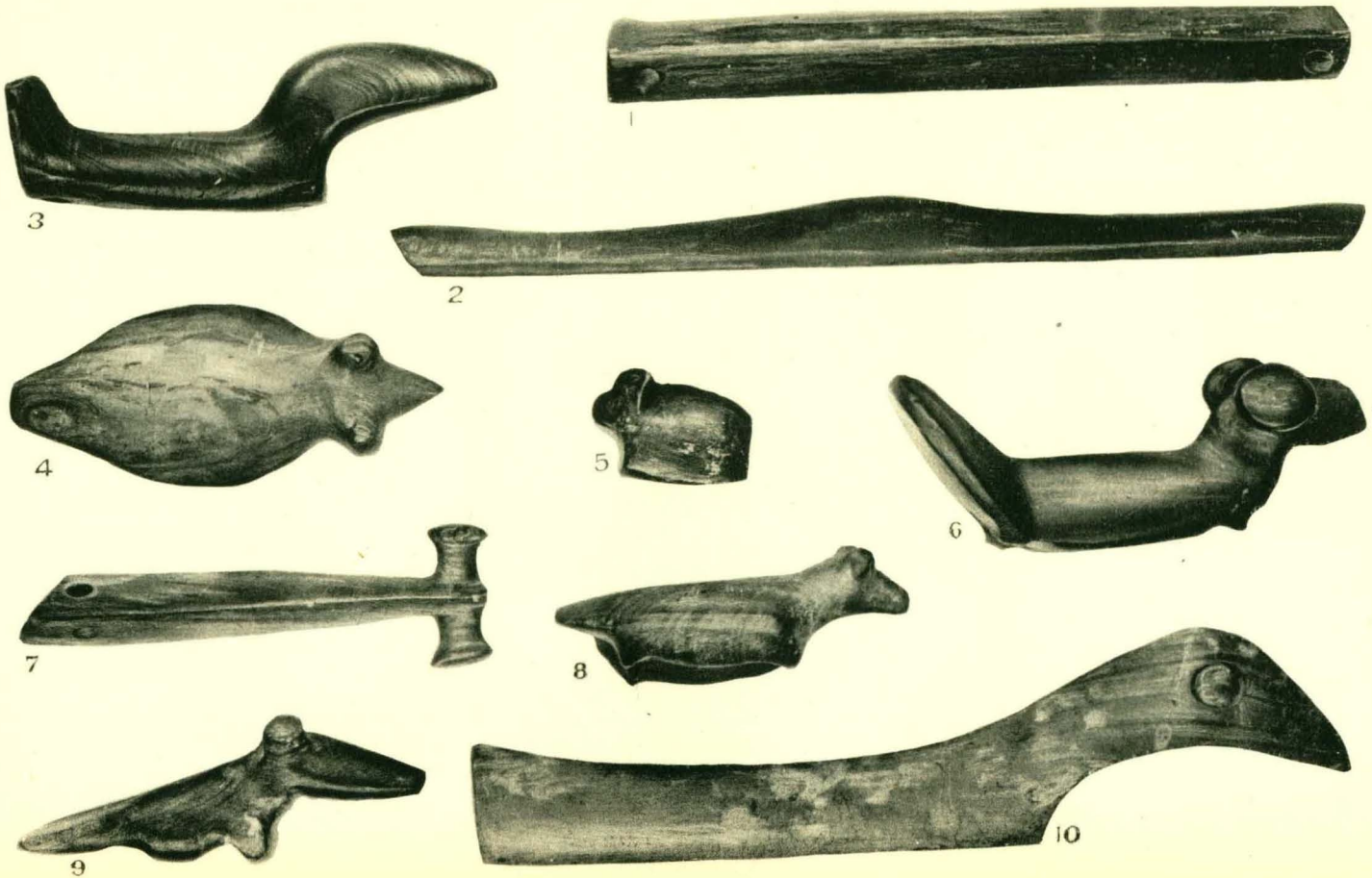
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PLATE IX

Banner stones and tubes from Algonkian sites

(½ natural size)

FIGURE 1. Lunate type of banner stone made of veined grey slate. From Halton co., Ont. Cat. No. VIII-F-8372.

FIGURE 2. Bipennate type of banner stone with bifurcate wings, made of veined grey slate. From Niagara tp., Lincoln co., Ont. Cat. No. VIII-F-8377.

FIGURE 3. Bipennate type of banner stone with flaring wings, made of veined grey slate. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4459.

FIGURE 4. Bipennate type of banner stone, made of soapstone. From Prince Edward co., Ont. Cat. No. VIII-F-8375.

FIGURE 5. Bipennate type of banner stone, made of veined grey slate. From lot 28, con. V, Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-5891.

FIGURE 6. Bipennate ("butterfly") type of banner stone, made of grey slate. From Bayham tp., Elgin co., Ont. Cat. No. VIII-F-1061.

FIGURE 7. Small, bipennate type of banner stone, made of veined, greenish grey slate. From lot 6, con. III, Anderdon tp., Essex co., Ont. Cat. No. VIII-F-8369.

FIGURE 8. Geniculate type of banner stone, made of veined grey slate. From lot 18, con. VIII, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-5910.

FIGURE 9. Tube made of veined grey slate. From Bayham tp., Elgin co., Ont. Cat. No. VIII-F-3329.

FIGURE 10. Tube of veined grey slate. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1202.

FIGURE 11. Ball-like ceremonial or tube, made of veined grey slate. From site on lots 16 and 17, con. IV, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-4460.

FIGURE 12. Unusual type of tube, made of veined, bluish grey slate. From near Glencolin, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1062.

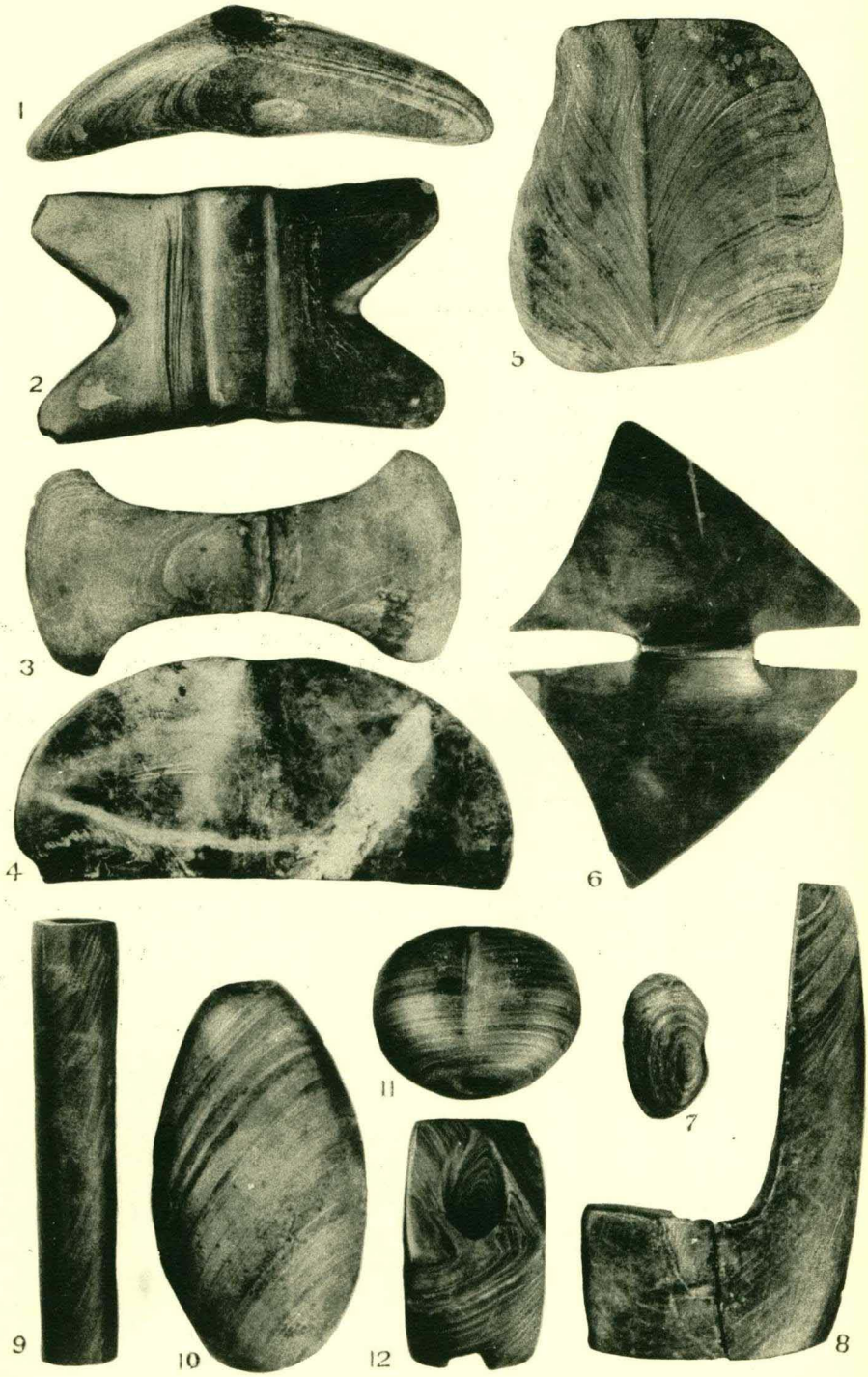
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PLATE X

Copper artifacts from Algonkian sites

(½ natural size)

FIGURE 1. Point for spear or knife. From southeast of Fairy lake, Hull co., Que. Cat. No. VIII-E-51.

FIGURE 2. Point for spear or knife. From lot 20, con. I, Grantham tp., Lincoln co., Ont. Cat. No. VIII-F-19051.

FIGURE 3. Point for spear or knife, triangular in cross-section. From near headwaters of Mississippi river, Frontenac co., Ont. Cat. No. VIII-F-8600.

FIGURE 4. Point for knife or spear. From site on lots 27-28, con. XII, Wilberforce tp., Renfrew co., Ont. Cat. No. VIII-F-17751.

FIGURE 5. Awl or point for arrow. From east shore of lake Nipigon, Thunder Bay district, Ont. Cat. No. VIII-F-15235.

FIGURE 6. Hollow, cone-shaped point for arrow. From lot 11, east range, Allumette island, Pontiac co., Que. Cat. No. VIII-E-38.

FIGURE 7. Fish-hook. From Fort William, Thunder Bay district, Cat. No. VIII-F-15672.

FIGURE 8. Fish-hook. From bed of Rainy river, Fort Frances, Rainy River district, Ont. Cat. No. VIII-F-17471.

FIGURE 9. Fish-hook. From site near Batiscan, Champlain co., Que. Cat. No. VIII-E-200.

FIGURE 10. Knife. From near Pagwa, Algoma district, Ont. Cat. No. VIII-F-15686.

FIGURE 11. Object of unknown use. From site near Batiscan, Que. Cat. No. VIII-E-201.

FIGURE 12. Bead. From same site as figure 11. Cat. No. VIII-E-202.

FIGURE 13. Spud. From Fort William, Thunder Bay district. Cat. No. VIII-F-15670.

FIGURE 14. Small chisel, or adze. From same locality as figure 6. Cat. No. VIII-E-41.

FIGURE 15. Object, perhaps awl. From Fort William, Ont. Cat. No. VIII-F-15674.

FIGURE 16. Gouge. From lot 5, con. VI, Bedford tp., Frontenac co., Ont. Cat. No. VIII-F-8602.

FIGURE 17. Small ax. From lot 23, con. XI, Grattan tp., Renfrew co., Ont. Cat. No. VIII-F-17750.


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PLATE XI

Algonkian pottery

(½ natural size)

FIGURE 1. Fragment with roulette decoration. From Thompson island, lake St. Francis. Cat. No. VIII-F-13612*a*.

FIGURE 2. Rim fragment with markings which look like cord impressions. From lot 13, con. VI, Blenheim tp., Oxford co., Ont. Cat. No. VIII-F-8310.

FIGURE 3. Fragment of body of pot with scarified surface and zigzag markings. From lot 8, con. V, Blandford tp., Oxford co., Ont. Cat. No. VIII-F-8291.

FIGURE 4. Fragment of body of pot with chequered surface. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3816.

FIGURE 5. Fragment of rim, with zigzag markings on the inside. From Plum point, Rideau lake, Lanark co., Ont. Cat. No. VIII-F-15324*e*.

FIGURE 6. Fragment of rim, with bosses on outside produced by punching holes from inside. From lot 29, con. VI, Camden tp., Addington co., Ont. Cat. No. VIII-F-13641*c*.

FIGURE 7. Fragment of body of pot with zigzag roulette markings. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3638.

FIGURE 8. Fragment of body of pot with markings produced with grass or sinew-wound twigs. From lot 8, con. IV, Blandford tp., Oxford co., Ont. Cat. No. VIII-F-8292.

FIGURE 9. Fragment of rim of pot with holes punched from outside and decoration produced with cord-wound twig. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3744.

FIGURE 10. Fragment of decorated rim. From Tar island, Leeds co., Ont. Cat. No. VIII-F-13624*b*.

FIGURE 11. Fragment of decorated rim. From Plum point, Rideau lake, Lanark co., Ont. Cat. No. VIII-F-15338*a*.

FIGURE 12. Fragment of decorated rim. From Malahide tp., Elgin co., Ont. Cat. No. VIII-F-506.

FIGURE 13. Fragment of decorated body of pot. From Plum point, Rideau lake, Lanark co., Ont. Cat. No. VIII-F-15328*b*.

FIGURE 14. Fragment of rim with stamped meander design. From Plum point, Rideau lake, Lanark co., Ont. Cat. No. VIII-F-15352*c*.

FIGURE 15. Fragment of decorated rim. From Tar island, Leeds co., Ont. Cat. No. VIII-F-13624*a*.

FIGURE 16. Fragment of decorated body of pot. From Plum point, Rideau lake, Lanark co., Ont. Cat. No. VIII-F-15328*a*.

FIGURE 17. Fragment of decorated pot. From north shore of Golden lake, Renfrew co., Ont. Cat. No. VIII-F-17775*b*.

FIGURE 18. Fragment of decorated neck of pot. From Brantford, Brant co., Ont. Cat. No. VIII-F-8615*a*.

FIGURE 19. Fragment of decorated neck of pot. From lot 19, Junction gore, Gloucester tp., Carleton co., Ont. Cat. No. VIII-F-15646*b*.

FIGURE 20. Fragment of decorated body of pot. From near Brantford, Ont. Cat. No. VIII-F-14377.

FIGURE 21. Fragment of decorated body of pot. From lot 32, con. I, N., North Cayuga tp., Haldimand co., Ont. Cat. No. VIII-F-15749*b*.


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PLATE XII

Stone and earthenware objects from Algonkian and Iroquoian sites

(½ natural size)

FIGURES 1 and 2. Triangular arrow points, chipped from grey chert. From Neutral-Iroquoian site of late pre-European period, lot 3, con. III, Tuscarora tp., Brant co., Ont. Cat. No. VIII-F-8876 *g, n.*

FIGURE 3. Notched arrow point chipped from grey chert. From Neutral site, Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-443.

FIGURE 4. Notched arrow point chipped from grey chert. From Neutral site, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-2124.

FIGURE 5. Plano-convex scraper chipped from grey chert. From post-European Tionontati site, lot 11, con. VIII, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-17698.

FIGURE 6. Small, decorated pebble pendant. From Neutral site, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1741.

FIGURE 7. Catlinite pendant carved to represent animal form. From post-European Tionontati site near Craigleith, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-14549.

FIGURE 8. Earthenware bead. From late pre-European Mohawk-Onondaga site on lots 26-27, con. III, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9144.

FIGURE 9. Discoidal stone bead. From same site as figure 8. Cat. No. VIII-F-9145.

FIGURE 10. Cylindrical soapstone bead. From late pre-European Mohawk-Onondaga site, lot 34, con. I, Osnabruck tp., Stormont co., Ont. Cat. No. VIII-F-13619.

FIGURE 11. Limestone disk. From late pre-European Huron site, Victoria co., Ont. Cat. No. VIII-F-8261*c*.

FIGURE 12. Perforated limestone disk. From late pre-European Huron site, lot 5, con. V, Bexley tp., Victoria co., Ont. Cat. No. VIII-F-8710.

FIGURE 13. Potsherd disk. From same locality as figure 11. Cat. No. VIII-F-8262*c*.

FIGURE 14. Perforated potsherd disk. From Neutral site of transitional period, lot 25, con. VIII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5792.

FIGURE 15. Micmac type of stone pipe. From lot 19, con. VIII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5951.

FIGURE 16. Monitor type of pipe, with stem missing. From Middlesex co., Ont. Cat. No. VIII-F-6077.

FIGURE 17. Stem of earthenware pipe, Algonkian. From Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-4472.

FIGURE 18. Earthenware pipe. From an Algonkian site, lot 4, con. VII, Blandford tp., Oxford co., Ont. Cat. No. VIII-F-8303.

FIGURE 19. Stemless stone pipe. From post-European Tionontati site, lot 12, con. I, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-17735.

FIGURE 20. Stemless vasiform soapstone pipe. From post-European Huron site, Medonte tp., Simcoe co., Ont. Cat. No. VIII-F-8537.

FIGURE 21. Stemless bird effigy stone pipe. From post-European Huron site, Tay tp., Simcoe co., Ont. Cat. No. VIII-F-8530.

FIGURE 22. Stemmed limestone pipe with animal form on bowl. From post-European Iroquois site, Barton tp., Wentworth co., Ont. Cat. No. VIII-F-8551.

FIGURE 23. Fragment of stone pipe bowl with human face and probable lightning symbols. From same site as figure 19. Cat. No. VIII-F-17739.

FIGURE 24. Stemless soapstone pipe with animal form on bowl. From post-European Tionontati site, lot 10, con. X, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-19007.

FIGURE 25. Soapstone animal effigy pipe. From post-European Iroquois site, lake Medad, Nelson tp., Halton co., Ont. Cat. No. VIII-F-8553.

FIGURE 26. Soapstone pipe. From same site as figure 25. Cat. No. VIII-F-8548.

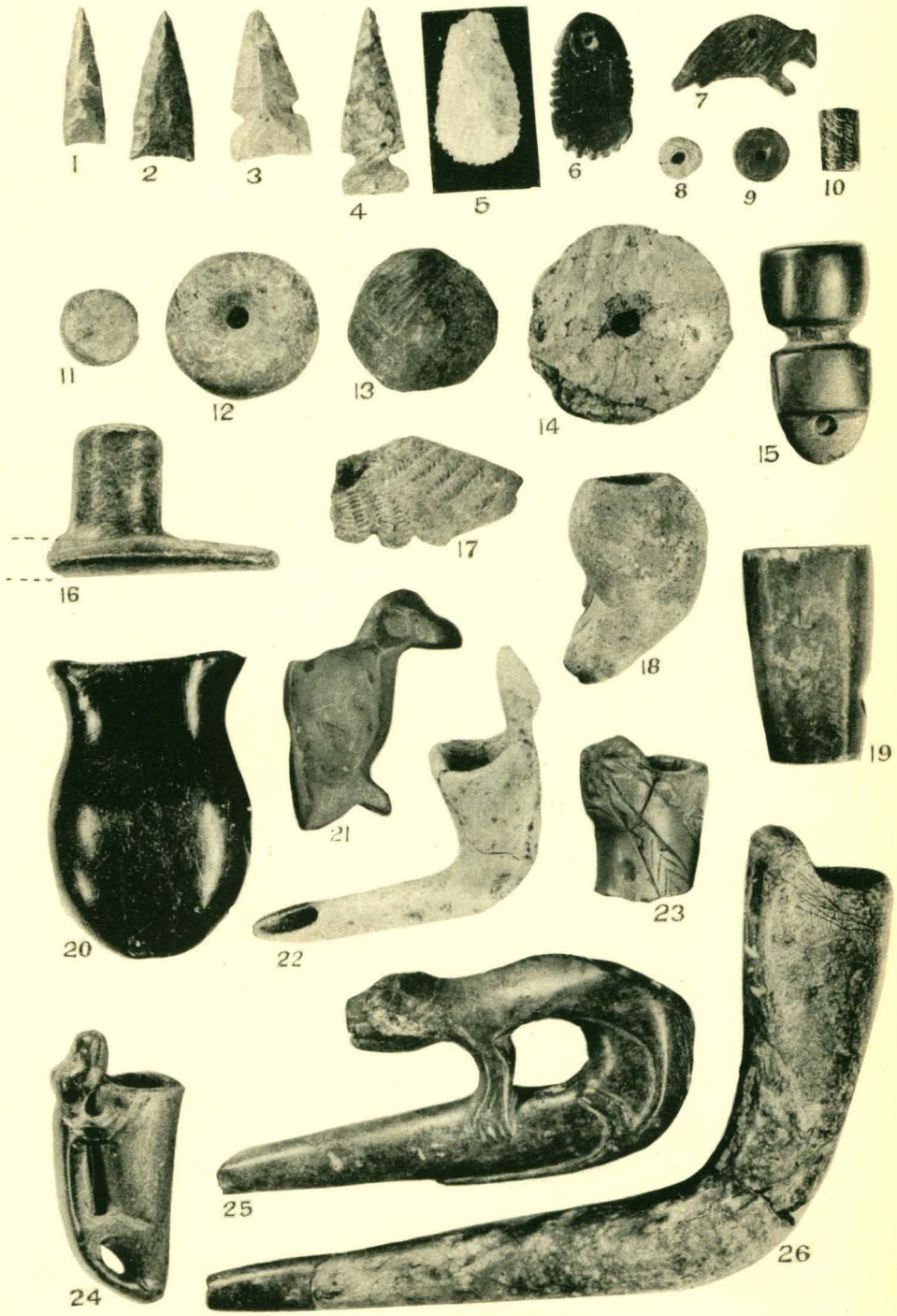
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PLATE XIII

Earthenware pipes from Iroquoian sites

(½ natural size)

FIGURE 1. Pipe with triangular stem and cylindrical bowl. From Neutral site of the archaic period, South Norwich tp., Oxford co., Ont. Cat. No. VIII-F-8474.

FIGURE 2. Pipe with barrel-shaped bowl and cylindrical top. From Neutral site of the transitional period, lot 25, con. VII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-5736.

FIGURE 3. Inverted cone type. From Neutral site of the transitional period, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-5764.

FIGURE 4. Bowl with unusual kind of decoration around top. From same site as figure 2. Cat. No. VIII-F-5656.

FIGURE 5. Part of pipe with lizard-like animal form. From Neutral site of transitional period, lot 60, con. III, Onondaga tp., Brant co., Ont. Cat. No. VIII-F-8825.

FIGURE 6. Pipe with barrel-shaped bowl. From Neutral site in Bayham tp., Elgin co., Ont. Cat. No. VIII-F-5734.

FIGURE 7. Trumpet type of pipe. From Neutral site of transitional period, lots 1 and 2, con. VIII, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-5660.

FIGURE 8. Cone-shaped, ringed type of bowl. From post-European Iroquois site, probably late sixteenth century, Trafalgar tp., Halton co., Ont. Cat. No. VIII-F-8464.

FIGURE 9. Inverted, truncated cone type of bowl. From late pre-European Huron site, Bexley tp., Victoria co., Ont. Cat. No. VIII-F-8266.

FIGURE 10. Ovoid type of bowl. From a Neutral site, lot 5, con. IX, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-5732.

FIGURE 11. Square-mouthed pipe with fluted stem. From post-European Iroquois site, lake Medad, Nelson tp., Halton co., Ont. Cat. No. VIII-F-8434.

FIGURE 12. Bowl modelled to represent bird. From a post-European Huron site, Medonte tp., Simcoe co., Ont. Cat. No. VIII-F-8501.

FIGURE 13. Owl face from pipe bowl. From same locality as figure 12. Cat. No. VIII-F-8506.

FIGURE 14. Pipe bowl modelled to represent a snake. From a post-European Tionontati site, lot 3, con. III, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-17709.

FIGURE 15. "Blowing-face" type of pipe of black ware. From same locality as figure 11. Cat. No. VIII-F-8495.

FIGURE 16. Bowl with modelled human face. From post-European Tionontati site, lot 12, con. I, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-17737.

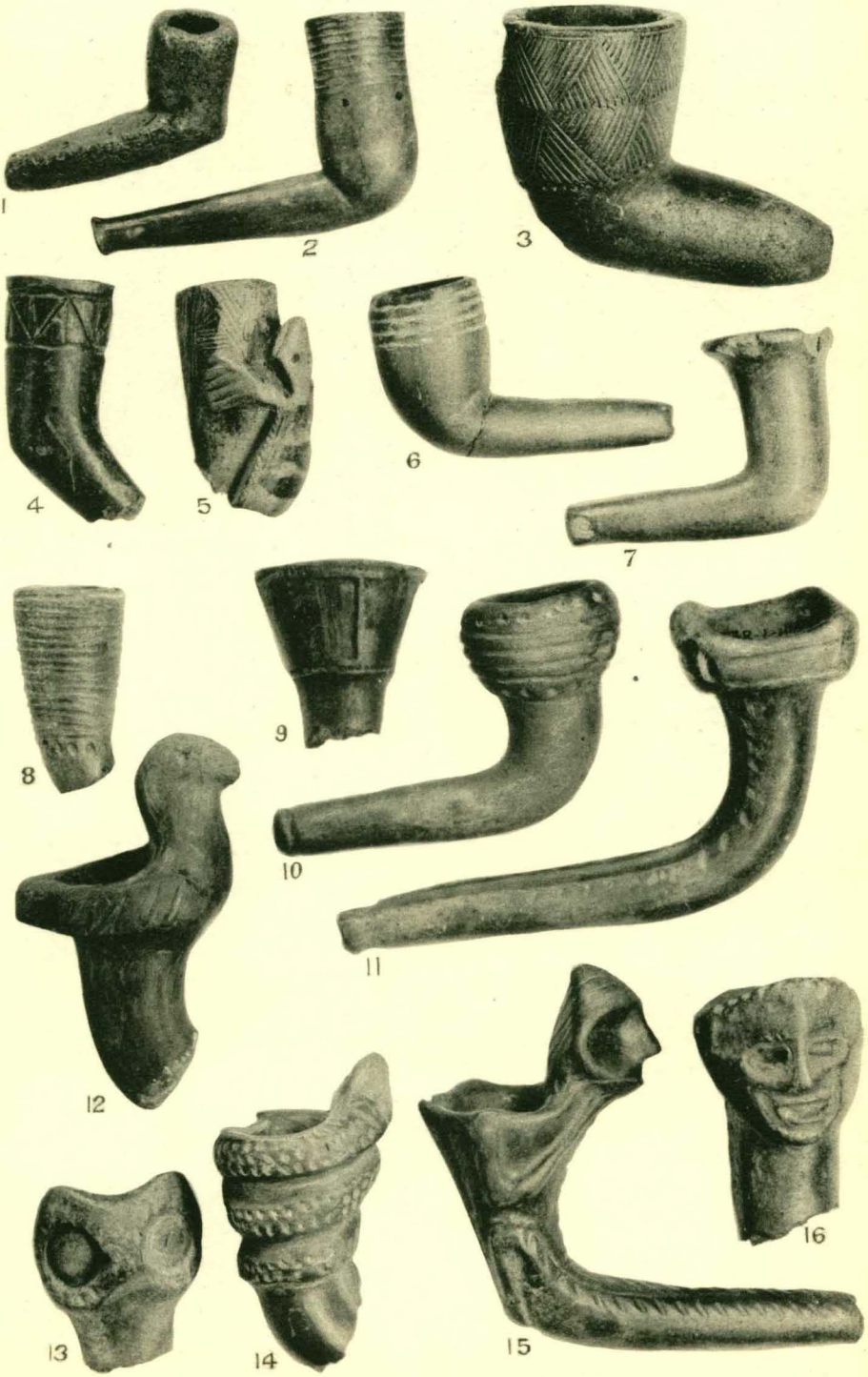
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PLATE XIV

Pottery fragments from Iroquoian sites

(½ natural size)

FIGURES 1 and 2. Rim fragments. From Neutral site of archaic period, lot 7, con. A, South Walsingham tp., Norfolk co., Ont. Cat. No. VIII-F-19014*a*, *b*.

FIGURE 3. Rim fragment. From late pre-European Mohawk-Onondaga site, lot 25, con. VI, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9102*s*.

FIGURE 4. Rim fragment with cord-impressed decoration. From post-European Tionontati site near Craigleith, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-15432.

FIGURE 5. Rim fragment with reticulate pattern. From Huron site, Simcoe co., Ont. Cat. No. VIII-F-15267*b*.

FIGURE 6. Rim fragment with chevron design. From late pre-European Mohawk-Onondaga site, lot 27, con. VII, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9105*b*.

FIGURE 7. Rim fragment with roulette decoration. From late pre-European Mohawk-Onondaga site, lots 26-27, con. III, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9129*c*.

FIGURE 8. Decorated rim fragment. From same site as figure 7. Cat. No. VIII-F-9125*b*.

FIGURE 9. Decorated rim fragment. From same site as figure 6. Cat. No. VIII-F-9105*c*.

FIGURES 10 and 11. Decorated rim fragments. From same site as figure 7. Cat. No. VIII-F-9126*c* and *g*.

FIGURE 12. Pot fragment with decoration on rim and neck. From Neutral site, Yarmouth tp., Elgin co., Ont. Cat. No. VIII-F-3721.

FIGURE 13. Fragment of pot with all-over decoration. From same locality as figure 4. Cat. No. VIII-F-14436.

FIGURE 14. Pot fragment with handle. From Huron site in Simcoe co., Ont. Cat. No. VIII-F-15271*b*.

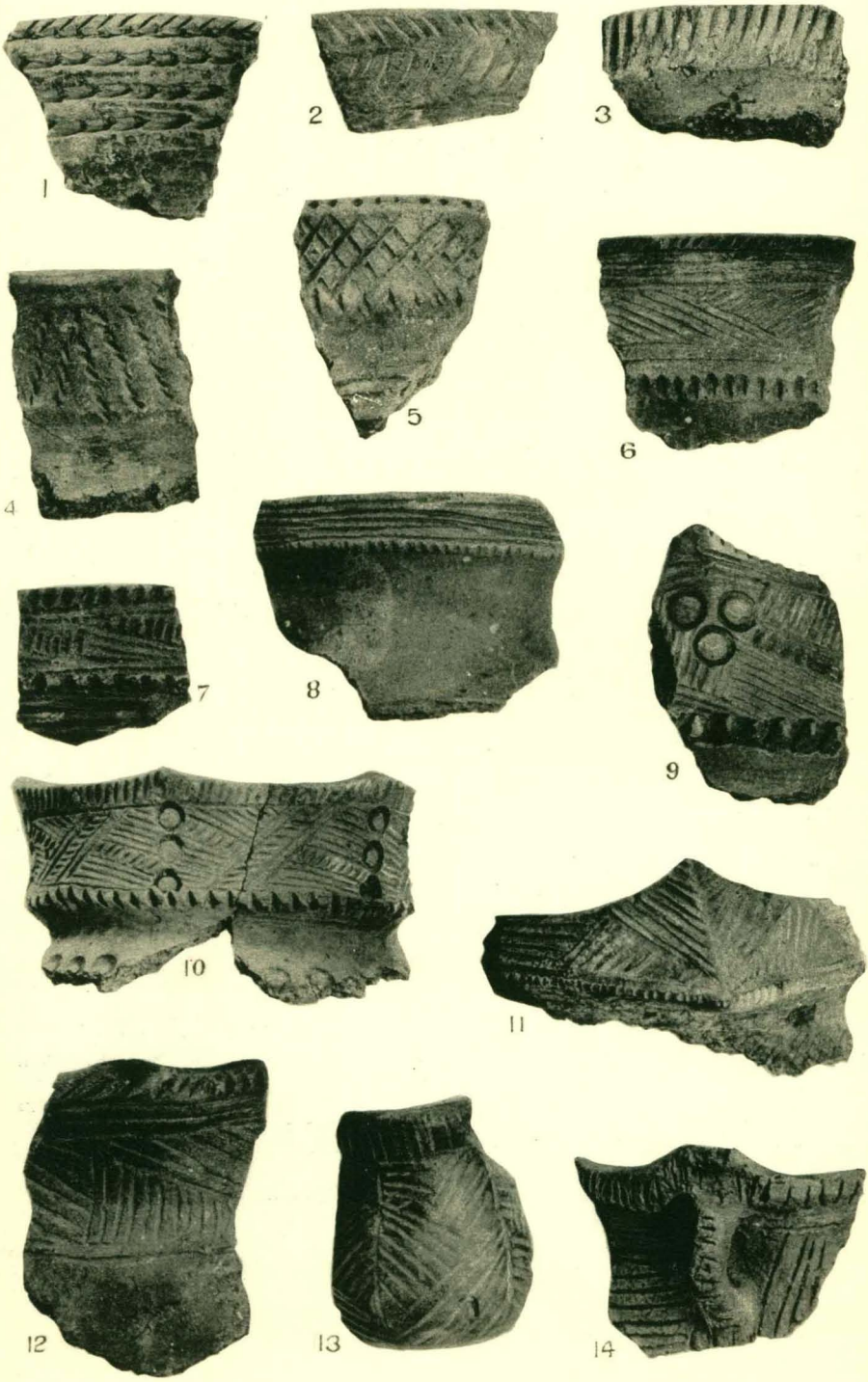
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Plate XV

Bone artifacts from Iroquoian sites

(½ natural size)

Figure 1. Bone point, probably for arrow. From a Neutral site, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-6854.

Figure 2. Hollow bone arrow point, made from radius of dog. From a transitional period Neutral site on lot 25, con. VII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-6299.

Figure 3. Bilaterally barbed harpoon point. From Elgin co., Ont. Cat. No. VIII-F-7973.

Figure 4. Awl made from fibula of bear or wolf. From a post-European Tionontati site near Craigleith, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-14321.

Figure 5. Awl made from ulna of dog. From same site as figure 2. Cat. No. VIII-F-6939.

Figure 6. Awl made from part of deer metatarsus. From same locality as figure 2. Cat. No. VIII-F-6808.

Figure 7. Smoothly finished awl. From Neutral site in Malahide tp., Elgin co., Ont. Cat. No. VIII-F-1510.

Figure 8. Smoothly finished, carved awl. From Neutral site in Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3103.

Figure 9. Netting needle. From post-European Iroquois site near lake Medad, Nelson tp., Halton co., Ont. Cat. No. VIII-F-14320.

Figure 10. Knife-like tool. From same site as figure 2. Cat. No. VIII-F-7827.

Figure 11. Tube, probably derived from femur of young bear. From the same site as figures 2, 10. Cat. No. VIII-F-7837.

Figure 12. Tube made from section of deer radius. From post-European Iroquois grave near Brantford, Brant co., Ont. Cat. No. VIII-F-399.

Figure 13. Probable unit for cup and pin game, made from proximal phalanx of deer. From same site as figure 2. Cat. No. VIII-F-203.

Figure 14. Flattened proximal phalanx of deer. From late pre-European Huron site on lots 4 and 5, con. V, Bexley tp., Victoria co., Ont. Cat. No. VIII-F-8656.

Figure 15. Notched deer incisor. From same site as figure 14. Cat. No. VIII-F-8232.

Figure 16. Perforated bear canine. From Neutral site in Bayham tp., Elgin co., Ont. Cat. No. VIII-F-8000.

Figure 17. Perforated fish vertebra used as bead. From same site as figure 14. Cat. No. VIII-F-8704.

Figure 18. Cylindrical bead. From same site as figure 14. Cat. No. VIII-F-8703*c*.

Figure 19. Cylindrical bead. From transitional period Neutral site on lots 1 and 2, con. VIII, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-6731.

Figure 20. Perforated "jewell" bone from head of Sheepshead. From Neutral site in Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3195.

Figure 21. Gorget made from piece of human skull. From Neutral site in Malahide tp., Elgin co., Ont. Cat. No. VIII-F-7843.

Figure 22. Turtle-shell rattle. From same locality as figure 9. Cat. No. VIII-F-14257.

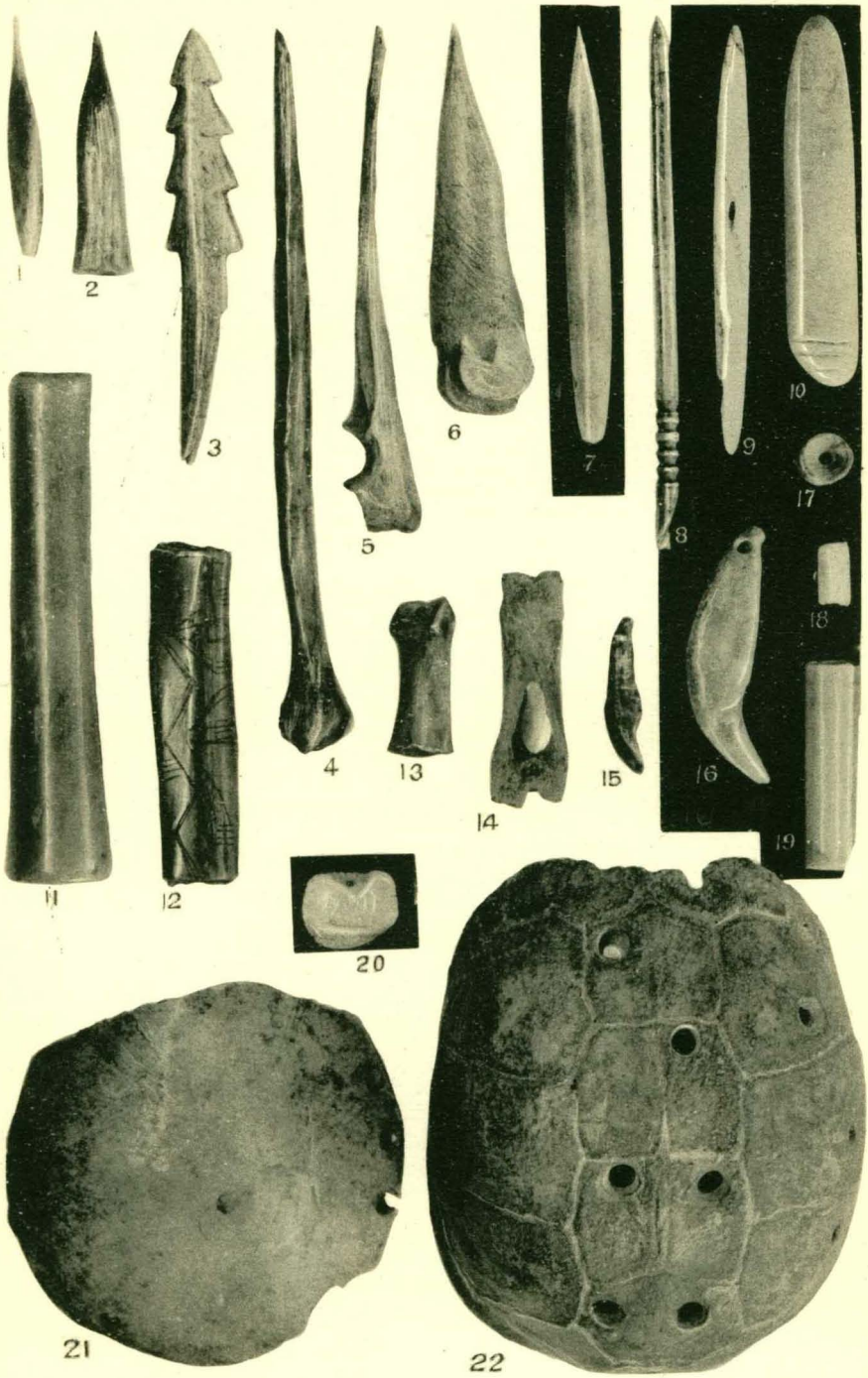
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Plate XVI

Antler artifacts from Iroquoian sites

(½ natural size)

Figure 1. Unilaterally barbed harpoon point. From a Huron site in Medonte tp., Simcoe co., Ont. Cat. No. VIII-F-14280.

Figure 2. Hollowed, cone-shaped arrow point. From transitional period Neutral site on lot 25, con. VII, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-7813.

Figure 3. Hollowed, cone-shaped arrow point with barbs. From a Neutral site near Jaffa, Malahide tp., Elgin co., Ont. Cat. No. VIII-F-3206.

Figure 4. Chisel or wedge. From Neutral site in Bayham tp., Elgin co., Ont. Cat. No. VIII-F-768.

Figure 5. Adze or scraper. From post-European Iroquois site, York tp., York co., Ont. Cat. No. VIII-F-14312.

Figure 6. Chipping tool. From post-European Iroquois site near lake Medad, Nelson tp., Halton co., Ont. Cat. No. VIII-F-14526.

Figure 7. Chipping tool. From same site as figure 2. Cat. No. VIII-F-7825.

Figure 8. Comb. From archaic Neutral site (Uren), Oxford co., Ont. Cat. No. VIII-F-16598.

Figure 9. Comb. From post-European Huron site in Tay tp., Simcoe co., Ont. Cat. No. VIII-F-14266.

Figure 10. Armlet. From transitional period Neutral site on lots 1 and 2, con. VIII, Bayham tp., Elgin co., Ont. Cat. No. VIII-F-8006.

Figure 11. Fragment of armlet with meander design. From late pre-European Mohawk-Onondaga site on lot 17, con. VI, Edwardsburgh tp., Grenville co., Ont. Cat. No. VIII-F-9110.

Figure 12. Arrow straightener (?). From post-European Tionontati site near Craigleith, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-14523.

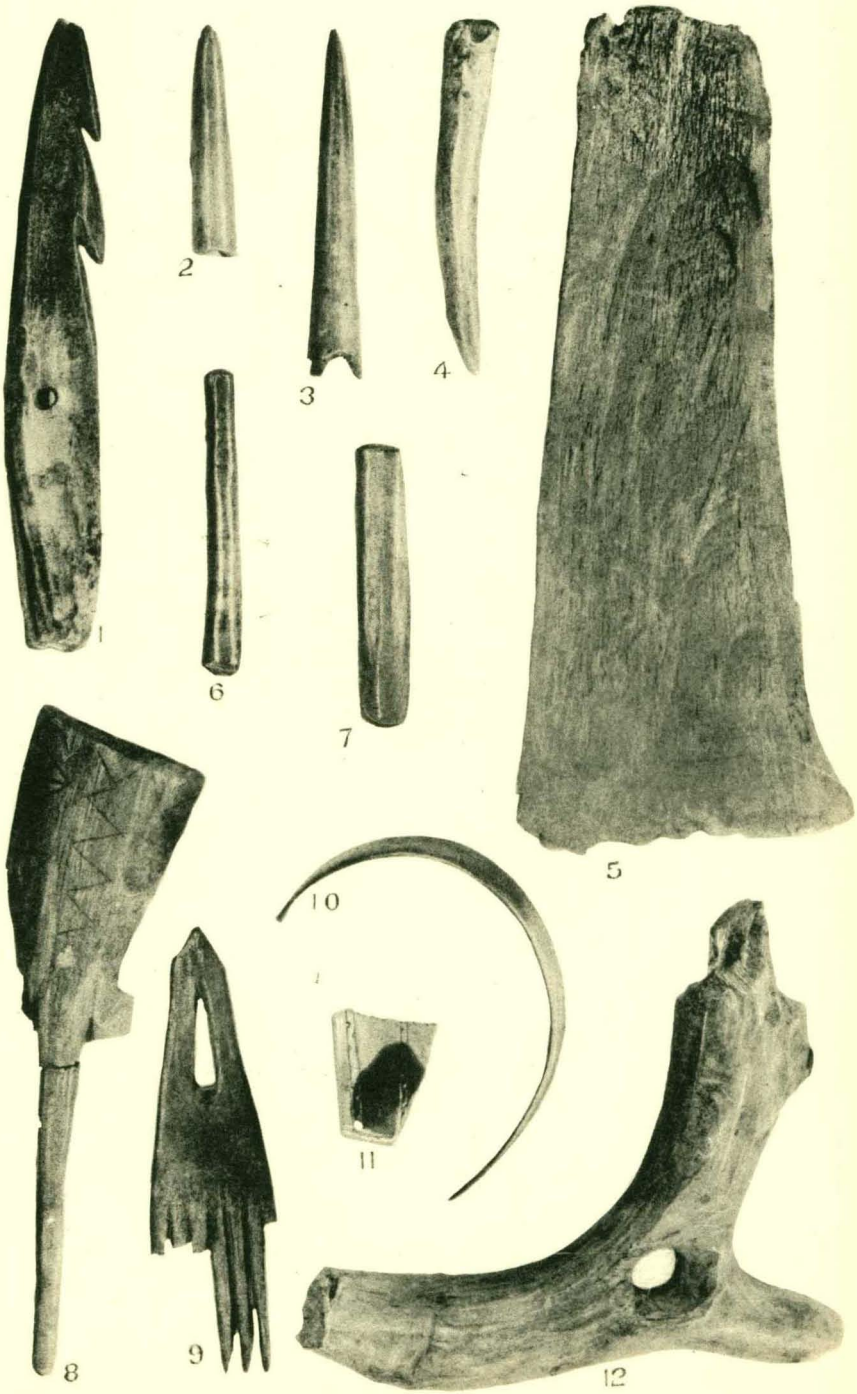
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PLATE XVII

Shell artifacts from Iroquoian sites

(½ natural size)

FIGURE 1. Bead made from shell of *Goniobasis livescens*, a freshwater snail. From a late pre-European Tionontati site on lot 8, con. V, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-17555.

FIGURE 2. Bead made from shell of *Campeloma decisum*, a freshwater snail. From a late pre-European Huron site on lots 4 and 5, con. V, Bexley tp., Victoria co., Ont. Cat. No. VIII-F-8657.

FIGURE 3. Bead made of shell of *Marginella apicina*, a marine snail. From post-European Tionontati site on lot 12, con. I, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-17727.

FIGURE 4. Bead made of marine shell *(Marginella* sp.). From a grave on lot 15, con. VIII, Sidney tp., Hastings co., Ont. Cat. No. VIII-F-13691*a*.

FIGURE 5. Cylindrical bead made from columella of small marine shell. From same site as figure 1. Cat. No. VIII-F-17557.

FIGURE 6. Cylindrical bead made from columella of large marine shell. From a post-European Iroquois grave, Trafalgar tp., Halton co., Ont. Cat. No. VIII-F-14232.

FIGURE 7. Small discoidal shell bead. From post-European Tionontati site on lot 11, con. VIII, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-17701.

FIGURE 8. Large discoidal shell bead. From post-European Iroquois site, near lake Medad, Nelson tp., Halton co., Ont. Cat. No. VIII-F-14140*c*.

FIGURE 9. Small "runtee" type of shell bead. From same site as figure 7. Cat. No. VIII-F-17702*a*.

FIGURE 10. Large "runtee" type of shell bead. From post-European Tionontati ossuary near Craigleith, Collingwood tp., Grey co., Ont. Cat. No. VIII-F-14551*a*.

FIGURE 11. Large spherical shell bead. From a grave in Barton tp., Wentworth co., Ont. Cat. No. VIII-F-14162*a*.

FIGURE 12. Pendant made of part of marine shell. From post-European Iroquois site, Barton tp., Wentworth co., Ont. Cat. No. VIII-F-14130.

FIGURE 13. Small crescent made of piece of marine shell. From post-European Tionontati site on lot 24, con. VII, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-17662.

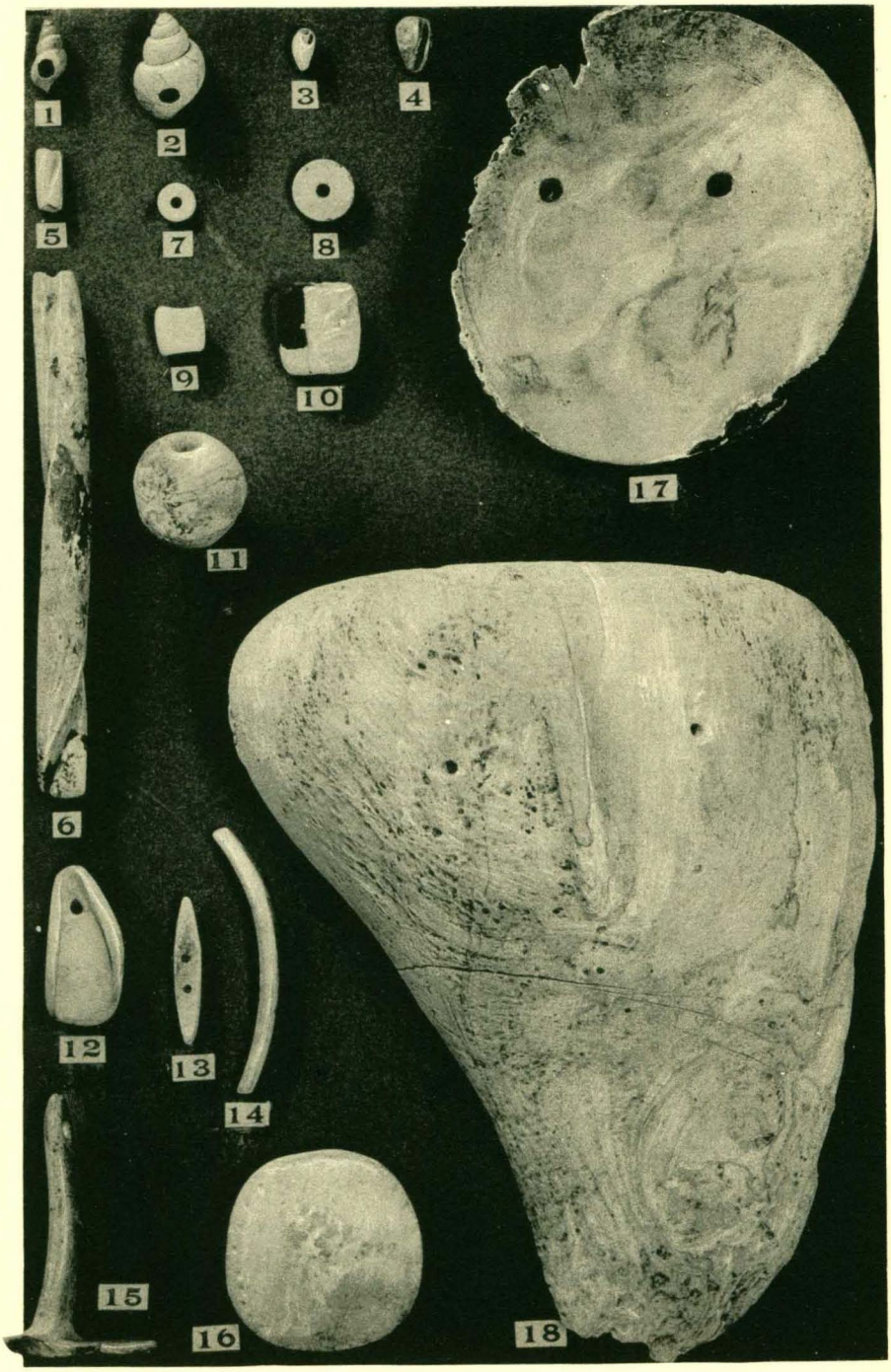
FIGURE 14. Large crescent made of marine shell. From a post-European Iroquois site near Lambton, Etobicoke tp., York co., Ont. Cat. No. VIII-F-14131.

FIGURE 15. Cast of shell "pin", original from post-European Tionontati site on lot 10, con. V, Nottawasaga tp., Simcoe co., Ont. Cat. No. VIII-F-19033.

FIGURE 16. Pendant made from part of shell of *Venus mercenaria*. From post-European Iroquois site in Barton tp., Wentworth co., Ont. Cat. No. VIII-F-14132.

FIGURE 17. Oval gorget made from part of large marine shell, probably *Fulgur perversa*. From a post-European Tionontati site near Craigleith, Collingwood tp., Ont. Cat. No. VIII-F-14134.

FIGURE 18. Large pyriform gorget or mask made from lip of *Fulgur perversa*. From a post-European site in Barton tp., Wentworth co., Ont. Cat. No. VIII-F-14128.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TECHNICAL METHODS IN THE PRESERVATION OF ANTHROPOLOGICAL MUSEUM SPECIMENS

By Douglas Leechman

CONTENTS

INTRODUCTION

Literature dealing with the preservation of museum specimens in general and anthropological collections in particular is scanty and widely scattered. There are only three books on the subject in English that are of any value and one of these is an out-of-date translation from the German. Moreover, two of these three books concern themselves principally with archæological specimens, and especially those excavated in Egypt. There appears to be no comprehensive volume in existence dealing with the preservation of anthropological specimens of North American origin.

The author does not feel that he can do more than offer a few suggestions within the limits of a short paper. The fullest acknowledgment must be made of his indebtedness to A. Lucas, whose "Antiques, Their Restoration and Preservation," is the best book available on the subject, indispensable to the serious student and useful as well to many others.

There are doubtless many workers who have evolved formulæ of their own that they have found satisfactory. If so, it is hoped that they will publish them so that they may be added to the stock of general information, and their value taken advantage of, or their dangers and defects pointed out. Lack of preservative treatment and the use of imperfect methods have robbed anthropological students of a vast quantity of material which would have been invaluable. Now that technical methods have reached their present perfection there is little excuse for the loss or deterioration of any specimen once it has reached the preparator's hands.

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Several things are necessary for the proper preservation of museum specimens: first, definite identification of the material of which the specimen in question is composed; secondly, a full understanding of what degenerative changes have taken place, and may be expected to take place in the future if the specimen is left untreated; and thirdly, a clear conception of the exact result intended to be brought about by treatment. To these must be added a knowledge of the chemistry of the materials involved and of the effect of the various chemical and physical processes employed.

The end in view should be so to treat the specimen that its appearance is not changed in any way (except, in some cases, very much for the better), and that it may reasonably be expected, if given proper after-care, to remain unchanged indefinitely; or, at least, over a period of some hundreds of years.

There are four definite steps in treatment: cleaning, repairing, restoring, and preserving. It is, of course, obvious that two of these, repairing and restoring, are not always necessary.

By cleaning is here understood the removal of dirt of all kinds and the putting of the specimen in the condition in which its original owner or maker would have kept it, were it still in his possession. This ideal is not always attainable, especially in the case of archæological specimens which have suffered as a result of burial in the soil.

Repairing implies the securing in their correct positions of any loose pieces of the specimen, usually by the use of some form of adhesive.

Restoration implies the making of new parts to replace missing ones.

Preservation is the process of so strengthening a specimen and so reducing the action of the various agencies that tend to its destruction, that it will remain unchanged over an indefinite period of time.

These various processes will be considered in order.

COLLECTING IN THE FIELD

Although it is not intended to go into details of field collecting, either in archæology or ethnology, there are a number of points often overlooked which, if observed, would greatly reduce the work in the laboratory and would prevent needless deterioration of the specimens.

In collecting osteological material, skulls should not be moved until the ear passages have been plugged with cotton wool or other suitable material. This will prevent the loss of the auditory ossicles in shipping. A further point worth mentioning is that the hyoid bone (the small bone in the tongue) is very seldom collected. It may, of course, have disintegrated; nevertheless, if search were made for it as soon as the skull is lifted out, it would frequently be recovered. Hair, too, is sometimes left behind when it could easily be collected. Work in the laboratory would be lessened if care were taken to put the bones from each hand and foot in separate bags, whether of cloth or of paper, and label them. Loose teeth should be held in place with a little pellet of plasticine in the socket or deliberately removed and put in a separate small bag or envelope.

All specimens, of whatever kind, should be numbered, preferably in pencil. If the number can be placed on the specimen itself, well and good; if not, the number should be written in pencil on a tag secured to the specimen. Pencil has the advantage that it will not run when wet, as do ink and indelible pencil. Blurred numbers are frequently almost illegible when the specimens are received.

Avoid the use of gummed labels. They frequently come off as soon as they are dry, and whether they adhere or not, they leave a mark on the specimen which it is almost impossible to remove.

In excavating Eskimo archæological material it is generally impossible to strip off more than a shallow layer of an inch or so of soil at a time, the remainder being frozen. It often happens that a specimen will be held fast by one end in the frozen earth, while the other end stands free. If left in this position over night the specimen may be found split and ruined in the morning. To overcome this, cover the exposed part of the specimen with a shovelful of earth, thus protecting it from the light and from too great a change in temperature and humidity.

Preservation in the Field

Many specimens, especially in archæological work, are found in such a friable condition that they cannot even be lifted, much less shipped. A thin solution of shellac in alcohol may be poured slowly on the specimen and the immediately surrounding soil. When the alcohol has evaporated, the treatment should be repeated as many times as may be necessary, until the specimen is sufficiently hardened to permit its removal and packing. The same results may be obtained by the use of a thin solution of celluloid in acetone, which may be carried already made up in a thick stock solution. This stock solution is thinned in the field to the required degree by the addition of acetone.

Specimens found in water or very damp situations should be shipped in the same condition in a water-tight container packed with enough moss or similar substance to prevent any movement. An attempt to dry the specimen will only result in cracking and warping it, often to such an extent that its original shape is no longer apparent.

Specimens infected, or suspected of being infected, with clothes moths, or other insect pests, should be sprayed or drenched with gasoline and then dried in the open air. Shipping infected material to a museum is so dangerous a proceeding that it would almost be better to do without the specimen. The preparator who is to handle the material when it is received should always be informed that it was infected and a warning should appear on the packing case.

Specimens from different areas should never be included in a single package. They may be shipped together in one packing case, if necessary, but should be done up in different bundles, each specimen numbered and a list accompanying each bundle. A duplicate of the complete list should be forwarded by mail at the time of shipping the specimens. Better handling results from the use of several small packing boxes rather than one or two large ones, and crumpled newspaper will be found to make the

best type of packing material. Even the most delicate pieces of pottery and wood carving will travel in safety if packed fairly tightly in an abundance of this material. Delicate specimens should not be packed so close to each other that they may rub together, and it is inadvisable to pack heavy and light material in the same box.

Necessary Data

Much confused and inaccurate cataloguing has been the result of collecting specimens with incomplete information about them. The fact that a specimen was bought from a Blackfoot Indian is no guarantee that he did not first obtain it from a Sioux and that it was not made by a Cree. The collector's list is made primarily to enable the specimen to be catalogued properly and is in no sense a substitute for the collector's field notebook which should contain all other needful information. The list forwarded with the specimens should give the date and place of collection; the original source of the specimen, that is to say, where the Indian or other owner obtained it and by what tribe it was made; a note on the materials employed in its manufacture, if these are not obvious; and the "description" of the specimen, usually its common name or a statement of its use. Such details as the original owner's names and the amount paid for the specimen may be important enough for the field notebook, but are seldom required for cataloguing.

CLEANING

When a shipment of specimens has been received in the laboratory, unpacked, and checked against the collector's list, and the packing material carefully examined to make sure that everything has been found, including small pieces broken off in transit and extras that the collector forgot to add to the list—when all this has been done, the next step is to clean the specimens. This must be done before they can be repaired, preserved, catalogued, or stored.

Dry cleaning, in the strict sense, is on the whole to be preferred to the use of water, alcohol, or gasoline, though the use of these liquids is essential at times. If the specimen is dry, superficial dirt and dust can be removed with a brush and a pair of bellows. The use of a cloth is not to be recommended, as delicate work is easily ruined in this way.

When liquids are to be used at all, it is better to immerse the specimen completely provided its nature permits. If not, small swabs of cotton wool on a short, slender stick, or a soft camel's-hair brush, should be used with as little of the liquid as will give satisfactory results. The swabs should be discarded as soon as discoloured and the brush thoroughly rinsed after each application.

Before using any liquid cleanser, unless one is quite familiar with the type of specimen in hand, its effect should be carefully observed by trying it on an inconspicuous corner or on a less valuable specimen of the same kind.

Grease and similar organic dirt are frequently very difficult to remove. If neither alcohol nor gasoline should prove a success, acetone, chloroform, ether, or benzol may be tried. Here again it will be necessary to make sure that the specimen itself will not be injured in the attempt to clean it.

The amount of cleaning desirable has often been discussed, and the statement has been made that specimens don't "look old" when they have been cleaned. It is felt that specimens should appear as nearly as possible as they would if they had just left the owner's hands; that is to say, they should be in the condition in which the Indian himself would have kept them, were he making use of them. There are times, of course, when this is not a practicable goal to aim at, and one should at all times be guided by the actual situation confronting one and not by any theoretical standard.

In cleaning, as in all other processes, it is well to remember that one must proceed with the utmost care in all cases. Such precautions may appear unnecessary when handling a series of some dozens, let us say, of arrow-points, but the careful habits of work induced by a rigid adherence to this rule stand one in good stead when working with rarer and more important material. A valuable motto is "treat every specimen as though it were the only one of its kind in the world," and you may be sure that in a good many cases it actually is.

PRESERVATION IN THE LABORATORY

When one brings to mind the many hundreds of materials and processes which have been proposed and employed in the preservation of antiquities, it is somewhat breath-taking, but very consoling, to discover that 90 per cent of one's troubles can be overcome by the magic formula "Celluloid in Acetone." It is literally true that there is no material of greater value to the anthropological preparator. As a safe and easy routine treatment, it has everything to recommend it, bearing always in mind that routine treatments can only be used when the nature of the specimen is already well known. This preparation was first brought definitely to the attention of the museum world by Mr. A. Lucas, who was responsible for much of the work of cleaning and preserving the specimens discovered in the tomb of King Tut-Ankh-Amen, and it has been adopted very widely since. It may be used for impregnating porous materials that are in need of strengthening; as a waterproof, air-tight varnish; or as a strong but semi-flexible cement, merely by varying the proportion of acetone in which the celluloid is dissolved.

Its preparation is simple and the ingredients inexpensive. Colourless sheet celluloid is cut into small pieces with scissors; pieces about an inch long and a quarter of an inch wide are satisfactory. A handful of these pieces is put in a quart bottle, a funnel being used as a hopper. Refractory bits can generally be forced in with a pencil, if they are not fed into the hopper too quickly. The bottle is then filled about three-quarters full with acetone and shaken vigorously and immediately. The mass of wet celluloid must be broken up as quickly and as thoroughly as possible, otherwise it will take a long time to dissolve. The bottle should be shaken fairly continuously for ten or fifteen minutes and may then be allowed to stand for half an hour. It is then tightly corked, turned upside down, supported in some way, and allowed to stand for another half hour. By now the celluloid will have formed a thick mass which coils and loops down through the acetone when the bottle is turned over. This process of reversing the bottle at intervals should be continued as long as convenient or until the celluloid is thoroughly dissolved and the solution of equal consistency throughout.

When complete solution is effected the material is ready to use. If it is to be employed as a spray or for impregnation it should be greatly thinned with acetone; if as a cement, it may be allowed to evaporate for a few minutes in a shallow dish and its viscosity will increase rapidly.

Amyl acetate may be used instead of, or in combination with, acetone, but as it is somewhat poisonous and no advantage attends its use, it is probably better to stick to the acetone. Again, cellulose acetate may be used instead of celluloid, but here, too, there is no advantage, except that the cellulose acetate is in the form of a powder and dissolves more rapidly in acetone, thus saving the time expended in cutting up the sheet celluloid. It is, however, not quite so satisfactory in actual practice.

Some trouble may be experienced in that the celluloid in acetone solution sometimes turns white after the acetone has evaporated. This is usually an indication of the presence of water, either in the acetone or on the specimen, perhaps in very small quantities. Microscopical examination of the white film formed shows it to be filled with minute bubbles. The difficulty may be overcome by using double-distilled acetone and making sure that the specimen is thoroughly dry before treating it. The white deposit, should it appear, may easily and quickly be removed by means of a little acetone on a tuft of cotton wool or a brush.

In using the celluloid in acetone solution as a spray an ordinary atomizer of the nose-and-throat type will be found useful. After use it must be cleaned with pure acetone or the solution will harden in the atomizer and freeing the passages will prove a long and tiresome process. The same rule applies to brushes, which should be rinsed very thoroughly in acetone after being used in the solution. It is well to keep a small, well-corked bottle of acetone for this purpose, and when it shows signs of thickening it can be added to the stock solution.

There are, of course, many other materials and processes which must be used in dealing with various specimens. These will be discussed in detail under the appropriate headings.

REPAIRING

Though most repairing involves little more than the use of cements and glues, the addition of braces is sometimes necessary. These may be made of any suitable material and should be so placed that they will be invisible when the specimen is exhibited. The fact that such material has been added to the specimen should always be noted in the catalogue.

In replacing old adhesives with new, the original glue or cement should always be softened with an appropriate solvent before any attempt is made to remove it. Dry adhesives are likely to take part of the specimen itself with them when they are chipped or scraped off. Surfaces to be cemented together should be perfectly dry and clean and the adhesive spread in a thin coat on both surfaces. Once the pieces have been placed in the correct positions they should be left clamped, tied, or braced together until perfectly set. Pulling them apart and replacing them while the cement is still wet will almost inevitably result in a poor job. In repairing brittle materials such as pottery, do not fit the edges together until you are ready to cement them, as the friction will be almost certain to chip off small fragments which are then lost and a perfect joint can no longer be secured.

A box or bowl filled with clean, dry sand will be found very useful to support the specimens in while the cement is drying. The broken pieces should be so placed that the force of gravity will hold them in contact.

Plaster of Paris will be found necessary for some repairs and plastic wood may be used for filling in pieces of woodwork which are deeply scarred or from which small fragments are missing.

RESTORATION

Restoration implies the making of duplicates of missing parts of specimens. This has to be done with much caution and self-restraint. The intention is not to deceive, but to indicate the appearance of the specimen when it was complete. Sometimes the best method is to make a copy of the entire specimen and to exhibit it side by side with the incomplete original. The facts of the case are then clearly explained on the label accompanying the specimen in the exhibition case. Full details should be entered in the catalogue if any restoration work is done, to prevent future students from assuming that the restored specimen is in the condition in which it was collected.

NUMBERING

Catalogue numbers should be on the specimen itself whenever this is at all possible and, preferably, in an inconspicuous position. In selecting a place for the number it is advisable to bear in mind that it may at some time be necessary to photograph the specimen from various angles, and numbers should, therefore, be kept well away from important details of construction. A great saving of time and trouble is effected by adopting a standard system of numbering similar articles. Thus all baskets might bear the number on the bottom, all spoons underneath the tip of the bowl, all masks just under the mouth at the back of the mask, and so on. In this way one knows at once where to look for a number on most specimens.

As a rule India ink shows up well, but when the object is black or nearly so, white water-colour paint is the best medium. When numbers have to be put on specimens that have a high polish or a vitreous surface there may be difficulty in making them distinct, as the ink has a tendency to concentrate in a number of droplets with dry spaces between them. This may be overcome by covering a sufficiently large area on the specimen with celluloid solution. When dry it will be found to provide a ground with an excellent "tooth" which takes the numbers well. When the India ink is, in turn, dry, another coat of celluloid is flowed lightly and quickly over it, and the number is thus locked between two celluloid layers. Entries in the catalogue should also be in India ink; if desired, a thinner grade than that used on the specimens, for many ordinary writing inks fade after a number of years, whereas every effort should be made to have the catalogues as permanent as possible.

In numbering large specimens, such as big boxes, canoes, totem poles, and so on, the number should be quite large but in an inconspicuous position. Few things are more annoying than having to search for half an hour for figures a quarter of an inch high on a 40-foot totem pole.

When the nature of the specimen quite prohibits putting the number right on it, the figures should be put on a tag which in turn is fastened to the specimen. Tags tied with string are seldom satisfactory and the use of iron wire is objectionable because it often rusts and marks the specimen. Monel metal wire will be found excellent for the purpose, being strong, flexible, and non-corrosive.

Very small specimens, such as single beads or auditory ossicles, are best put in a small phial with a numbered tag and packed with cotton wool to prevent motion.

STORAGE

Many points demand consideration when the storage of specimens not immediately needed for exhibition or study is in question. The essentials are that the specimens be at once safe and accessible. Their safety demands freedom from: continuous light, high temperature, excessive dryness or humidity, insect pests, dust, breakage, and fire. Their accessibility is secured by systematic arrangement on enclosed adjustable shelves and in a series of storage cases with interchangeable trays.

Canoes may be stored by the construction of a rack like those used in boat houses, and much space will be saved by devoting a corner of the storage room to such a rack.

Harpoons, bows, blow-guns, spears, and other long objects may be cared for very conveniently by constructing a rack like a rifle rack round the walls of the room or down one side of an aisle.

Clothing, whether of fur, buckskin, or other material, is better hung up than rolled or folded in a storage tray; furthermore hanging facilitates inspection. If possible a moth-proof room should be devoted to this type of storage.

All specimens in storage, except perhaps osteological and archæological material, should be inspected carefully at least once a month. A printed form, about 3 by 5 inches in size, may be fastened to the outside of the storage case. On this form appear three columns, one for the date, one for the months (already printed on the form), and a third column in which the condition of the material on the day of inspection can be indicated. In this way, the history of each case for the current year can be read at a glance and suspected cases, marked on the form with red pencil, kept under specially careful observation.

EXHIBITION

The very natural tendency is to put the best specimens on exhibition. Unfortunately, continuous exhibition is very detrimental to the material exhibited, and in all too many cases a specimen exhibited is a specimen doomed. The action of light appears to be highly destructive and there does not seem to be any ready means of eliminating it. The use of tinted glass in the exhibition cases has been suggested, but the expense of the glass is increased and the colours of the specimens are falsified. Covering

cases with blinds which the visitor has to remove in order to see the contents has also been tried, but is not satisfactory as the visitor either ignores such a case and turns to others more easily examined or leaves the blind pulled to one side. The best solution is the use of artificial light only, in the exhibition halls, as its actinic strength is less than that of daylight, but this is possible, as a rule, only in museums which have been built with that idea in mind. Much may be done, especially in summer, by covering all windows with heavy blinds which are lowered when the museum closes and not raised till it opens again the next morning. In this way, unnecessary light is kept out of the exhibition halls for several hours a day and the specimens spared to that extent.

Specimens on exhibition should be inspected just as regularly and as carefully as those in storage. The presence of insects can generally be detected by observing minute pellets on the deck of the case, or the cast skins of larvæ. Sometimes adult insects are seen, but as most of them are negatively phototropic and shun light, the fact that they are not to be seen does not imply that larvæ are not busily at work between the specimens and the diaphragm.

FUMIGATION

During recent years much experimental work has been done in search of a fumigant effective in the extermination of insect pests, but not harmful to the material to be fumigated or dangerous to the men using it. Nearly all the numerous chemicals suggested were found to have some defect and it was not until 1927 that a wholly satisfactory fumigant was evolved. This is a mixture of three parts by volume of ethylene dichloride with one part of carbon tetrachloride. Carbon disulphide, hydrocyanic acid gas, chloropicrin, and many others are still in use but all have their disadvantages.

Ethylene Dichloride-Carbon Tetrachloride Mixture

This mixture was discovered by Messrs. Cotton and Roark, of the United States Department of Agriculture, who have performed numerous tests with it and find it highly effective. It consists of three parts by volume of ethylene dichloride and one part by volume of carbon tetrachloride. As the boiling points of these liquids are within a few degrees of each other, once they are mixed they form a homogenous fluid and may be treated as a simple chemical. The liquid in evaporating gives off a gas which is about three times as heavy as air and which is highly toxic to insect life.

Ethylene dichloride alone will burn, though with difficulty. It is for this reason that the carbon tetrachloride is added to it, making it absolutely non-inflammable. It may, in fact, be used as a fire extinguisher. The vapour, if inhaled, has an effect very like that of chloroform, but not so rapid. If breathed in high concentrations for a long time it would be dangerous, but under ordinary conditions it is perfectly harmless. It has no injurious effect on animal, vegetable, or mineral specimens. As the gas is heavier than air, the liquid should be placed in shallow pans supported above the specimens.

The quantity required to kill insect pests varies with the temperature of the room or fumigator in which it is used. For ordinary conditions, 5 quarts (14 pounds) per 1,000 cubic feet of space is recommended, if the temperature is 65 degrees F. or higher. The specimens should be exposed to the gas for at least 24 hours. Two or three weeks later the fumigation should be repeated, so that any eggs that may have escaped the first treatment may be given an opportunity to hatch out in time for the second.

Advantages. Highly toxic to insects, non-explosive, non-inflammable, non-toxic to man unless highly concentrated and breathed for protracted periods of time, non-injurious to specimens, inexpensive, easily applied.

Disadvantages. Apparently none.

Carbon Disulphide

This gas has long been used in museum work and has given excellent results. It is highly toxic to insects and when used in concentrations of about 8 pounds to each 1,000 cubic feet of space at a temperature of 65 degrees F. for 24 hours or more is 100 per cent lethal. The gas given off is heavier than air and the pans containing the liquid should, therefore, be placed near the top of the case, room, or fumigator. Its great disadvantage is its dangerously explosive and inflammable nature, and it is probable that the new mixture of ethylene dichloride and carbon tetrachloride will displace it entirely.

Advantages. Highly toxic to insects, non-injurious to specimens, inexpensive, easily applied.

Disadvantages. Poisonous, highly inflammable, explosive.

Carbon Tetrachloride

This material can be used alone as a fumigant and will give satisfactory results if used in concentrations of about 20 pounds to each 1,000 cubic feet of space. In this case, too, the gas is heavier than air and the receptacles should be placed above the specimens.

Advantages. Toxic to insects, non-injurious to specimens, non-explosive, non-inflammable, non-poisonous, inexpensive, easily applied.

Disadvatages. Less toxic than the mixture of ethylene dichloride and carbon tetrachloride, requiring about four times as much liquid to produce satisfactory results.

Hydrocyanic Acid Gas

This material has the great advantage that it is very highly toxic and will certainly exterminate any insects that are exposed to it. It may be applied in any one of three ways: the pot method in which the gas is generated on the spot by the action of sulphuric acid and water on sodium cyanide; the calcium cyanide method, in which the chemical is sprinkled on sheets of paper laid on the floor and allowed to evaporate; and the liquified hydrocyanic acid method in which the poison is shipped in high pressure tanks and liberated in the fumigator in pre-determined quantities.

The cyanide used in all three methods is so dangerous to human and animal life that it cannot be recommended for general museum practice in view of the availability of other less dangerous and equally effective chemicals. It should be borne in mind that this gas is lighter than air and necessitates suitable arrangements for ventilating the room or fumigator in which it has been used.

Advantages. Absolute toxicity, non-injurious to specimens unless they are splashed with the sulphuric acid, non-explosive, non-inflammable, fairly inexpensive.

Disadvantages. Extremely poisonous to human beings and all other forms of animal life; somewhat difficult of application, requiring the services of a competent, experienced operator. Its use should never be attempted by an amateur.

Fumigator

A satisfactory type of fumigator which can be used with the mixture of ethylene dichloride and carbon tetrachloride, with carbon disulphide or with carbon tetrachloride, is a large box measuring about 6 feet by 3 by 3, which is lined with sheet metal. The joints, laps, and corners must be carefully soldered so that the gas can not leak out of the box. The lid is also sheeted in metal and is supported on the edges of the box, which are grooved all round to take half-inch rubber tubing. The top is held to the sides of the box with window catches, so arranged that the lid, which may be lifted right off to put specimens in the fumigator, is forced tightly against the rubber tubing, thus making a gas-proof joint. The tubing should be renewed at intervals, as it will harden after the lapse of a year or two. Two short metal pipes, fitted with screw caps, pass through the lid of the box, one near each end, so that the liquid may be poured in after the specimens have been inserted and the lid clamped down. These tubes lead into two shallow pans (such as photographic developing trays) which receive the fumigant, and their capacity should be determined in advance so that the correct quantity of liquid to use will be known.

The fumigator should be thoroughly cleaned after use, and it is well to make a practice of leaving specimens exposed to the gas for at least two days, and then fumigating them again after the lapse of two or three weeks.

HEAT AND COLD

Clothes moths and other insect pests can maintain existence only between certain limits of temperature, and may be exterminated by carrying the materials in which they are found beyond these limits. In many parts of Canada advantage may be taken of below zero weather to destroy insects by exposing infected specimens to a temperature below zero Fahrenheit for a period of at least 24 hours. Temperatures above zero are much less effective; thus, some clothes moth larvæ were found to be still living after three weeks' exposure to a temperature of ten degrees above zero. This same method may at times be employed to rid storage rooms and even houses of pests, after emptying all water pipes and removing anything that might be damaged by freezing.

To destroy insects by means of heat, the room or heating box should be kept at a temperature of 130 degrees F. for at least 6, and preferably 12, hours. A temperature of more than 140 degrees F. is likely to damage specimens, and indeed many of them cannot safely be heated to even 130 degrees F. If this method is to be used in a museum, the construction of a special room or large box with heating coils and automatic thermostatic control is advisable.

Advantages. Effective if properly applied; no expense in the use of low temperature; large rooms and even buildings can be treated.

Disadvantages. In the case of cold, not always available; in the case of heat, only some specimens can be treated and specially constructed apparatus is required.

DRY ICE

Dry ice is a trade name for solidified carbon dioxide gas. It is a homogeneous, white, marble-like substance with a temperature of about 110 degrees below zero Fahrenheit. It may prove very useful in an emergency, when fumigation is for some reason inadvisable or impossible. The dry ice is placed in the storage room, all cracks around doors and windows having been sealed. The quantity can only be determined by experiment, depending as it does on outside temperature, the size of the room, and the thermal conductivity of the walls, floor, and ceiling. The dry ice vaporizes slowly giving off carbon dioxide, a harmless gas not to be confused with the deadly carbon monoxide, heavier than air, and the temperature of the room is rapidly reduced. It should be brought down to zero and held there for at least 24 hours. Dry ice must never be handled with bare hands, as frost-bite would be the immediate result.

Advantages. Useful in emergencies, when fumigation is impossible; effective if the temperature is brought down to zero and held there.

Disadvantages. May prove somewhat expensive, and is not always readily obtained except in large cities.

NAPHTHALENE

This material, though extremely useful, even essential, is not to be considered as a fumigant but merely as a repellant. Though it is true that it is lethal to insects when high concentrations are used, the fumes are given off very slowly and it is desirable that a fumigant should act rapidly so that damage may be arrested at once. Naphthalene may be obtained both in flakes and in balls. The balls present but little surface to the atmosphere and are not so effective as the flakes which vaporize much more rapidly, presenting as they do a much larger surface. It should always be used liberally in storage cases, and sprinkled in the trays. If, on opening a storage case, the air is sufficiently permeated with naphthalene vapour to make the eyes and nose smart, or if crystals of naphthalene have formed on the inside of the case, it may be taken for granted that it is being used in sufficient quantities and that there will be no danger from pests.

Paradichlorobenzene is very similar to naphthalene in its effects, and is equally satisfactory. As it is, however, more expensive, there seems to be no good reason for preferring it to naphthalene.

INSECT PESTS

Beetles

Beetles are best controlled by fumigation, whether they be carpet beetles or of the wood-boring type. In the case of the latter, "worm-holes" in the wood, accompanied by grains of freshly extruded dust, may be taken as indicative of their presence. Carpet beetles are generally first suspected by the finding of a shed larval skin or a living larva, and in other cases the adult beetles themselves are found. Beetles of the wood-boring type may also be destroyed by filling the pores of the infected specimen with the celluloid in acetone solution.

Cockroaches

Cockroaches are very easily controlled. Sodium fluoride, a white powder, is sprinkled along the baseboards and radiator pipes where the cockroaches are usually found. The powder adheres to their legs and feet and they are poisoned in their attempts to clean themselves. Sodium fluoride retains its strength indefinitely and so may be left in position as long as desired. It should be kept away from children and domestic pets.

Clothes Moths

Clothes moths are probably the most dangerous insect pest to be considered in museum work. They will attack practically any specimen of animal origin, though some materials are preferred to others. It is to be borne in mind that the damage is done by the grub or larva and not by the adult insect, though these should always be killed on sight. Clothes moths on the wing are notoriously difficult to catch, and when handling specimens which are known to be infected it is a good thing to have a wire-mesh fly-swatter handy, as they seldom escape from one so armed.

Normally the eggs hatch out 7 to 10 days after being laid, but the life of the larva which does the damage varies greatly in length in different individuals, its duration depending on food supply, humidity, and temperature. The insects in both larval and adult forms are negatively phototropic and instinctively make for the darkest corner available when light is turned on them.

Specimens that have been well cleaned before being stored and that are kept in moth-proof storage cases with a liberal supply of naphthalene flakes will seldom be attacked. Specimens which on receipt show signs of having been infected at some time in the past, even though it may have been months or years before, should be very carefully cleaned and then fumigated before being stored. If specimens are seen to be actually infected by living clothes moths they should first be fumigated, then thoroughly cleaned, especially in seams, corners, and inside, then refumigated and stored.

Careful and frequent inspection is the price of immunity from this most dangerous and persistent pest. If there is any doubt as to the safety of a case, whether on exhibition or in storage, it is well to spray in a little formalin with an atomizer; if any insects are there, they will soon show themselves.

Silverfish

Silverfish are sometimes known as fish-moths and feed largely on starch and glue, finding their food in the bindings of books, on heavily coated paper, on gummed labels, and even on wallpapers. They are slender, silvery grey, wingless insects which run rapidly to a dark corner when exposed to light. They may most readily be controlled by cleaning the part of the building which they infest and following this up with a sprinkling of sodium fluoride, in the way recommended for destroying cockroaches.

FUNGI AND LICHENS

Fungi and lichens attack many of the larger museum specimens, especially before collection. They may be found on skulls and other bones, on archæological "surface" specimens, on totem poles, house-posts, and so on. It is often felt that their presence is unimportant and a guarantee in some way of the antiquity of the specimen. They should be removed at once, as there is every probability that they will spore as soon as they get damp, and that other material will be contaminated. If difficult to remove, they may be softened with a dilute solution of ammonia in water. A one per cent solution of carbolic acid in water may also be used as a softening agent.

MATERIALS OF ANIMAL ORIGIN

Antler

Antler resembles bone in its general characteristics and may be treated in the same way. Most ethnological specimens made of this material will be found in good condition and, as it is but little subject to deterioration, they will seldom need treatment. The condition of archæological specimens depends on the chemical nature of the soil in which they were buried, some being in excellent condition and others almost entirely eaten away by the solvent actions of what are loosely termed humous acids. Such specimens should be immersed in a thin solution of celluloid in acetone and allowed to remain in the bath until no more air bubbles rise from the specimen even when it is turned over. They should then be taken out, dried, and the treatment repeated. Specimens which are suspected of containing salt, due to burial on the seacoast or in other saline soils, should be soaked in repeated changes of water until tests show that all salt has been removed. Antler is slightly susceptible to the attacks of insects, especially when fresh.

Babiche

Babiche, or shaganappi (hide cut into thongs), becomes dry and brittle with age. It is best treated with vaseline, which in the case of snowshoes may best be applied by rubbing it on with a cloth, working from both sides and removing any surplus with a clean dry rag. Only a little vaseline should be used, and two or three applications at intervals of a week or so will be found better than a single heavy treatment.

The netted hunting bags of Mackenzie district are best treated with warm vaseline applied with a brush, though incidental trimmings of buckskin, wool, and other materials have to be avoided. No organic oil should be used on babiche, as the acid formed when the oil becomes rancid will attack the babiche and "burn" it.

Babiche is frequently attacked by insects and should be inspected carefully.

Baleen

Baleen, or whalebone, is essentially a keratin and of the same nature as horn. With the lapse of time, it becomes brittle, owing to the loss of moisture, and the edges of specimens are apt to fray. The pliability of baleen is considerably increased by immersing it in boiling water and it may then be restored to its original form if it has, at any time, become warped. It will also retain a shape given it while hot, if allowed to cool in the required position. The preservative treatment necessary is generally one which will prevent its becoming brittle. Experiments indicate that heating the baleen in a thin solution of gelatin in water, drying it, and immersing it in formaldehyde will form a coating resistant to water that will aid in the preservation of the baleen.

Eskimo archæological specimens made of baleen, such as matting, nets, and occasionally bows and sled runners, will sometimes be found to be thickly coated and impregnated with animal fats and grease. These should be soaked in a bath of benzine until all the grease is dissolved, then transferred to a second clean benzine bath, dried, and well soaked in a thin celluloid solution. Much dirt will be loosened in the first benzine bath, and should be washed from the specimen by agitating the vessel in which the benzine is contained. There should be no loose dirt present when the specimen is transferred to the celluloid bath.

Baleen is slightly subject to the attacks of insects, especially when fresh, or impregnated with animal fats.

Bone

Bone specimens are of two principal classes: human and animal skeletal remains; and bone artifacts.

Skeletal Remains. These should be handled as soon as possible after receipt; if damp they should be dried thoroughly but slowly, as rapid drying is likely to cause warping which might invalidate future measurements. The ear passages of skulls should be plugged with cotton wool immediately to prevent the loss of the auditory ossicles (if this precaution was not taken in the field). Frequently the meati are blocked with sand or other debris, in which case it is probable that the ossicles are still in place. If this is not the case, careful search must be made all through the wrappings and packing, as the ossicles are almost sure to have fallen out during shipment. The search is most readily made by unfolding and shaking every sheet of wrapping paper over a large shallow tray and then emptying into the same tray all the debris in the packing case. The materials so obtained are then put through two sieves, one coarse enough to let the ossicles through and one fine enough to retain them. Sieves with openings of one-quarter and one-tenth of an inch, respectively, are suitable.

Ossicles thus secured, as well as any obtained by shaking the skull carefully while cleaning it, may best be kept in small glass phials, with a numbered slip corresponding to the catalogue number of the skull and with a tuft of cotton wool to prevent movement.

If the bones are in good condition and strong enough to be handled freely, they should be thoroughly cleaned with a fairly stiff brush. Broken pieces, especially of the long bones, will frequently be found to contain large quantities of sand which must be worked out by gentle shaking and tapping. Bones which are in a fragile condition should be cleaned as much as appears safe and then soaked in a thin celluloid solution, dried, and soaked again. If they are excessively fragile, it may be necessary to wrap them in cheesecloth or bind them with white cotton tape before immersing them. This binding will also be of help in removing the specimens from the bath. The wrappings should not be removed until the bones are soaking in the second bath, when they should be strong enough to permit handling. If there is any doubt as to the possibility of lifting the specimen out of the bath without injuring it, it is best to pour off the liquid and let the bone dry in place. If it adheres to the bottom of the tank, it may be freed with a few drops of acetone at the point of contact.

Teeth which are loose should be held in place with a small pellet of plasticine forced into the socket. This will hold the tooth effectively and yet permit its removal for examination at any time, which would be impossible if the old method of gluing the teeth into place were followed. Care should be taken not to remove any deposits of calculus or tartar from the teeth. If there is calculus present and it shows signs of scaling off, or if the enamel chips readily, the teeth should be painted with a thin celluloid solution.

Repairs to human bones are seldom advisable. The cement always takes up a certain amount of space, even though small, and measurements of the bones will be inaccurate to this extent. In the case of fractured skulls, the danger is even greater, as distortion is almost inevitable.

It sometimes happens that efflorescences of salt will appear on bones that have been buried in saline soils. These must be soaked in repeated baths of fresh water, preferably distilled for the more valuable specimens, until the wash water shows no sign of salt on testing. The water may be tested for salt by the following method: take a small quantity of the water in a test tube and add a drop of silver nitrate solution. If there is any salt in the water, a cloudiness will appear; or, if there is much salt, a heavy flocculent mass. If after repeated washing the silver nitrate test still causes cloudiness, it may be due to the presence of organic salts, in which case a drop or two of nitric acid should be added to the water before introducing the silver nitrate. Should no precipitate now appear the washing may be considered satisfactory. Bones from marine shell-mounds frequently need such treatment.

Bone Artifacts. These are usually in good condition when received, but are subject to cracking and splitting if allowed to become too dry or if they are exposed to strong light for a long period of time. In many cases they will stand washing with soap and water, preferably warm, followed by very thorough rinsing and drying. If they are too fragile for this treatment they may be strengthened with celluloid as described under the

previous heading *(Skeletal remains)*. Cracking and splitting are difficult to prevent, but a thorough soaking in a thin celluloid solution will be of great value. If a specimen is cracked throughout a great part of its length, it is often advisable to complete the fracture intentionally and then cement the two pieces with celluloid.

Bone artifacts are sometimes marred by heavy deposits of grease or fat. This may be removed by soaking the specimen for about 24 hours in benzine, followed by very complete drying and then washing in water. In case it is necessary to bleach the specimen a bath of dilute ammonia and hydrogen peroxide in equal parts should be used, again followed by thorough washing and a celluloid bath.

Bone, especially when fresh and carrying small particles of muscle or other tissue, is frequently attacked by insects and should be kept under careful observation.

Buckskin

Buckskin seldom requires treatment, unless it is very dry and brittle, a condition which is sometimes the result of allowing it to get wet and then drying it without taking any precaution to retain its softness. In cases where it is so brittle that there is danger in handling it, an improvement will be effected by painting it with hot vaseline in small quantities. Two or three applications at intervals of a week or so are better than attempting to make the buckskin absorb all the vaseline it will in one dose. After the first application, it is generally possible to handle the specimen freely, and the second and third coats should be rubbed in well and the skin "worked" between the hands to restore its pliability. This method will darken the leather to a certain extent and can not be used when there is any trace of native paint on the specimen.

Buckskin is attacked by moths and beetles, and clothing made of this material should be hung on racks in a moth-proof room, rather than folded or rolled and stored in drawers.

Feathers

All specimens which include feathers must be handled with special care, as they become very brittle with age. They may be strengthened with a fine spray of very dilute celluloid solution delivered from an atomizer, but in small quantities only, to prevent matting. They are very subject to attack by insects and must be watched carefully. Occasionally feathers that have been kept long under poor storage conditions become bent; they may be straightened by holding them in a jet of hot water-vapour from a kettle and shaking them gently, when they will return to their original shape. Grease and oil stains on feathers may be taken out by dipping the feather for a short time in benzine and then drying it in a current of air, such as that from an electric fan. Several applications may be necessary, but care should be taken not to rub the feathers.

Fur

Fur is one of the most perishable materials encountered and requires careful handling and constant inspection. If specimens show that they have been attacked by moths in the past they should be fumigated. After

fumigation they should be brushed and shaken and all indications of the previous presence of moths removed. It is important that they be rolled or folded as little as possible in storage. If they can be hung up in a moth-proof room or case, so much the better. Heat and lack of moisture are especially detrimental, and a room with a temperature of about 40 degrees F. or less is desirable. If the skin is allowed to become very dry it will split and tear on the least provocation and the hair will fall out. The skin side may be treated with vaseline, warmed and rubbed in thoroughly in small quantities. Care should be taken not to use oils which acidify, as they will "burn" the skin; olive oil and neat's-foot oil which are sometimes recommended for softening leather should on no account be used, for that reason. Air-tight storage cases or rooms and a liberal use of naphthalene flakes will generally keep moths away from the fur, but it must be inspected regularly and thoroughly. Rabbit-skin robes are particularly susceptible to moths and need extra care. Should a large collection of fur become infected, the whole room should be fumigated, preferably with the mixture of ethylene dichloride and carbon tetrachloride.

Hair

Hair is very little subject to deterioration and seldom requires treatment. If it should become dry and brittle, as may happen in old scalp locks or on masks, it may be treated with lanoline or vaseline which will restore the gloss and reduce brittleness, if used in small doses. It should be noted that human hair often turns a reddish brown after a number of years and the colour of the hair on a scalp or in a grave is not a certain criterion of its original colour.

In some cases beads are strung on hair, usually horsehair, which has become brittle and lost its tensile strength. New hair may be substituted in those parts which need repairing and by this means one may secure protruding ends long enough to tie in to the solid parts of the specimen.

Hair is subject to attack by insects but will not be harmed as a rule unless little other food is available.

Horn

Horn is even less subject to deterioration than is hair or bone and can usually be handled freely, requiring little treatment beyond cleaning. Soap and warm water will often suffice, but musk-ox horn ladles are often thickly coated with hardened grease and oil. Much of this may be removed with a small wooden or ivory spatula, and thorough washing with wood alcohol or benzine will take off the remainder. This will leave the surface somewhat dull, a defect which may be remedied by polishing with a stiff brush. Horn which has become warped may be straightened by steaming and bending, and repairs are best made with celluloid cement.

Spoons from the west coast made of mountain goat horn, often with elaborately carved handles, need very thorough cleaning, as the crevices in the carving and the junction between the bowl and the handle are often filled with grease. Wood alcohol or benzine and a stiff, pointed brush will remove most of the grease, but care must be taken that any abalone shell

inlays which are present be not lost. The alcohol will dissolve the resin with which the inlays are usually held in place. As soon as an inlay appears loose, it should be taken out carefully, the cavity cleaned, and the inlay replaced with celluloid cement.

Horn is slightly subject to insect pests, especially when fresh or greasy. A thorough soaking in a thin celluloid solution will strengthen the specimen and will also be of assistance in repelling insects.

Ivory

Ivory is fairly resistant to many of the ordinary influences that affect specimens, but it is subject to cracking and warping. Objects in good condition may be cleaned with a brush, but it is not advisable to use water, as ivory will sometimes split when wetted. Much dry cleaning can be done with an ordinary typewriter eraser, if the dirt or stain resists ordinary brushing. Some Eskimo objects will be crusted with dry oil and grease which can generally be removed with wood alcohol or benzine, after the greater part has been chipped off mechanically or scraped off with a spatula. Pieces which are in bad condition should be soaked in a thin celluloid solution, and a good deal of loose dirt can be removed from them while in the bath. Dice, pendants, and other objects made from the teeth of animals should always be well soaked in celluloid, as they will inevitably split if not treated.

Warping of ivory specimens is very common and somewhat difficult to prevent. Valuable pieces may justify special treatment as follows: the specimen is soaked in phosphoric acid until somewhat transparent. It is then removed, washed, and dried, when it will be soft and flexible. While in this condition it may be restored to its original form by bending and then allowed to dry completely in a current of air, when it will return to its original hardness. Experimental work with unimportant pieces should be done before attempting this treatment, particularly to determine to what degree the phosphoric acid should be diluted.

In Eskimo archæological collections pieces made from darkly patinated, "fossil" ivory are common. In many cases these will be found to have become pulverized in a shallow layer immediately under the patinated surface. Any attempt to clean such specimens results in the loss of the outer skin and the destruction of the appearance and, to some extent, the form of the specimens. They should be soaked in the celluloid solution and dried thoroughly. Ivory specimens stained with grease may be bleached with hydrogen peroxide, after which they should be thoroughly washed and dried.

Leather

Leather is handled in much the same way as fur. Exceptionally dry and brittle pieces should be soaked in a bath of warmed vaseline or lanoline that is worked in by rubbing and the surplus wiped off after the specimen has cooled. In a recent case in the British Museum, a roll of leather with an inscription on it was so dry and hard that all efforts to unroll it had been abandoned. Eventually it was decided to soak it in a thin celluloid solution. While still wet it was successfully extended and was laid on a backing and allowed to dry in that position, all without damage to the inscription.

In preserving leather, care should be taken to avoid the use of oils or greases which acidify, as they will "burn" the leather and ruin it. Mineral oils are safe, but most animal and vegetable oils are to be regarded with suspicion unless their merits have been proved by long experience. Lanoline appears to be a safe emollient.

Leather is, of course, very susceptible to the attacks of both moths and carpet beetles. Storing with naphthalene flakes and constant inspection are necessary.

Rawhide

Rawhide demands much the same treatment as leather. In applying vaseline to soften the rawhide it is frequently necessary to avoid injury to paintings, as in the case of parfleches from the prairies. The vaseline should be applied warm, in very small quantities and on several occasions, always working on the unpainted side of the specimen.

Drumheads, which are usually of rawhide, often cause much trouble by splitting. An application of vaseline soon after receipt of the specimen will do much to prevent this, but care should always be taken to keep the drums away from excessive heat. The splitting is often seen to start from the sharp edge of the drum hoop, rather than from weak areas in the drum head itself. It is sometimes advisable to round off the edge of the hoop, if the drum head can be removed without difficulty, and then replace the head. In most cases, however, the drum head is either nailed or laced into place and its removal uninjured is almost impossible. At times matters may be improved by slacking off the cross lacings at the back of the drum.

The waterproof gut coats of the Eskimo are very apt to become extremely dry and brittle, so much so that they can hardly be handled without splitting them. Here, too, a thin coat of vaseline applied in very small quantities and thoroughly rubbed in will prove of value.

Rawhide, in all its forms, is very likely to be attacked by insects, and should be inspected carefully and frequently.

Shell

Shell specimens are generally improved by immersion in a thin celluloid solution. If they are suspected of containing infiltrated salts, and their condition permits the treatment, soak them in several changes of pure water, until the silver nitrate test shows that all salt has been removed, then dry them and soak them in celluloid.

Abalone shell specimens, including shell inlays from the west coast, whether abalone or opercula, are often marred by dirt and resin, which may be removed by means of wood alcohol or benzine. They should not be scraped or rubbed hard, as this would be likely to obliterate the minute surface corrugations that give rise to their iridescence. When inlays are found to be loose, they should be removed, the cavity thoroughly cleaned, and the inlay recemented in place with celluloid cement. In some cases the inlay, when replaced, will be found to be lower than the level of the surrounding material. Scraps of paper, cut to the correct size, should be soaked in celluloid and used to build the under surface of the inlay up to the correct thickness.

Dentalium, wampum (both cylinder and disk) and other shell specimens should be soaked in the celluloid solution. They are quite often highly porous, especially the wampum, and require careful handling. Contained salts should be removed and the celluloid used to strengthen the shell.

In some cases shells from kitchen-middens will pulverize when dry. They should be kept damp by shipping them in wet moss. The shells, without being cleaned, are dropped in a 5 per cent solution of clear gelatin in water, and while in this bath dirt may be removed with a soft brush. If much dirt is present, they should be transferred to a second gelatin bath of the same strength after cleaning. They are then removed directly to a bath of formaldehyde. This has the effect of hardening the gelatin and forming an insoluble substance that will preserve the shell indefinitely. They should be allowed to dry slowly after removal from the formaldehyde.

Sinew

Lashings and braided sinew cords become very stiff and dry in storage. They should be moistened with water before any attempt is made to tighten lashings or to retie fastenings of this kind. In some cases it is advisable to hold a lashing in place with a dab of celluloid cement and then coat the whole lashing with a celluloid varnish.

Sinew is subject to attack by insects and should be inspected with this in mind.

Turtleshell

Turtleshell rattles from the eastern woodlands may be cleaned with soap and warm water and a stiff brush. After drying, a very little vaseline well rubbed in will restore the gloss, but too much vaseline will collect dust. Care should be taken that the interior of the shell is as free as possible from desiccated animal matter as this would attract insect pests.

Wool

In a general way, wool may be treated as any other textile, but deserves separate mention on account of the great attraction it has for moths. Large specimens, such as the mountain goat wool blankets from the west coast, should be laid out on a lawn in bright sunlight and lightly beaten to free them from dust and dirt, each side being treated in turn. In storage they should be rolled or folded with layers of naphthalene in the folds. Smaller specimens, which are in a fragile condition, may be sprayed with a very thin solution of celluloid in acetone, or laid on a piece of wire netting and immersed in the solution. The solution must be very thin, or the spaces between the warp and the weft elements will be filled up and the appearance of the specimen ruined.

Very small fragments of woollen textiles, such as are occasionally removed in excavation, often charred, may be mounted in Canada balsam on glass in the same way that slides are prepared for the microscope. This secures the specimen from damage and permits its ready examination either in the hand or with a lens. The number of the specimen may be painted or scratched on the glass itself.

MATERIALS OF VEGETABLE ORIGIN

Basketry

Baskets become very brittle with age, often so much so that they can hardly be handled safely. In this case it is best to treat them before attempting any cleaning. Baskets in better condition should be cleaned as thoroughly as possible with bellows and brushes and then treated with a solution of beeswax in gasoline. Enough wax should be shaved into the gasoline to make a thin slush. The gasoline on evaporation will leave the wax in the tissues of the basketry and pliability will be maintained indefinitely. Paraffin in turpentine has been recommended for the same purpose, but has the disadvantage of darkening the basket. Slight rubbing of the specimen after the application of the beeswax in gasoline will impart a pleasant gloss and any colours, such as appear in the imbricated baskets of the southern interior of British Columbia, are considerably freshened.

Baskets are subject to attack by wood-boring beetles. The use of the beeswax-gasoline solution will usually be found an effective method of eradicating the pest. Fumigation is also satisfactory.

Birchbark

The drying and increasing brittleness of birchbark that has been long in storage are due to the loss of moisture and volatile oils. Any attempt to replace these with more of the original oils lost is useless as they would again evaporate. Experiments have been performed with a variety of materials, with varying degrees of success. It was felt that Canada balsam dissolved in turpentine would restore to the birchbark a substance resembling in some degree the material lost, but the result was unsatisfactory, as the penetration was poor and a film of balsam varnish was left on the specimen. Birchbark is highly impervious to fluids, even alcohol penetrating only slightly. Paraffin wax dissolved in turpentine left a greasy surface; beeswax in gasoline, though penetrating only slightly, left a smooth surface without discoloration. Celluloid in acetone gives a satisfactory surface, but does not greatly increase the pliability of the bark.

Some measure of success attended a method in which the bark was first painted with beechwood creosote. When this had dried, the surface was repainted with formaldehyde. The action of the formaldehyde with the creosote forms a condensation product which leaves a preservative coating on the birchbark, with only a slight discoloration. Experiments with this material are still in progress.

Resin

The terms gum, resin, and pitch are used very loosely and considerable confusion has arisen as a result. Gums and resins are nearly always plant exudations, by which they may be distinguished from pitch, which, except when artificially produced, may be classified as a mineral. Gums are soluble in water, or absorb it in large quantity, but are insoluble in alcohol. Resins are nearly all soluble in alcohol, but insoluble in water. Pitch, or bitumen, is insoluble in both water and alcohol. In actual practice gum and mineral pitch are rarely, if ever, encountered in Canadian anthropological specimens, but resin is frequently used as an adhesive. The fact

that it is soluble in alcohol has to be borne in mind when dealing with specimens on which it has been used, especially in the case of goat-horn spoons from the west coast, where resin holds shell inlays in place. If alcohol is used to remove the grease often found on these spoons, it is almost certain to loosen the inlays, which should be replaced when the spoon is dry and secured with celluloid cement.

The seams of birchbark canoes, the lashings of west coast whaling-harpoons and sometimes of arrowheads are served with resin which is, in many cases, chipped and flawed from hard usage. If the resin is painted with alcohol, the edges of the fractured surfaces will be softened and will reunite readily, restoring the object to approximately its original condition. A coat of celluloid in acetone also will help matters, as acetone too dissolves resin and will, after evaporation, leave the specimen covered with a coat of celluloid that is firmly united to the resin.

Textiles

Textiles, in which for convenience cordage may be included, are of animal or vegetable origin. For textiles of animal origin see "Hair" and "Wool". Vegetable textiles are comparatively seldom attacked by insects, but appear to decay by a process of slow combustion, possibly aided by bacteria and fungi. Very small specimens should be mounted in Canada balsam on glass; larger pieces are most satisfactorily strengthened by spraying or brushing them with "Duroprene" in benzol or xylol. The solution may be made very dilute, as much as three parts of the diluent to one of "Duroprene". "Duroprene" diluted with xylol was used with great success in strengthening fabrics from the grave of King Tut-Ankh-Amen, and there was no film left between the various fibres. This material, which appears to be a chlorinated solution of rubber, may be obtained from Messrs. Baird and Tatlock, 14-15 Cross street, Hatton Garden, London, E.C.1. It is probable that similar and equally effective substances may be secured from other manufacturers.

If textiles are sprayed with a very dilute celluloid solution, a thin film of celluloid may be found to have filled the spaces between the individual threads and the natural appearance of the material is destroyed, an opalescent effect being given to the specimen. Celluloid in a solution of not more than 2 or 3 per cent may be used, however, if "Duroprene" is not available.

Washing textiles with water is seldom advisable, unless they are in very good condition. Pressing the material with a damp cloth and a hot iron is often beneficial and greatly improves its appearance. Specimens that are stained with grease or spotted should be brushed with a mixture of four parts of benzol to one of wood alcohol, dried, brushed with a fairly stiff brush, and pressed. Careful tests should be made in the case of dyed or painted fabrics to be sure that none of the chemicals employed will be injurious to the pigments.

In some cases, textiles are improved by dampening them with a weak solution of alum and gum arabic in water. The alum appears to preserve and freshen the colours and the gum adds strength. The fabric should be draped on wire netting or other similar support while drying and should not be allowed to become damp after this treatment.

Wood

Wooden specimens occur in such a variety of forms that their effective treatment offers a special series of problems. The chief destructive agencies are excessive dryness, with its attendant splitting and warping, insect pests, and fungi. Special cases occur, also, such as wooden specimens collected in a wet or moist soil, which will warp and shrink out of all recognition if allowed to dry at all.

Drying. Reasonable drying of wood is one of the best methods of preserving it, but the excessively dry conditions to which wooden specimens in museums are frequently exposed are very destructive. If at all possible, provision should be made for keeping the air in both storage and exhibition rooms at a normal humidity. When this cannot be done, and specimens show the effects of over-dry conditions, they should be treated with a solution that will fill the pores of the wood and strengthen the fibres. The best material for this purpose is a thin solution of celluloid in acetone. Small specimens may be dipped and allowed to remain in the bath until no more air bubbles rise from them when they are moved. Larger specimens must have the solution painted on them. Very large wooden objects such as dug-out canoes, grave monuments, and totem poles may be treated by applying the solution to them in a fine jet by means of a syphon arrangement. A large jar or tank of the celluloid solution is supported 3 or 4 feet above the specimen and a long rubber tube, terminating in a small glass nozzle, forms the syphon. The wood should be thoroughly dry when the solution is applied and large quantities will be absorbed. When the wood has soaked up as much as it will, it should be allowed to dry and should then be treated again in the same way, and the alternate drying and spraying should be continued until the wood refuses to accept any more of the solution. Specimens treated in this way become quite hard and are resistant to all destructive agencies, but their appearance will not be changed in any way.

Insects. Wood-boring beetles are the principal insect pests to be guarded against and their presence is easily detected by the observation of "worm-holes" in the wood and the fine wood dust expelled by the larvæ. Fumigation will kill the beetles, but if the celluloid solution is used fumigation is unnecessary as the insects will be very effectively embalmed.

Fungi. These organisms depend on the presence of moisture and air for their active existence. A thoroughly dry specimen which has been attacked by fungi is safe until it becomes moist again, as it will do when the atmospheric humidity increases beyond a certain point. "Dry rot" and the various "stains" are the principal fungi to be feared and usually occur to a serious extent in large specimens only. Various chemical solutions have been suggested as fungicides, one of the best being mercuric chloride in alcohol, a 2 per cent solution being sufficiently strong. This is an extremely poisonous substance and should be used with the greatest care. "Dry rot" is readily identified by the dry, powdery, friable appearance of the wood, which is often broken up into more or less cubical fragments in badly infected specimens. Celluloid solution applied to these areas will consolidate the fragments and prevent their loss, thus retaining the original shape of the specimen. It is also effective in killing the fungus itself by preventing its access to air and moisture. In advanced cases of

"dry rot" it is sometimes advisable to remove those parts of the specimen which are most seriously affected and burn them. The parts removed may in some cases be restored with new material, if the appearance of the specimen would otherwise be misleading. Solutions of chemicals in water are often recommended as fungicides. Though these may be satisfactory in commercial practice, the wetting of museum specimens cannot always be recommended.

Wet Wood. When wooden objects are actually lying in water at the time of collection or are found in very wet soil, they should be shipped to the museum in water. Moss may be used in sufficient quantities to prevent movement of the specimen and the quantity of moss so regulated as to secure a degree of humidity as nearly as possible equal to that in which the specimens were found. A small quantity of wood alcohol, not more than 10 per cent, may be added as a temporary preservative. When the specimens are received at the museum they should be soaked in baths of wood alcohol diluted with water, of gradually increasing strength, as follows: 25 per cent, 50 per cent, 75 per cent, 95 per cent, and pure wood alcohol. About two days in each bath will be required. After the bath in pure alcohol, the objects are to be transferred, without drying, to a bath of xylol (xylene) for another two days. The xylol bath is then repeated with fresh xylol for another two days, and the specimens are then suspended in melted paraffin wax in a water bath or "double-boiler." They should be allowed to remain in the hot paraffin for several hours, then removed and allowed to cool. Any excess paraffin may be removed, after the wax has solidified, with a little benzine on a cloth or brush. The paraffin wax will darken the wood to some extent, but this is seldom a disadvantage, as water-soaked specimens are likely to be dark in colour in any case. If desired, the specimens may be transferred from the xylol to a celluloid in acetone bath (cold) instead of the paraffin. This gives a more durable specimen, and one, moreover, which will not leave paraffin wax stains when it is placed on an exhibition case diaphragm.

Large Wooden Objects. Restoration of totem poles and other large wooden objects, such as house-posts, which are to be left in the field, exposed to the weather, is an undertaking that requires special apparatus and experience. Mr. Harlan I. Smith, archæologist, has done much of this work and his methods appear to have been entirely successful. The poles were found in many cases to have fallen; in other cases they were in danger of doing so, owing to rotting below the ground-level.

When the pole to be treated was still standing, it was supported in an A-frame by means of ropes. Chafing was avoided by wrapping the pole with burlap where the ropes touched it. The pole was then sawn off at the ground-level and lowered to the ground, where it was supported on cross timbers. A channel about a foot wide and a foot deep was excavated along the back of the pole for a distance of half or two-thirds of its length. In the channel thus prepared a new timber, cut to fit snugly, was laid and bolted to the pole with bolts running from side to side and from front to back. The heads of the bolts and the nuts were sunk in square sockets in the pole which were subsequently filled with plugs so that the bolts would not be conspicuous. The new pole thus laid into the old one was allowed to extend about 6 feet beyond the butt, and this protruding part was set in cement in a pit dug to receive it. Temporary struts were fastened

solidly to the new pole and forced into the ground in such a way as to hold it steady while the cement was setting; otherwise wind-shake would have stirred the pole enough to prevent the cement setting in close contact with the wood, a condition that would have allowed the infiltration of water.

The new pole, before being laid in the old one, was treated very thoroughly with creosote. The cement foundation came close to, but not actually up to, the ground-level and the old pole was supported about an inch above the foundation. This space of an inch was filled with a waterproof, plastic gum which neither hardens when cold nor runs when hot. The gum was bevelled off where it came in contact with the cement foundation in such a way as to throw off any rain water that trickled down the pole, and the surface of the foundation was levelled off even with the ground and covered with gravel or sod to match the surroundings.

The old pole was painted with warm, double-boiled linseed oil. It is possible that raw linseed oil would have been better, but it dries so much more slowly that the time lost in waiting seemed too great a price to pay for the slight extra advantage. When the oil had dried, and any surplus had been removed to prevent a glossy appearance, the pole was painted. Difficulty was encountered here, as the old colours had almost entirely vanished, and the Indians themselves were in great doubt as to what colour should be used in certain parts of the carvings. The final decision was always left to the Indians, and the old native colours were approximated as closely as possible. The poles, when re-erected and repainted, looked somewhat crude and glaring, but experience has already shown that the colours are rapidly softened by weathering and there is no doubt that the treatment has been of very material assistance in prolonging the existence of the poles.

The top of the pole, and all projecting parts well above eye-level were capped with plastic gum to prevent the penetration of rain water, and on top of the pole the plastic gum was further covered with a sheet of canvas and a second layer of plastic gum. The application of double-boiled linseed oil darkens the pole slightly, but this may be overcome by adding to the oil a small quantity of light earth colour, sufficient to counteract the darkening effect of the oil. Experiments have to be made to determine the correct amount to use.

In some cases the poles were found to have decayed beyond the point at which they could safely be re-erected. In such a case the pole was laid on cross-timbers, treated to a very thorough oiling and held together as firmly as possible with bands of strap iron. The pole was protected from the weather by the erection of a long pent-house over it with a railing to keep out intruders.

It should be noted that the native colours were never pure. They were confined largely to red and black, though white and yellow were also used to a less extent, and occasionally a blue. The colours were generally made by calcining rock. The black paint made from charcoal was, apparently, not used by the natives on totem poles. The red has a large proportion of black in it due to the presence of impurities, and the black has a decided reddish cast for the same reason. The "Indian Red" of commerce is far from being the colour here discussed, the "Garnet Brown" of Ridgway being a closer approximation.

MATERIALS OF MINERAL ORIGIN

Amber

In treating amber, which is usually in the form of beads, it must be borne in mind that it is a fossilized resin, and has to be handled accordingly. It is soluble in alcohol, acetone, benzol, and other organic solvents and these should, therefore, be avoided in cleaning it. Rubbing is inadvisable, for friction will often cause amber to fly to pieces. Soap and warm water, with very gentle rubbing with the finger tips, are generally sufficient to clean specimens, and fragments of dirt can be removed from holes and crevices by means of a stiff bristle or a horsehair. Care must be taken that the small section of the bead through which the perforation runs is not broken off; it is usually more fragile than the rest of the specimen, having already been subjected to strain in the process of drilling.

Amber is easily repaired with celluloid cement. When there is disintegration and flaking of the surface, the solvent action of acetone may be taken advantage of. The specimen should be painted with acetone, moistening the edges of the minute flakes and loose particles and causing them to re-adhere to each other when the acetone has evaporated. It is well to give all amber specimens a coat of the celluloid solution before storing or exhibiting them. It will cause no discoloration, and they should then need no further treatment.

Beads

Beads, in Canadian anthropological specimens, are usually of glass, though there are also shell beads, frequently of native manufacture, also beads of bone, seeds, and other materials. The methods of treatment suggested for individual beads are to be found under the heading of the material employed in their manufacture. It often happens, however, that the beads themselves are less in need of care than the fibre on which they are strung. There are two methods of treatment available. One is to replace the original fibre with new, the other to strengthen the fibre without removing it.

When it is necessary to substitute new fibre, it is of great advantage to be able to hold the beads securely in their correct relative positions while the work is in progress. A convenient method is to roll out a sheet of wax or plasticine about half an inch thick and of sufficient size to accommodate the entire specimen. This sheet of plasticine is supported by a board, so that it may be turned and handled easily. The beads are then pressed firmly into the plasticine, care being taken to see that all the beads are actually touching it and held in place. The old fibre may then be cut and removed, either all at once or in sections as the work advances. It is advisable to follow the original maker's method in re-stringing the beads, or the appearance of the specimen may be altered. If possible, also, they should be re-strung on the same material, whether it be sinew, cotton, silk, horsehair, or vegetable fibre. A note of the repairs made and of the substance substituted should be entered in the catalogue.

In many cases it is not necessary to replace the fibre throughout the whole specimen, and new pieces can be tied or spliced in. All knots should be made on the "wrong" side of the specimen. Vegetable fibres may be

strengthened to a certain extent by treating them with a thin solution of gum arabic in water. In other cases the celluloid solution will be found better. Any spare beads should be carefully kept, their utility in repair work being very great and the difficulty of buying beads to match a certain size and colour being considerable.

Clay

Soft clay specimens, as distinguished from baked clay or pottery, are rare in Canadian anthropology. They obviously cannot be washed and there is only one satisfactory method of treatment available. The specimen must be cleaned as much as is practicable and then fired in a kiln. The assistance of somebody experienced in the firing of pottery should be enlisted, unless the preparator is already familiar with this operation. A slight change in the size and appearance of the specimen is inevitable, but this is to be preferred to its loss, which is certain if firing is not resorted to. After firing, it is usually possible to clean the specimen more completely by mechanical methods, if it seems desirable.

Copper

There are probably several dozen so-called "recipes" for the cleaning of copper and bronze available, many of them harmful or useless. In dealing with copper specimens two possible conditions confront the preparator: they may be so badly corroded that little or none of the original metal is left; or, there is more or less unsightly patina and corrosion product which has to be removed.

Badly corroded specimens, where the original metal is largely eaten away, are beyond cleaning, save for the removal of superficial adherent dirt, except by electrolysis. The best plan is to prevent further corrosion by giving the object a preservative coating. First, the specimen should be washed in several changes of water, to make sure of the elimination of all soluble salts. When this treatment is found, on testing with silver nitrate, to be complete the specimen should be well dried and then dipped in a solution of celluloid in acetone, where it remains until no more air bubbles can be induced to rise to the surface when the object is moved or turned over. It is then dried and the celluloid bath repeated if desirable. Specimens in this condition should give no further trouble, even though their appearance may be unsatisfactory.

When specimens are less severely affected, corrosion products and patina may be removed in either of two ways: by the use of Rochelle salts, or by the use of acetic acid. The Rochelle salts method is easy of application and quite satisfactory. The formula published by Lucas is an alkaline solution of Rochelle salt (sodium potassium tartarate) containing 15 parts of Rochelle salt and 5 parts of caustic soda to 100 parts of water. The specimen should be allowed to soak in the solution for several hours or even a day or two and then rinsed and brushed with a stiff brush. A brass-wire (not steel-wire) brush may be used if it is found not to be too severe in its action. The specimen may be coated with a layer of red oxide that should come off with brushing. A second bath in a fresh solution of the same salt should be followed by thorough washing and drying. If the specimen appears to be too bright in colour it may be allowed to stand in ordinary room atmosphere for a time until a slight tarnish appears, when it is to be coated with the celluloid solution.

A solution of 10 parts of strong acetic acid in 100 parts of water is also satisfactory. The specimen should be allowed to soak in it until the green corrosion has disappeared and given place to the red oxide which may be removed by brushing. The after treatment is the same as if the Rochelle salts had been used.

In many cases much of the corroded material may be removed by careful flaking and chipping with a fine watchmaker's chisel or even an ordinary pocket knife. The object should be wet, or under water, while this work is being done as the dry dust is very injurious to the lungs and mucous membrane. Sometimes all the corrosion products may be removed in this way. This mechanical treatment should be followed by the Rochelle salt bath, drying, and a preservative coating of celluloid. A dilute solution of sodium sulphide will give the specimen a darker colour which may be preferred to the bright metallic copper. All the above suggestions are also applicable to bronze.

Glass

Glass specimens in Canadian anthropological collections are generally beads. Broken glass may be repaired with the celluloid cement, which is colourless. Glass which is disintegrating, a not very uncommon condition, should be soaked in water until any infiltrated salts have dissolved, then transferred to alcohol, dried, and coated with celluloid.

Gold

Gold seldom needs treatment of any kind. If it is dirty, soap and warm water are generally effective. If the gold has been engraved, as are some bracelets from the west coast, a very soft brush may be employed, but care should be taken not to scratch the soft metal. A 10 per cent solution of ammonia in water may be used to remove obstinate stains, or a weak solution of hydrochloric acid in water to remove incrustations due to burial, either in a coffin or in the soil. Thorough washing in several changes of water must follow either of these solutions. A final coating with the celluloid solution may be added but is not essential.

Iron

Specimens that are so badly rusted that little or none of the metallic iron is left should be cleaned as far as is practicable, washed to remove all contained salts, dried, and soaked in celluloid solution. They may also be improved by boiling them in a strong solution of caustic soda or carbonate of soda in water.

When the rusting is only superficial, much of the rust may be removed by brushing with a steel-wire brush working under water or with a wet specimen. The object is then placed on a layer of granulated zinc in an iron or porcelain vessel. More zinc is placed over the object until it is completely buried and a 10 per cent solution of caustic soda in water is then added, sufficient in quantity to cover the layers of zinc completely. It is allowed to simmer gently for several hours. When removed, the specimen will be covered with a black deposit. It is again brushed with a steel-wire brush and the treatment with zinc and caustic soda repeated if necessary. If not, it is dried quickly, preferably in a hot oven, and immediately dipped in or painted with the celluloid solution.

The use of linseed oil, varnish, paraffin wax, and other disfiguring substances is not to be recommended. The fact that many of them acidify after the lapse of a little time makes their use actually dangerous to the specimen. Objects that have been treated in any of these ways in the past should be re-cleaned and treated properly.

Another method of removing rust, which may be preferable in some cases, is to wrap strips of zinc round the specimen instead of burying it in granulated zinc. When wrapped in the zinc strips it is immersed in a 10 per cent solution of caustic soda and treated as already indicated.

Lead

Lead is found chiefly as an inlay in tobacco pipes and sometimes as a sinker on fishing tackle from the Arctic. It seldom needs any treatment, but corrosion and tarnish do occasionally appear. They may usually be removed mechanically. The fact that lead is generally used in conjunction with stone and other materials prohibits boiling it in a 10 per cent solution of acetic acid in water, which is effective for specimens that are composed of lead throughout. If a lead inlay shows signs of becoming loose it is sometimes possible to lift it right out of the cavity, boil it in the acetic acid, and replace it, but such methods are not recommended as routine practice. A coat of the celluloid solution will prevent any further corrosion.

Pictographs

Pictographs are usually executed on rock surfaces in red ochre or, less frequently, cinnabar. They deteriorate gradually, for the washing away of the pigments by rain, though slow, is continuous. Lichens also frequently grow over the pictographs and obscure them. Any attempt to remove the lichens while they are dry is apt to pull off the pigment at the same time, but it will be found that a weak solution of ammonia or carbolic acid in water will soften them so much that they can easily be removed with a brush. When the area has been thoroughly cleaned of dirt and lichens the whole surface may be sprayed with a thin solution of celluloid in acetone. This work should be done only when the rock is thoroughly dry, usually after several days of hot summer weather. This will have the effect of binding the remaining pigment to the rock surface and will also prevent the rain from soaking into the rock and freezing in winter, one of the most active agencies in the disintegration of rock surfaces. An area extending several feet away from the actual pictograph should be sprayed. Chemical preservatives dissolved in water will leach out in wet weather and are usually of little value.

Pottery

Pottery specimens are very common in Canadian anthropological collections and frequently have to be handled in considerable quantities. It is a mistake to put pottery away in storage without treatment, as is so frequently done. The specimens have, as a rule, been secured by excavation and may contain salts which will deliquesce in wet weather and recrystallize in dry, causing efflorescence and sometimes flaking of the surface of the pottery, a mechanical action due to the expansion of the crystals. Continued soaking in water is the only cure, provided that the pottery will permit it. This may take several weeks and numerous changes of water.

Experiments at the British Museum have shown that the process may be speeded up very considerably by making a thick pulp of white blotting paper in distilled water. This pulp is applied to the specimen in a layer about a quarter of an inch thick and allowed to become perfectly dry, when it is peeled off, bringing most of the contained salts with it. Indeed, so much of the salt is removed in this way that the specimens are usually safe from deterioration if the process is repeated two or three times. Flaking may be prevented by soaking the specimen in celluloid solution after the salts have been removed.

In the case of rough pottery from Alaska, generally lamps and cooking pots, the material is often filled with fatty substances that should be removed by soaking in benzine or gasoline. This should be done out of doors if possible; the roof of a museum building is often a safe and convenient place for such work.

Repairs to pottery may be made with celluloid cement, and missing portions may be restored by following the valuable suggestions of Mr. W. Orchard in Indian Notes 2:297-308, Oct. 1925, Museum of the American Indian, Heye Foundation, New York.

The foregoing applies only, it should be noted, to unpainted pottery specimens. Painted pottery is extremely rare in Canada, if not entirely absent, but should such specimens be encountered, it is safer to avoid soaking altogether, to remove the salts with pulp, working from the unpainted side, and to apply a liberal coat of celluloid to the specimen when dry.

Specimens with incrustations of soil and debris on the exterior which cannot be removed mechanically may be dipped for a short time in a 20 per cent solution of muriatic acid in water, washed for several hours in clean water, and then dried and treated with celluloid.

Much time and tedious handling of specimens may be saved by using a photographer's washing tank in which the water is made to circulate through the whole tank before running to waste. The current should be slow but steady. The progress of the operation may be determined by testing the water with silver nitrate at the point where it leaves the tank.

Silver

Silver rivals copper in the number of methods of treatment suggested. Nearly all silver tarnish yields to the very simple method of soaking the specimen in a 5 per cent solution of formic acid in water. It should be allowed to soak for a minute or two and may then be taken out and rubbed gently with the finger tips, or with a tuft of cotton wool dipped in formic acid (5 per cent solution), thoroughly rinsed and washed in water, dried, and coated with celluloid. The work should be done in a glass bowl, graniteware, or porcelain. No metal vessel should be used. If the tarnish is advanced to the stage of corrosion, it may be necessary to use a 10 per cent solution of formic acid in hot water, keeping it warm and leaving the specimen immersed for several hours. If the corrosion is very advanced soak the object first in a 50 per cent solution of a mmonia in water and then use the hot 10 per cent formic acid solution. Avoid the temptation to chip off incrustations, as may be done with copper and bronze. Such methods if attempted with silver will be almost certain to ruin the specimen.

Silver that needs brightening only, rather than the removal of a tarnish or corrosion, may be cleaned with a weak ammonia solution in very hot water, using a soft brush and then polishing with a chamois skin.

Stone

Porous stone specimens may be treated as pottery *(q.v.)*, if they are found to be impregnated with salts or show signs of flaking or scaling. Care should be taken not to use an iron tank or vessel to soak the stone in as iron stains would result. A lead-lined tank is more satisfactory and the specimen should be kept off the bottom of the tank by small brick supports. Thorough soaking of stone may take several weeks or months and it is advisable to add a very small percentage of copper sulphate to the water to prevent the growth of freshwater algæ. Keeping the tank covered and away from the light is recommended for the same purpose.

Stones that have been painted cannot be treated in this way and it is generally best to apply the celluloid solution to them without any preparatory treatment.

Repairs on stone specimens, if small, may be done with celluloid cement; larger repairs can be done with plaster of Paris, tinted, and, if necessary, tooled to produce the desired appearance.

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