CANADA

DEPARTMENT OF MINES

HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

NATIONAL MUSEUM OF CANADA

W. H. COLLINS, ACTING DIRECTOR

BULLETIN No. 68

Annual Report for 1930

CONTENTS

	PAGE
GENERAL ACTIVITIES OF THE NATIONAL MUSEUM OF CANADA: W. H. COLLINS	1
THE SO-CALLED *Agropyron caninum* (L.) BEAUV. OF NORTH AMERICA: M. O. MALTE	27
DINOSAUR TRACKS FROM PEACE RIVER, BRITISH COLUMBIA: C. M. STERNBERG	59
A NEW SUBSPECIES OF WILLOW PTARMIGAN FROM THE ARCTIC ISLANDS OF AMERICA: P. A. TAVERNER	87
A NEW HYBRID GROUSE: P. A. TAVERNER	89

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1932

GENERAL ACTIVITIES OF THE NATIONAL MUSEUM OF CANADA

By W. H. Collins, Acting Director

Very satisfactory progress was made in the activities of the National Museum of Canada during the year 1930, as is shown by the administrative reports of the Anthropological and Biological Divisions, and by the reports prepared by the Palæontological and Mineralogical Divisions of the Geological Survey with regard to their museum activities. These reports show very plainly, also, that a live museum is not a depository of more or less interesting curios, as a few still suppose it to be, but an active organization for modern scientific investigation.

The scientific investigations of the National Museum are based upon a great mass of information and material collected by trained men in the field. The Anthropological Division carried on field work among the Indians of southern Ontario and Quebec with a view to ascertaining the effect on aboriginal culture of contact with European races; investigated the social organization, customs, and beliefs of the Indians living at Kitimat, British Columbia, and around lake Abitibi, Ontario and Quebec; made an anthropometric study of the Indians living in the vicinity of Lesser Slave lake; made an archæological reconnaissance of Magdalen islands; and excavated pre-European Indian village sites in New Brunswick and southern Ontario.

The Biological Division completed a botanical survey of Wood Buffalo park, northern Alberta, started a botanical survey of the province of Nova Scotia, studied and collected material in southeastern British Columbia to be used in a report on the mammals of that area, and conducted ornithological investigations in the vicinity of Churchill on the west coast of Hudson bay.

In addition to acquiring a great deal of very valuable material for study purposes the officers in charge of the field parties procured some choice material for exhibition in the museum halls.

The equipment of the exhibition halls was increased during the year by the purchase of five upright glass cases with metal frames for the Palæontological hall, and by the manufacture by the museum staff of a large, upright glass case with mahogany frame for the Biological hall, a large wall case for a dinosaur mount, three magohany table cases for geological and palæontological exhibits, and a mahogany case specially designed to carry sixteen small, standard insect cases.

Good progress was made during the year in setting up exhibits in the museum halls. In the east Anthropological hall a number of instructive and well-conceived synoptic exhibits were installed, such as Indian cradles, musical instruments, and games. In the Biological hall some very fine habitat groups of birds and mammals were set up. The collection of nonmetallic minerals was augmented by an exhibit in an upright case showing the mode of occurrence, origin, and uses of talc, and by additional cases showing amber and mineral resins and the constitution of coal. Additions

were made to the palæontology exhibits, the most striking of which is a wall mount of a plant-eating horned dinosaur found in Alberta and mounted in the attitude in which it was found. Two large Kwakiutl house-posts and their cross-beam erected at the archway between the east and west Anthropological halls present a pleasing and striking appearance. Mention should be made, also, of an excellent example of Indian carving in wood on a tomb obtained through the agency of the Department of Indian Affairs from the Musqueam reserve in British Columbia. This tomb has not yet been placed on exhibit.

During the year D. Jenness at his own request was relieved of the responsibilities of the position of Chief of the Anthropological Division and reverted to the position of ethnologist.

The Acting Director of the Museum wishes to express his appreciation of the enthusiastic co-operation of those members of the Geological Survey staff who have devoted time and thought to the exhibition of palæontological, geological, and mineralogical material. He is most grateful to other Government departments and to other institutions for assistance: the North West Territories Branch, Department of the Interior, has turned over to the museum valuable biological collections obtained by explorers in northern Canada; the National Parks Branch, Department of the Interior, and the Hudson's Bay Company have made important contributions of biological specimens; the Department of Indian Affairs has assisted in acquiring anthropological specimens; and the Entomological Branch, Department of Agriculture, has set up the first of a series of systematic and economic exhibits of insects. These and other federal government departments have shown a commendable willingness to assist in the building up of a museum creditable to the country, and it is to be regretted that limitations of space prevent the fullest measure of co-operation.

The Canadian public is showing a growing interest in the work of the National Museum and is turning to it more and more for assistance in the solution of natural history and anthropological problems. Requests for information are numerous and many collections of specimens are submitted for determination. Exchanges of specimens with other museums for study purposes are common, and provision is made for the accommodation of scientists of other institutions desiring to carry on special investigations with Canadian material. As a result of the increasing interest many valuable specimens with related data are acquired by gift and exchange. The Acting Director is grateful to many individuals and organizations for gifts and exchanges and for gratuitous assistance rendered in scientific research.

EDUCATIONAL AND PUBLICITY WORK

G. W. Richardson reports:

It is generally recognized that a museum should be an educational institution and not merely a storehouse for specimens. A main objective of the work of the National Museum of Canada is, therefore, the dissemination of information pertaining to the natural history of Canada and the life and customs of the aborigines. Though it is not possible for most Canadians to visit the National Museum, it is hoped to overcome the

barrier of distance by furnishing teachers, naturalists, and lecturers, with lantern slides, motion pictures, and information on anthropological and natural history topics.

The National Museum has an excellent collection of photographs, chiefly of anthropological and biological interest, taken during the course of field work over a period of many years. Many requests are received for photographs of Indians and Eskimos, and of their modes of life, for use in illustrating articles and books. Prints are supplied at cost, and the National Museum receives considerable publicity through the acknowledgment of the source of the photographs when they are published.

A fine collection of photographs of birds and bird habitats has been assembled. Lantern slides have been made of many of these photographs and are lent to teachers and other responsible persons, but only a small part of the requests for these slides can be granted because sufficient duplicate sets are not available. It is considered that the Museum has a national duty to perform in arousing widespread interest in bird conservation and, as one of the best means of accomplishing this is by illustrated lectures, it is desirable to have a large collection of good lantern slides available for loan to experienced lecturers.

Motion pictures have been taken by Museum officials during the course of field work, chiefly to supplement other results of field work, and the following films have been assembled for loan to other museums, to schools, churches, clubs, etc.: The Conquest of Mount Logan; Hunting Dinosaurs in the Badlands of Alberta; A City Garden and Its Birds; In Canada's Fjords; The Bella Coola Indians of British Columbia; The Carrier Indians of British Columbia; The Tsimshian Indians of British Columbia; The Coast Salish Indians of British Columbia; the Kootenay Indians of British Columbia; A Naturalist in the Arctic.

The following motion picture films were acquired during the year from the R. K. O. Pathe Distributing Corporation by long term lease: Volcanoes; Glaciers; Scuplture of the Land by Rivers; Shore Lines and Shore Developments; The Work of Underground Water; and The Cycle of Erosion.

An automatic balopticon was purchased during the year and installed in the rotunda of the Museum. Sets of lantern slides of subjects relating to the work of the National Museum and the Geological Survey have been prepared and are used in this machine, the sets being changed at regular intervals.

An important phase of the educational work of the National Museum is the series of lectures given each winter. A statement concerning those delivered during the winter of 1930-31 is given elsewhere in this volume.

MUSEUM LECTURES

M. E. Wilson, of the Museum Lectures Committee, has prepared the following statement:

The National Museum of Canada is an educational institution and as such one of its tasks is to disseminate information regarding natural history and other branches of science, and thus to arouse public interest in, and gain public support for, the various scientific activities of the Government Departments and the conservation and economical development of Canadian natural resources. With this objective in view the National

Museum, some years ago, organized courses of lectures both for school children and for adults. These lectures have now become an assured success and attendance and interest in them have grown from year to year. Ottawa possesses in the Government service a large number of scientists who are authorities on their special subjects of study and it is from these that the lecturers are chiefly selected. The committee in charge of the lectures endeavours to include in each lecture course as many branches of science as possible. Thus, lectures on such subjects as "The Life History of a Mosquito," "The Building of Mountains," and "How a New Variety of Wheat has been Developed" may be found in the same program. Practically all lectures are illustrated by coloured slides and appropriate motion pictures.

The lectures for children are given on Saturday mornings at 10 and 11 a.m., and at these hours hundreds of children may be seen wending their way in small groups towards the museum. It is a tribute to the interest of the lectures that the children of their own accord flock to the museum in such numbers that the lectures must always be repeated once and on some occasions twice. The benefit derived by the children from these lectures can hardly be over-estimated. They learn something about the natural resources of Canada and the value of science in the conservation and development of these resources, and they acquire much other information that will be remembered long after their school days are over. Future scientists, philanthropists, business men, and leaders in the public life of the country are being inspired, as well as instructed, so that early in life their interests are directed towards the beauty and usefulness of the things of nature and the important rôle played by science in preserving and developing our national inheritance.

The lectures are given in a more extended form for adults at 8.15 on Wednesday evenings. Much of the information imparted by these lectures is the same as that of university lecture courses on similar subjects; most of the speakers have the rank of university professors in their training and knowledge of their subjects. On the whole, however, by the use of coloured slides, motion pictures, and in other ways, the lectures are given in a more popular way than that prevailing in the university classroom.

The total attendance of children at the Saturday morning lectures of the 1930-1931 series was 9,200, with an average of 613; the total attendance of adults at the Wednesday evening lectures was 4,857, with an average attendance of 303. Following is a list of the lectures delivered:

Fur-bearing Animals and the Furs We Wear, by F. D. Burkholder.
Indian Drums, Rattles, and Whistles, by Douglas Leechman.
Sunspots and Their Effects on Living Things, by Ralph E. DeLury.
Chemistry of Familiar Things, by R. D. Whitmore.
Why Forests Change, by D. Roy Cameron.
Experiences in the Rocky Mountains, by C. S. Evans.
Wild Life in Southern Manitoba, by Norman Criddle.
French Canada, by Marius Barbeau.
Town Planning—the Social Science of Living Conditions; the Evolution of Two Capitals—Paris Today: Ottawa Tomorrow? by Noulan Cauchon.
An Evening with the Microscope, by William E. Harris.
Sulphur—Where We Get It and How We Use It, by A. W. G. Wilson.
The Seasons in the Garden, by George Simpson.
Mere Maps, by Lawrence J. Burpee.
The Romance of the Canadian Hen, by S. C. Barry.
Picturesque Gaspe, by F. J. Alcock.

Publicity is given the lectures by means of printed programs and accounts in the newspapers. Editorials regarding the lectures have also appeared in the papers from time to time. To attract school children, copies of the program are mailed to the school principals for distribution to the teachers. No other efforts to increase the attendance of school children are being made, because the audiences now almost fill the lecture hall. The lecture course has the full support of the School Inspectors and Principals and there is little doubt that double the present attendance could and would be secured if the lecture hall were large enough. The average attendance at the Saturday morning lectures of the autumn course of 1930 was 796. The seating capacity of the lecture hall is 406 or 812 for two lectures and hence only 8 more than the average attendance.

The average attendance at the Wednesday evening lectures for adults for the winter course of 1929-30 was 246 and for the autumn course of 1930-31, it was 269. Though the attendance has been gratifyingly large experience indicates that it can be considerably increased. In 1917 copies of the program were mailed to about 1,500 persons selected from the membership registers of the Ottawa Field Naturalist Club, the Woman's Canadian Club, and other organizations, with the result that the average attendance at the lectures was nearly doubled. It seems certain, therefore, that with the experience gained in selecting speakers, with the steady improvement in educational motion pictures, and by making use of a larger mailing list for the programs, the full capacity of the lecture hall will eventually be attained for most of the Wednesday evening lectures.

The following classified list of lectures delivered during the years 1922-1931 shows the scope of the work:

Aeronautics

Flying in Canada, by J. A. Wilson, Jan. 7-11, 1928.
Airplanes and How They Fly, by A. Ferrier, Dec. 15-19, 1929.

Agriculture

The Making of Honey, C. B. Gooderham, Jan. 24-28, 1925.
How We Make a New Wheat, by L. H. Newman, Dec. 26-30, 1925.
How We Make a New Apple, by W. T. Macoun, Feb. 27-Mar. 3, 1926.
Poultry Keeping for Young People, by Fred. C. Elford, Mar. 27-31, 1926.
The Story of Good Seed, by F. T. Wahlen, Jan. 29-Feb. 2, 1927.
The Fruit Industry of Canada, by C. E. Macintosh, Mar. 5-9, 1927.
How Fruit is Marketed, by A. Fulton, Dec. 17-21, 1927.
The Importance of the Tobacco Industry to Canada, by R. J. Haslan, Jan. 19-23, 1929.

Archæology

The Beginnings of Handicrafts, by Harlan I. Smith, Jan. 5-9, 1923-24.

Anthropology

The Iroquois, as Warrior, Agriculturist, and Hunter, by F. W. Waugh, Dec. 23-27, 1922.
The Objibwa, a Typical Migratory Hunting Tribe, by F. W. Waugh, Feb. 24-28, 1923.
Folk Songs of Canada, by C. M. Barbeau, Mar. 3-7, 1923.
Indians of Vancouver Island, by E. Sapir, Dec. 8-12, 1923.
Indian Wisdom, by C. M. Barbeau, Feb. 16, 1924.
Our Neighbours—Yellow, Red, and Black, by E. Sapir, Feb. 7-11, 1925.
How Some of the Indians Lived, by Douglas Leechman, Dec. 5-9, 1925.
Indian Masks and Totem Poles, by C. M. Barbeau, Mar. 6-10, 1926.
Who Are the Indians, by D. Jenness, Dec. 18-22, 1926.
Indian Songs and Dances, by Marius Barbeau, Jan. 28-Feb. 1, 1928.
Glimpses of Native Life in Far-off New Guinea, by D. Jenness, Dec. 1-5, 1928.
Indian Whale Hunters of Vancouver Island, by Douglas Leechman, Dec. 14-18, 1929.
Indian Drums, Rattles, and Whistles, by Douglas Leechman, Nov. 8-12, 1930.
French Canada, by Marius Barbeau, Jan. 10-14, 1931.

Art

Why People Like Pictures, by Mrs. F. Maud Brown, Jan. 21-25, 1928.

Astronomy

A Visit to the Stars, by R. M. Motherwell, Nov. 13-17, 1925.
Sun Spots and Their Effects on Living Things, by R. E. DeLury, Nov. 22-26, 1930.

Bacteriology

Children's Lecture: Germs—What Are They? What They Are Like? and What do They do?
Adult's Lecture: Bacteria—Their Place in the Everyday World, by Norman MacL. Harris, Nov. 23-27, 1929.
An Evening with the Microscope, by Wm. E. Harris, Jan. 24-28, 1931.

Biology

Where Animals go in the Winter Time, by Clyde L. Patch, Dec. 2-6, 1922.
Snakes, by Clyde L. Patch, Jan. 27-31, 1923.
What Animals Eat, by Clyde L. Patch, Dec. 1-5, 1923.
Fur Bearers and Trapping, by Clyde L. Patch, Dec. 6-10, 1924.
Fish Culture, by J. A. Rodd, Feb. 26-Mar. 2, 1926.
What Are Snakes Good For, by Clyde L. Patch, Jan. 22-26, 1927.
The Fisheries of Canada, by J. A. Rodd, Feb. 18-22, 1927.
A Naturalist in Baffin Island, by J. Dewey Soper, Mar. 12-16, 1927.
Unusual Features of the Animal World, by Clyde L. Patch, Nov. 12-16, 1927.
Fur-Bearing Animals and the Furs We Wear, by F. D. Burkholder, Nov. 8-12, 1930.
Wild Life in Southern Manitoba, by Norman Criddle, Jan. 3-7, 1931.

Botany (Including Forestry)

The Forests of British Columbia, by M. F. Bancroft, Feb. 3-7, 1923.
What the Forests Mean to Canada, by R. D. Craig, Feb. 21-25, 1925.
The Fight Against Forest Fires in Canada, by E. H. Finlayson, Mar. 28-April 1, 1925.
The People's Forests, by D. Roy Cameron, Mar. 20-24, 1926.
Canada's Forest Wealth, by R. D. Craig, Nov. 20-24, 1926.
Interesting Facts About Trees, by J. R. Dickson, Mar. 3-7, 1928.
The Wonders of the Microscopic World or the Accident of Size, by Miss C. W. Frits, and Others, Nov. 10-14, 1928.
How Trees Grow, by R. D. Craig, Jan. 5-9, 1929.
The Romance of Wild Flowers, by D. A. MacKay, Feb. 22-26, 1930.
Why Forests Change, by D. Roy Cameron, Dec. 6-10, 1930.

Chemistry

Chemistry of Familiar Things, by R. D. Whitmore, Nov. 29-Dec. 3, 1930.

Education

Museum Work, by Harlan I. Smith, Jan. 6-10, 1923.

Engineering

The Ups and Downs of a Topographer's Life, by E. E. Freeland, Dec. 9-13, 1922.

Entomology

Insect Enemies of Our Forests, by J. M. Swaine, Jan. 17-21, 1925.
The Fight Against the Insects, by Arthur Gibson, Feb. 28-Mar. 4, 1925.
How Insects Live, by H. G. Crawford, Dec. 12-16, 1925.
Some Insect Invaders, by L. S. McLaine, Feb. 13-17, 1926.
Small Friends and Foes, by L. S. McLaine, Feb. 12-16, 1927.
Insects and their Ways, by J. M. Swaine, Dec. 3-7, 1927.
The Wonders of the Microscopic World or the Accident of Size, by J. J. deGryce and Others, Nov. 10-14, 1928.

Geology

A Trip Through The Pas Mineral Belt, by F. J. Alcock, Jan. 13-17, 1923.
The Yukon, by W. E. Cockfield, Feb. 17-21, 1923.
Gaspe Peninsula, by F. J. Alcock, Dec. 15-19, 1923.
The Search for Oil, by G. S. Hume, Jan. 12-16, 1924.
Northwestern Quebec, by W. F. James, Jan. 26-30, 1924.

Geology—Concluded

Some Interesting Features of Our Peat Bogs, by A. Anrep, Mar. 1-5, 1924.
The Story of a Lump of Coal, by D. B. Dowling, Jan. 3-7, 1925.
British Columbia, by George Hanson, Jan. 31-Feb. 4, 1925.
The Basin of Lake Agassiz, by J. F. Wright, Feb. 14-18, 1925.
Rocks and How They are Formed, by W. F. James, Jan. 2-6, 1926.
Volcanoes Old and New, by F. J. Alcock, Jan. 9-13, 1926.
Earthquakes and Their Autographs, by E. A. Hodgson, Jan. 30-Feb. 3, 1926.
The Building of Mountains, by J. F. Walker, Feb. 6-10, 1926.
Iron in the Lake Superior Region, by T. L. Tanton, Nov. 27-Dec. 1, 1926.
A Piece of Coal, by B. R. MacKay, Jan. 15-19, 1927.
Petroleum and Natural Gas, Their Origin and World Distribution, by G. S. Hume, Feb. 5-9, 1927.
The Mining Industry in British Columbia, by C. E. Cairnes, Feb. 11-15, 1928.
The Rouyn Mineral Area, by W. F. James, Feb. 25-29, 1928.
The Wonders of the Microscopic World, by M. E. Wilson and Others, Nov. 10-14, 1928.
Petroleum in North America, by G. S. Hume, Nov. 24-28, 1928.
The Story of Iron, by T. L. Tanton, Feb. 2-6, 1929.
From Cactus-land to Ice Fields in British Columbia, by H. C. Gunning, Feb. 23-27, 1929.
The Interior of the Earth, by F. J. Alcock, Nov. 30-Dec. 4, 1929.
The Quest for Ore Deposits in the Canadian Shield, by J. F. Wright, Feb. 1-5, 1930.
Experiences in the Rocky Mountains, by C. S. Evans, Dec. 13-17, 1930.
Picturesque Gaspe, by F. J. Alcock, Feb. 28–Mar. 4, 1931.

Geography (Including Exploration and Travel)

Sightseeing at Banff and Lake Louise, by M. F. Bancroft, Dec. 16-20, 1922.
Canada's National Playgrounds, by J. B. Harkin, Feb. 10-14, 1923.
Canada's Far North West, by Fred V. Seibert, Dec. 22-26, 1923.
Experiences in India, by B. R. MacKay, Feb. 2-6, 1924.
How Explorers Travel, by A. C. T. Sheppard, Feb. 9-13, 1924.
Maps that are Different, by E. E. Freeland, Feb. 23-27, 1924.
Picturesque Nova Scotia, by F. H. Kitto, Dec. 13-17, 1924.
Canada's Unknown Playgrounds, by Fred V. Seibert, Mar. 7-11, 1925.
A Trip Through Southern Ontario, by W. J. Boulton, Mar. 21-25, 1925.
The Ascent of Mount Logan, by H. F. Lambert, Feb. 20-24, 1926.
Five Weeks in Sunny Spain, by M. E. Wilson, Feb. 19-23, 1927.
Glimpses of Gothic Cathedrals, by W. C. N. Marriott, Dec. 10-14, 1927.
Across Sub-Polar Canada, by John L. Foreman, Feb. 4-8, 1928.
A Visit to the West Coast of Canada, by Miss M. B. Williams, Dec. 8-12, 1928.
Canada's Arctic Regions, by R. M. Anderson, Jan. 12-16, 1929.
A Trip to Australia, by J. M. Swaine, Feb. 23-27, 1929.
The Golden Isles, by Madge Macbeth, Nov. 16-20, 1929.
A Cruise to the West Indies and Panama, by Wilfrid S. Lawson, Dec. 7-11, 1929.
The Peace River Country, by D. M. Kennedy, M.P., Feb. 8-12, 1930.
Java Past and Present, by D. Jenness, Feb. 15-19, 1930.
Glimpses of South and East Africa, by W. H. Collins, Mar. 1-5, 1930.
Mere Maps, by Lawrence J. Burpee, Feb. 14-18, 1931.

History

A Visit to Canadian Forts and Battlefields, by Arthur A. Pinard, Jan. 10-14, 1925.
Some Landmarks in Canadian History, by Arthur A. Pinard, Feb. 9-13, 1929.

Horticulture

Horticulture in Canada, by L. F. Burrows, Mar. 10-14, 1928.
The Seasons in the Garden, by George Simpson, Feb. 7-11, 1931.

Mineral Technology

A Cup and Saucer, by H. Frechette, Jan. 16-20, 1926.
A Pinch of Salt, by L. H. Cole, Dec. 11-15, 1926.
Enamels, by J. F. McMahon, Nov. 19-23, 1927.
Bricks, Ancient and Modern, by L. P. Collin, Nov. 9-13, 1929.
How Glass is Made, by L. H. Cole, Jan. 25-29, 1930.
Sulphur, Where We Get it, and How We Use It, by A. W. G. Wilson, Jan. 31-Feb. 4, 1931.

Ornithology

The Study of Birds, by Hoyes Lloyd, Dec. 20-24, 1924.
Bird Chums, by Harrison F. Lewis, Dec. 27-31, 1924.
Birds and Their Protection, by Hoyes Lloyd, Dec. 4-8, 1930.
The Story of Our Migratory Birds, by Hoyes Lloyd, Dec. 4-8, 1926.
Our Canadian Bird Sanctuaries, by Harrison F. Lewis, Nov. 26-27, 1927.
Experiences with Ottawa Birds, by R. E. DeLury, Nov. 17-21, 1928.
Ridiculous Birds, by Harrison F. Lewis, Jan. 4-18, 1930.

Palæontology

Animals of the Past, by Charles Sternberg, Jan. 20-24, 1923.
Horses and Their Relations, by Charles Sternberg, Jan. 19-23, 1924.
Why do We Hunt Fossils, by Charles Sternberg, Mar. 14-18, 1925.
The Place of Fossils in Earth History, by W. S. Dyer, Mar. 13-17, 1926.
Hunting Dinosaurs in the Badlands of Alberta, by Charles Sternberg, Jan. 23-27, 1926.
The Age of Mammals, by Charles Sternberg, Jan. 14-18, 1928.
Ancient Reptiles of Sea and Air, by Charles Sternberg, Jan. 18-22, 1930.

Miscellaneous

The Lighthouse Service of Canada, by J. G. McPhail, Jan. 11-15, 1930.
Town Planning—the Social Science of Living Conditions; The Evolution of Two Capitals—Paris Today, Ottawa Tomorrow, by Noulan Cauchon, Jan. 17-21, 1931.

DIVISION OF ANTHROPOLOGY

D. Jenness reports:

The scientific staff of the Division of Anthropology remained unchanged during the past year except that D. Jenness, who had been Chief of the Division since 1925, requested permission to revert to the position of ethnologist. His transfer was effected on March 1, 1931.

Nearly 10,000 new specimens were acquired by the division during the fiscal year, as follows:

Ethnological	223
Osteological	2
Archæological	9,648

The most noteworthy accessions were two valuable Iroquois wampum records, a very fine Coast Salish grave monument secured through the efforts of Harlan I. Smith and Dr. D. C. Scott, and an excellent archæological collection from France presented by the late Dr. H. M. Ami. Several thousand specimens were cleaned, repaired, and, whenever necessary, treated with preservatives.

The exhibition halls have been the scene of much activity. J. D. Leechman, with the assistance of W. G. Roberts, has continued with the installation of the series of synoptic exhibits commenced last year. He has completed four new exhibits, one of Indian cradles, a second of Indian musical instruments, a third of aboriginal games, and a fourth giving a bird's-eye view of European archæology in palæolithic times. In the remaining large cases set aside for synoptic exhibits he has installed temporary series of specimens, and in four wall cases has illustrated the relation of European to Canadian archæology. The archæological specimens that were formerly displayed in the centre of the west hall have been removed

to the wall cases in the east hall, and a more artistic series is being arranged in their place. Although the series is not yet complete, it already includes exhibits of jade, slate carvings from Queen Charlotte islands, carved wooden plaques from British Columbia, Indian wampum, and both native and European beads. The gradual substitution of large-type for small-type labels in all the cases is greatly improving their appearance and increasing their usefulness, and the two large Kwakiutl house-posts and their cross-beam that have been erected between the east and west halls make a very impressive archway.

The division lent several hundred specimens to the Oblate Order for a celebration held during August in Montreal, where their exhibition attracted much attention from the half-million visitors. The number of loans to Normal School students decreased slightly, but there were requests from other sources that brought the number of collections loaned during the year to nineteen. In addition, J. D. Leechman prepared for the Boy's Hobby Show in Ottawa a special exhibit of the archæological specimens that might be found in the surrounding district.

The number of visitors was much the same as in previous years. Among these were Dr. Carl Guthe, Chairman of the Division of Anthropology and Psychology in the United States Research Council, who was deeply interested in the archæological files; Dr. E. M. Box, Toronto University, who worked for several days on the dental diseases apparent in Eskimo crania; Dr. C. H. M. Williams, Toronto University, for whom Mr. Leechman made some two hundred impressions in beeswax of Eskimo teeth; and Mr. W. Davidson, of Yale University, who received assistance in the preparation of a thesis on the artistic concepts and ideals of the Pacific Coast Indians.

Field Work

The division had five parties in the field during the summer months, three in eastern Canada, one in Alberta, and one in British Columbia.

C. M. Barbeau spent six months in Quebec, Ontario, and New Brunswick, studying handicrafts. In the course of his sojourn on several Indian reserves he collected much information relating to the ancient manual arts that have survived, after many changes, to the present day; in particular, moose-hair and bead embroidery, snowshoe-matting, and basket-making. He also continued his study of French-Canadian handicrafts in the neighbourhood of the reserves, and confirmed the conclusion he had already reached that most of the modern museum collections of Indian specimens from the eastern woodlands do not represent ancient handicrafts. These museum specimens have been collected during the last twenty-five to fifty years, and their past evolution is closely connected with the colonial arts of the whites. Several periods can be discerned, also distinct influences from various quarters. Thus the floral designs taught by the Ursulines to the Algonkian girls have given rise to much of the floral art prevailing in the north; to the school of Mgr. de Laval go back the geometric designs of the Micmacs, who went annually from Cape Breton to the Ste. Anne shrine at Cap Tourmente to barter their furs; and the Caughnawaga and St. Regis Indians were under the influence of the craftsmen, particularly of the Quevillon school, belonging to île Jésus, near Montreal. No study

of the manual arts of the eastern woodland tribes can profitably be undertaken unless it be coupled with an extensive knowledge of the colonial arts of the same period.

W. J. Wintemberg carried on archæological explorations from June to October, first in the Maritime Provinces, then, at the end of the season, in Ontario. A reconnaissance of Magdalen islands revealed few evidences of Indian occupation, but from a pre-European Micmac site in eastern New Brunswick he obtained much pottery and other interesting material. Even more fruitful was a pre-European Neutral-Iroquoian site that he excavated in southern Ontario. It yielded large quantities of pottery, pipes, arrowpoints, and other artifacts of bone or stone, belonging to a transitional cultural stage that preceded the culture found in this area by the earliest Europeans.

J. C. Boileau Grant, now Professor of Anatomy in the University of Toronto, who has been making an anthropometric survey of the Canadian aborigines, visited the Cree Indian reserves in the vicinity of Lesser Slave lake, and examined more than two hundred individuals. The working up of his results was proceeded with during the winter months in such leisure as his university duties permitted.

I. A. Lopatin, now attached to the University of Washington, Seattle, investigated, from the middle of June until early September, the social organization and religious beliefs of the Indians at Kitimat, Douglas channel, B.C.

J. T. MacPherson, of the University of Toronto, visited, early in June, the Indian reserves on lake Abitibi, on the Quebec-Ontario boundary, to study the organization, customs, and beliefs of the local Ojibwa Indians. He completed his investigations in September, and commenced the writing of his report during the winter months.

The services of Harlan I. Smith, archæologist of the National Museum, were lent to the National Parks Branch, Department of the Interior, throughout the summer in order that he might reorganize its tourist museum in Banff, Alberta. While engaged in this work he labelled some of the nature walks within the Banff National park and took motion pictures of the animal life and of the Stony Indians in the vicinity.

Office Work

D. Jenness devoted most of his attention during the year to the preparation of his textbook on the Indians of Canada, a book in two parts: the first being a general account of their manners, customs, religious beliefs, and earlier history; the second a description of the individual tribes. Early in the year the National Research Council appointed Mr. Jenness chairman of the Anthropological sub-section of the Fifth Pacific Science Congress which meets in Vancouver, May, 1932, and a considerable proportion of his time has been devoted to the drawing up of a suitable anthropological program. For the same congress he is compiling a series of ten papers, by competent authorities, on the "Origin and Antiquity of the American Aborigines," which will be published in book form for distribution to the delegates. He published two papers during the year: "The Indian's Interpretation of Man and Nature," in the Transactions of the Royal Society, and "The Yukon Telegraph Line," in the Canadian Geographical Journal.

C. M. Barbeau devoted most of his office time during the winter to the completion of his museum monograph entitled, "Tsimsyan Songs from Northern British Columbia," which is now ready for publication. On request he prepared two articles relating to the activities of the division: "Canada and the Red Man," for publication in England, and "Gaspe," for the Canadian Geographical Journal. He supervised in its early stages the transcription of French-Canadian folk-songs by Mr. Cyril Rickwood, whose services have been lent to the Museum since February by the National Parks Branch, Department of the Interior; and he assisted in the cataloguing of the material he collected during his summer's field work.

Harlan I. Smith, after his return from the field, worked on the motion pictures he had taken during the summer, and on the rearrangement and indexing of the archæological files. He actively participated in the organization of the series of lectures for children and adults, now an established activity of the Museum.

W. J. Wintemberg completed the archæological report on the Roebuck Village site, on which he has been working for several years. He then commenced the preparation of a report on the Lawson Village site, another pre-European settlement of Iroquoian Indians in southeastern Ontario.

Publications

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

Totem Poles of the Gitksan, Upper Skeena River, British Columbia. By Marius Barbeau. National Museum of Canada, Bulletin 61, 1929, pp. I-VI, 1-275.

An Indian Paradise Lost. By Marius Barbeau. Canadian Geographical Journal, vol. 1, No. 2, pp. 133-148.

Totem Poles: A Recent Native Art. By Marius Barbeau. The Geographical Review, vol. XX, No. 2, pp. 258-272.

The Modern Growth of the Totem Pole. By Marius Barbeau. The Twentieth International Congress of Americanists, September, 1928, pp. 505-511.

Haunts of the Thunder-bird. By Marius Barbeau. A Study in Wood (111), Thos. Nelson and Son, pp. 1-5.

The Yukon Telegraph Line. By D. Jenness. Canadian Geographical Journal, December, 1930.

The Indian's Interpretation of Man and Nature. By D. Jenness. Transactions of the Royal Society of Canada, vol. XXIV, 1930, section II, pp. 57-62.

Lectures

Canadian Handicrafts. By Marius Barbeau. Address at the opening of the Annual Exhibition of the Canadian Handicrafts Guild at the Arts Association, Montreal, September, 1930.

French Canada. By Marius Barbeau. At the University of Montreal, January, 1930.

Nos Anciennes Églises. By Marius Barbeau. At the University of Montreal, January, 1930.

L'ancienne Tradition en Architecture au Canada. By Marius Barbeau. College Bourget, Rigaud, P. A. March, 1930.

Ancienne Sculpture et Architecture au Canada. By Marius Barbeau. Institut Canadian, Ottawa, March 3, 1931. Also before the Canadian Club, Chicoutimi, Que., March 8, 1931.

Native Music in Canada, By Douglas Leechman. Address before the Hundred Club, Carleton Place, October, 1930.

Indian Drums, Rattles, and Flutes. By Douglas Leechman. National Museum Lecture, November 15 and 19, 1930.

The Eskimo. By D. Jenness. Address at McGill High School, December 13, 1930.

Accessions to Museum

(a) FROM STAFF:

From C. M. Barbeau:
33 specimens, Quebec.

From J. T. MacPherson:
27 ethnological specimens, La Sarre, Quebec.

From W. J. Wintemberg:
51 boxes of archæological specimens, Brant county, Ontario.

From I. A. Lopatin:
1 mask, Kitimat, B.C.

(b) DONATIONS:

From Mr. H. McGregor:
11 stone beads, Stillwater, B.C.

From C. C. MacNeill:
3 archæological specimens.

From Mr. F. H. Kitto:
2 archæological specimens.

From Mr. McKeller:
4 archæological specimens, Grimshaw, Alberta.

From The Peabody Museum:
38 Egyptian archæological specimens.

From Mr. R. T. D. Wickenden:
A small collection of pottery and chipped stone artifacts from near Moose Jaw, Sask.

From Mr. C. L. Patch:
1 carved wooden ring, from Nova Scotia.

From Mr. Karel Wiest:
58 archæological specimens from several parts of the United States.

From Mr. J. A. Gillies:
1 piece of pottery from lake Timiskaming.

From Mr. G. C. Monture:
Sample of Indian corn bread.

From Mr. Harry Loken:
A hatchet head from Pontiac county, Quebec.

From Miss Florence McGillivray:
1 Candle-lantern.

(c) PURCHASES:

From Mr. A. E. Porsild:
Greenland kayak and fittings.

From Mr. Richard White, jun.:
126 specimens, Nain, Labrador.

From Mrs. G. D. Burgess:
28 specimens, Quebec.

From Mr. W. R. McColl:
2 archæological specimens, Owen Sound, Ont.

From Chief W. D. Loft:
2 Iroquois wampum strings.

Through Dr. D. C. Scott:
A Coast Salish grave monument.

DIVISION OF BIOLOGY

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

Field Work

During the field season of 1930, the biological reconnaissance of the region in southern British Columbia, along the International Boundary, was concluded. This work, begun in 1927 at Huntingdon, had been carried eastward as far as Moyie river. In 1930 it was extended east as far as Morrissey in Elk River valley, B.C. The work was under the charge of H. M. Laing who had done field work for the Museum during the nine preceding field seasons. In 1930 he was engaged by the National Parks Branch but was allowed to delay his time of reporting until June 1, thus permitting him to finish work in southeastern British Columbia, for the Museum. He began work on April 23, 4 miles southeast of Cranbrook along the bank of Gold creek (altitude 3,014 feet). This region is mostly logged-off land, and not very satisfactory for collecting, but a few specimens especially desired from this transition region were collected. On April 27 he moved to Newgate (altitude, 2,371 feet). Here he was joined by Mr. Ian McTaggart-Cowan, who acted as student assistant. This region provided a diversified ground for collecting. The bottom of Kootenay River valley is heavily wooded with black poplar and white spruce overtopping jungles of shrubbery. Typical transition zone country prevails on the slopes on both sides of the river, with open woods of yellow pine and Douglas fir predominating. Western larch was found in only one spot east of the river, but west of the river appeared commonly. An interesting feature is the presence of ridges and flats of short-grassed lands of considerable extent lying east of the river. Some small lakes lie in the hollows, with clumps of white poplar, and the "draws" between the ridges are wooded with yellow pine. Much of this region has good soil and is heavily grazed, but agriculture could only succeed if irrigation were resorted to. Kootenay river here seems to be a dividing line between different mammalian forms. All the chipmunks east of the river are the buff-bellied form *(Eutamias amoenus luteiventris)*, whereas those west of the river are the paler Columbian chipmunk *(Eutamias amoenus affinis)* which occupies a large area in southern British Columbia. The brown pocket gopher *(Thomomys fuscus)* and the Columbian ground squirrel *(Citellus columbianus)* were exceedingly abundant and are a great pest to the ranchers. The badger, which has been nearly exterminated in most of the valleys of southern British Columbia, was fairly common on the lower benches on the west side of the river where the ground-squirrels were most abundant. Fur-bearing mammals were scarce, but coyotes were common. Bird life was fairly abundant. Breeding-birds of interest on the Tobacco plains were Bartramian sandpiper, chestnut-collared longspur, and McCown's longspur.

Work was continued in the Newgate region until May 31, when Mr. Laing assumed his duties with the National Parks Branch, first at Jasper and later at Banff. Mr. Cowan accompanied Mr. Laing to Jasper and Banff, and under his general supervision collected specimens for the Museum and studied the wild life of the two parks. In Jasper park work

was done at Jasper, junction of Snaring and Athabaska rivers, Snaring lake, Swiftwater valley 4,000-6,000 feet, Talbot lake, Pocahontas marsh, Rocky river, Tonquin valley 6,540 feet, Snaring lake, Athabaska river, Astoria creek, Prairie creek, and Henry House. In Rocky Mountains park, collecting was done at Cascade basin 7,100 feet; Boom creek 5,600 feet, and Boom lake, 5,600 feet. Good collections were made from the areas worked in both parks.

On October 1, Mr. Laing located camp near the abandoned town of Morrissey (altitude 3,200 feet) about 12 miles south of Fernie, B.C. Morrissey is only about 30 miles northeast of Newgate, but in this distance as Elk River valley is ascended from Kootenay river a marked change in the vegetation takes place due to a change from arid to semi-wet conditions. The yellow pine and antelope brush association on Kootenay river gives way at Morrissey to heavy western cedar (mainly logged), white spruce, white birch, and white and black poplar. Thimble-berry, a typical coastal shrub, grows abundantly, and there are other evidences of abundant moisture. Heavy, grassy ground-cover and dense shrubbery are common in many places. Richardson red squirrels were abundant in every clump of spruce, flying squirrels were common locally, and buff-bellied chipmunks were numerous at low elevation. White-footed mice were not abundant, but four species of voles were taken, as well as long-tailed weasels and pack rats. Rocky Mountain pikas were taken on one rock slide. Deer are plentiful in this region. The western white-tailed deer mostly inhabit the valley, but work up in summer to some elevation. The Rocky Mountain mule deer summer in the ranges to the eastward and come down to Flathead and Elk rivers in winter. The river valley is a wintering ground for deer and a great migration is reported to take place annually at the first heavy snow. Mr. Laing states that during 1930 this wintering ground was set aside as a game refuge—the only sort that can accomplish anything where deer have unlimited summer range and very restricted winter range, a condition that is true everywhere in southern British Columbia.

P. A. Taverner, ornithologist, conducted zoological investigations in the neighbourhood of Churchill, Manitoba. Arriving at Churchill, via the Hudson Bay railway, on May 26, with B. C. Lloyd as camp man and taxidermist, camp was made in the immediate vicinity. On June 9 he was joined by Victor E. Gould as student assistant. On June 18 camp was moved to Mosquito point 7 miles up Churchill river. On July 7 camp was moved to lake Rosebelle, 3 miles from Churchill. Through the courtesy of the Hudson's Bay Company Mr. Taverner, on June 30, embarked on the schooner *Fort York* for Chesterfield. He arrived there on July 3, left on July 6, and reached Churchill on July 11, remaining there until July 28, when he returned to Ottawa. Gould remained in the field until September and Lloyd until September 30. This is the first time that trained zoologists have spent a complete summer, including the breeding season, on the west side of Hudson bay. The results obtained amply justify the effort. Amongst other things, considerable new and, in part surprising, information was obtained regarding the northern distribution of many birds, especially some of the waterfowl of interest to sportsmen, or that come under the provisions of our treaty with the United States.

Considerable material was collected for both study and exhibition purposes, including 650 birds and 68 mammal study skins besides nests, eggs, and downy young to make about a dozen habitat bird groups, some of which are already completed and on exhibition. Many of these are quite unique. Coloured drawings that will be of great value to taxidermists and artists as well as to ornithologists were made of the fading soft parts of birds. Many wild life photographs were taken and the motion pictures obtained were sufficient to fill out two reels of film that are available for showing, under the titles of "A Naturalist in the Arctics," Reel I, in Baffin bay, and Reel II, in Hudson bay.

Thanks are due to the Hudson's Bay Company and its officers and to the Department of Railways and Canals whose co-operation was of great assistance in the work.

Clyde L. Patch, chief taxidermist and herpetologist, D. Blakely, taxidermist, Claude E. Johnson, artist, and Miss W. K. Bentley, museum assistant, collected material from the Ottawa district, to fill out the collections and to provide accessories for habitat group work.

Museum Work

Progress has been made in the work of preparing and installing biological exhibits in the Museum halls. A number of interesting habitat groups have been finished, these include:

Mammals

Arctic fox and young (Baffin island).
Varying hare and young (Quebec).
Red squirrel and young (Ontario).

Birds

Blue goose and young (Baffin island).
Pacific eider (North West territories).
Groups of birds, with nests, eggs, or young, from Churchill district, northern Manitoba: Arctic loon; old-squaw; Arctic tern; red phalarope; white-rumped sandpiper; least sandpiper; red-backed sandpiper; semipalmated sandpiper; stilt sandpiper; Hudsonian curlew; semipalmated plover; willow ptarmigan; horned lark; Lapland longspur; Harris sparrow; and tree sparrow.

The Churchill material, listed above, was collected by P. A. Taverner and his party. The specimens of downy young birds were mounted in the field. Sections of the sod containing nests were cut out, shipped to Ottawa, and there the groups were assembled by C. L. Patch. The casting and modelling of plants and other accessories for nine groups were done by C. E. Johnson, and for four groups by Miss Bentley.

The following single specimens were mounted to fill gaps in the systematic exhibition cases: northern white-tailed deer (doe); Ross gull; hooded merganser; baldpate, greater scaup; lesser scaup; buff-breasted sandpiper; greater yellowlegs; Sora rail; sharp-shinned hawk; pigeon hawk; raven; redstart; and brown thrasher.

One dovekie was mounted for the National Parks Branch, and two species of lemmings were mounted for the North West Territories and Yukon Branch, Department of the Interior.

Forty-six large mammal skins (deer, bear, seal, fox, otter, beaver, badger, wolverine, and marten) were tanned by J. E. Perron for the reserve series of the Museum. A number of large, mounted mammal heads, skin rugs, and robes were fumigated and repaired for other Government branches. Considerable work is continually being done on skins that come to the Museum in a salted, soft, or unfinished state, and many skins prepared by inexperienced collectors have to be re-made. In all, 207 bird and small mammal skins were prepared, mostly by D. Blakely, for the study collections. Jos. Rochon, osteological preparator, cleaned and prepared a considerable amount of skeletal material of mammals and birds.

C. E. Johnson, Artist of the Division of Biology, did work as follows:

Colouring maps and lantern slides	52
Colouring plates	9
Colouring photo enlargements	10
Coloured plates of Canadian mammals for illustrations	6
Black and white drawings and lettered labels	14
Plaster moulds	138
Wax and celluloid accessory pieces for exhibition groups (mostly for Churchill bird groups)	2,815

During the year, 282 mammals, birds, and amphibians were loaned to educational institutions for use in art and nature study. Of the mammals, the beaver was in greatest demand, with the muskrat a close second; of the birds, the chickadee and the robin were used most.

Considerable progress was made in the careful examination and identification of the accumulated mammal collections of the Museum, which now total 11,125 catalogued specimens, an increase of 7,163 specimens since the end of 1920. At the end of 1912, the mammal collection consisted of only 1,804 specimens.

Several consignments of specimens were identified for various Canadian collectors and institutions, among which were the Royal Ontario Museum of Zoology, Toronto, the Provincial Museum, Victoria, B.C., and the Provincial Museum, Regina. The Museum specialists are always glad to examine such material from any part of the country, and in so doing not only aid collectors and owners of specimens, but also secure for the Museum authentic records of distribution of species in different parts of the country and, in occasional instances, establish new records of occurrences. The first record for Canada of the least brown bat, or Lieb's bat, *Myotis subulatus leibii* (Audubon and Bachman), collected by Eli Davis, near London, Ontario, May 9, 1929, and sent by him to the Museum for determination, resulted from the examination of a small lot of specimens. Officers of the division are prepared to identify and return any Canadian specimens of mammals, birds, reptiles, or amphibians, which are sent in a fair state of preservation and with sufficient data regarding locality and date of collecting. These may be addressed to the Director, National Museum of Canada, Ottawa. Where possible the Museum would be pleased to have duplicate specimens sent for deposit in the National collection.

Mr. Arthur Gibson, Dominion Entomologist, and Honorary Curator of Insects in the Museum, has aided in the installation of systematic collections of typical specimens of several important orders of insects and also a series of life history and habitat groups of insects of economic importance in Canada.

The Forestry Branch, Department of the Interior, is preparing additional exhibits of trunks, fruit, etc., of some of the most important Canadian forest trees.

Mr. Taverner continued his studies of the bird collections, particularly the water birds, upland game birds, hawks, and owls.

Mr. Patch attended to a number of requests for information regarding, and identification of, reptiles and amphibians.

Publications

R. M. Anderson continued work on a "Check List of Canadian Mammals"; the number of recognized species and subspecies known in Canada is now 504. While attending the annual meeting of the American Society of Mammalogists, held in New York city, Mr. Anderson examined at the American Museum of Natural History, a considerable number of specimens of Canadian mammals, particularly from British Columbia, compared them with specimens brought from Ottawa, and made notes on the Canadian mammal material in the Museum. Other valuable information was obtained from naturalists who have done field work in different parts of Canada. Progress has been made in the preparation of a popular, descriptive and illustrated book on the "Mammals of Canada." The large number of specimens, together with extensive life history notes, resulting from the field work of the past four years in British Columbia, are being studied as a basis for a report on the mammals of southern British Columbia. At the request of the Director, North West Territories and Yukon Branch, a set of notes accompanied by two distributive maps were prepared. These were published as "Appendix B, Notes on the Musk-ox and the Caribou" in a bulletin by W. H. B. Hoare, "Conserving Canada's Musk-oxen, being an account of an investigation of Thelon Game Sanctuary 1928-29 with a brief history of the area and an outline of known facts regarding the Musk-ox," Department of the Interior, Ottawa, 1930. Several reviews of publications relating wholly or in part to Canadian mammals were published in The Canadian Field-Naturalist, Ottawa. Mr. Anderson also continued work as general editor of scientific reports of Canadian Arctic Expedition 1913-18.

P. A. Taverner continued work on the preparation of a report on "Water Birds, Game Birds, Hawks, and Owls of Canada."

C. L. Patch continued work on a report on "Reptiles and Amphibians of Canada."

The following lectures were delivered by members of the division:

"The Present Status of the Musk-ox." By R. M. Anderson. Delivered at the 12th Annual Meeting of the American Society of Mammalogists, New York City, May 21, 1930.

"The Gannets of Bonaventure." By C. L. Patch. Presented at a meeting of Hawkesbury Women's Club, May 12, 1930.

"Amphibians and Reptiles." By C. L. Patch. Presented at a meeting of Carleton Place 100 Club, October 2, 1930.

Accessions to Museum

The bird collections have grown in a very satisfactory manner through the year, the accessions totalling 1,034 specimens. Among the most important accessions of the year is the final part of a collection made by J. D. Soper, in southwestern Baffin island, under the auspices of the North West Territories and Yukon Branch, Department of the Interior. This accession consists of one hundred and seventy birds and nearly as many eggs. Other officers of the North West Territories and Yukon Branch were also active in our behalf. We gratefully acknowledge the receipt of valuable specimens from nearly inaccessible localities in northwest Canada, obtained by Major L. T. Burwash and Mr. A. E. Porsild. These materials fill some important distributional gaps in our collections.

Accessions to the Zoological Collections

Mammals received and catalogued	667
Birds received and catalogued	1,050
Amphibians and reptiles received and catalogued	129

Mammals

By Members of Staff:

H. M. Laing, 125 mammals from southeastern B.C.
Ian McTaggart-Cowan, 63 mammals from Newgate, B.C., 136 from Jasper park, and 86 from Banff park, Alta.
Victor E. Gould, 64 from Churchill district, Man.
P. A. Taverner, 6 from Churchill district, Man.
C. L. Patch, 8 from Ottawa district.
C. E. Johnson, 4 from Ottawa, 1 from St. Thomas, Ont.
R. M. Anderson, 3 from Que.

By Gift:

Stuart Criddle, Treesbank, Man., 2 skins with skulls of pale flying squirrels, 3 antlered skulls of northern white-tailed deer from Man., 1 skull of Rocky Mountain mule deer from Okanagan valley, B.C.
W. E. Saunders, London, Ont., 2 hairy-tailed moles, 2 smoky shrews.
Dr. Frank T. Shutt, Central Experimental Farm, Ottawa, 1 albino Drummond meadow-mouse, from the Rev. Father Michel, O.M.I., Experimental substation, Good Hope, N.W.T.
E. F. G. White, Ottawa, 1 mounted head of moose from N.S., 1 skull of red fox taken within city limits of Ottawa.
T. E. Townsend, St. Brieux, Sask., 1 head of western white-tailed deer.
Norman H. H. Lett, Ottawa, 1 mounted head of bull wapiti from Sask.
Mrs. W. C. Hughson, Ottawa, 1 mounted head of moose from Que., 1 mounted head of wapiti (probably from Man.).
Mrs. H. S. Arkell, Britannia Heights, Ont., 1 weasel, in the flesh.
Major Allan Brooks, Okanagan Landing, B.C., 1 big-eared bat *(Myotis evotis)*.
Ovila Lalande, Ottawa, 1 star-nosed mole, alive.
Dr. G. M. Gorrell, Morrisburg, Ont., 2 little brown bats *(Myotis lucifugus)*.
Wm. H. Moore, Scotch lake, York county, N.B., 1 short-tailed shrew, 1 white-footed mouse, 1 red-backed mouse, 2 meadow-mice, 1 Cooper lemming mouse, 1 meadow jumping-mouse, 1 woodland jumping-mouse.
C. B. Dawson, Ottawa, 1 skull of Barren ground bear, killed east of Great Slave lake, N.W.T., in summer of 1929.
Guy H. Blanchet, Ottawa, skin and skull of Barren ground bear, killed near mouth of Coppermine river, Mack., in 1930.
J. A. Munro, Okanagan Landing, B.C., skull of mountain sheep from Ashnola mountain, B.C.
R. E. DeLury, Ottawa, 1 red squirrel, in the flesh.

MAMMALS—*Concluded*

By Gift—Concluded

Kenneth Racey, Vancouver, 2 brown mountain beaver *(Aplodontia rufa)*, skins and skulls.

H. M. Laing, Comox, B.C., 2 skulls of Vancouver Island black bear, 1 skin, skull, and leg-bones of Columbian black-tailed deer.

North West Territories and Yukon Branch, Department of the Interior, 21 skins of fork-clawed lemming *(Dicrostomys rubricatus)*, 14 specimens of brown lemming *(Lemmus trimucronatus)*, 2 skins of Arctic ground squirrel *(Citellus parryii)* from west side of Hudson bay, 5 meadow mice from Charlton island, James bay, collected by A. E. Porsild. Eleven mammals from southwestern Baffin island, collected by J. D. Soper.

National Parks of Canada, Department of the Interior, 1 coyote from Prince Albert National park, Sask., 1 skull of bull wapiti, 1 male and 1 female of Rocky Mountain mule deer, from Waterton Lakes park, Alta., 6 skulls of mountain goat (killed by cougar) from Rocky Mountains park, Banff, Alta., 1 skin of wolverine (with skull) and 6 skins of Rocky Mountain marten, from Jasper park, Alta.

Hudson's Bay Company, through District Managers by arrangement with the Governor of the Company:

Fort Vermilion, Peace River, Alta., skins of 4 Athabaska red-backed mice, 4 northern white-footed mice, 1 white-footed mouse and one long-tailed shrew in formalin; skulls of 1 Canada lynx, 3 red fox, 5 martin, by A. P. W. Clark, Post Manager.

Fort Grahame, B.C., skulls of 7 marten, 6 beaver, 5 weasel, 4 squirrel, 1 lynx, and 1 red fox, by H. Ravenal.

Mistassini Post, South of Lake Mistassini, Que. Skulls of 2 beaver, 2 otter, 1 marten, 1 red squirrel, by W. Jefferys.

Woswonaby Post, Abitibi District, Que. 2 skulls and 1 skeleton of marten, 1 weasel, 2 skins of red squirrel, 3 bottles of mice and shrews in formalin, by Fred MacLeod.

Chipewyan, Athabaska Lake., Alta., 8 skins and 6 skulls of northern white-footed mouse, Athabaska red-backed mouse, 1 Drummond meadow-mouse, by Clara Hooker.

Davis Inlet, Lab., flat skins and skulls, 3 white-footed mice, 3 meadow mice, 1 Labrador phenacomys.

Simpson, Mack., 2 skins of albino northern white-footed mouse.

Fort Chimo, Ungava Bay, Que., 80 mammals, mostly skulls: 1 black bear, 4 Labrador marten, 4 mink, 20 weasel, 5 otter, 4 Labrador red fox, 2 Ungava white fox, 1 ringed seal, 1 bearded seal, 2 red squirrel, 1 Labrador porcupine, 9 Labrador arctic hare, 5 varying hare, 9 meadow-mice (with 3 skins), 8 Labrador fork-clawed lemming (with 2 skins).

BIRDS:

By Members of Staff:

H. M. Laing, 42 from southeastern B.C.

Ian McTaggart-Cowan, 58 from southeastern B.C., Jasper park and Banff park, Alta.

P. A. Taverner, 210 from Churchill district, Man.

Victor E. Gould, 177 from Churchill, Man.

Bert Lloyd, 279 from Churchill, Man.

D. Blakely, 11 from Ottawa district.

C. L. Patch, 1 from Wakefield, Que.

By Gift:

R. E. DeLury, Central Experimental Farm, Ottawa, 4 northern shrikes, 1 barred owl, 1 downy woodpecker, 2 flickers, 1 red-eyed vireo, 1 house wren, 2 black-and-white warblers, 1 Maryland yellow-throat, 1 oven-bird, 1 ruby-throated hummingbird, 1 cowbird, all in the flesh.

California Academy of Sciences, San Francisco, 3 skins of timberline sparrow, from Atlin district, B.C.

Mrs. George Black, Ottawa, 1 skin of male pheasant from Vancouver district, B.C.

BIRDS—*Concluded*

By Gift—Concluded

Garnet Kliggans, Bristol Mines, Que., 1 goshawk, in the flesh.
Leslie Stone, Ottawa, 1 sora rail, in the flesh.
Mr. Ranson, Eardley, Que., 1 American bittern.
W. E. H. Richardson, Ottawa, 1 Canada warbler.
Jong Berges, Ottawa, 1 nighthawk, in the flesh.
F. L. Farley, Camrose, Alta., 1 set of 4 eggs of piping plover.
E. F. G. White, Ottawa, 1 blue-winged teal, 1 green-winged teal, 1 raven.
Mrs. A. D. Hotson, Allenby, B.C., head and tail of Richardson grouse, freshly killed.
L. M. Cavanagh, Calabogie lake, Barryvale, Ont., 1 Florida gallinule, fresh.
J. A. Munro, Okanagan Landing, B.C., 1 nest and set of eggs of bush-tit, 2 fresh skins of Bohemian waxwing.
L. McI. Terrill, Montreal, fragments of Pomarine jaeger, near Montreal.
C. S. McDonald, D.L.S., Department of the Interior, 1 long-tailed jaeger, from Artillery lake, N.W.T.
G. B. Greene, Lochaber bay, Que., 1 yellowlegs, 1 hooded merganser, in the flesh.
E. M. Kindle, Ottawa, 1 great horned owl, in the flesh.
Mrs. J. J. Urquhart, Maxville, Ont., 1 canary *(Serinus canarius)*, found dead.
Mr. McDonald and Oscar Carter, Ottawa, 2 birds found dead (14738-24739).
R. F. Howard, Ottawa, 1 hooded merganser, in the flesh.
Victor E. Gould, Wolfville, N.B., 18 fresh skins of black duck.
R. A. Cumming, Vancouver, B.C., 13 birds.
National Parks of Canada, Department of the Interior, 1 mounted whistling swan (seized at Sault Ste. Marie, Ont., and forfeited to the Crown), 1 skin of horned grebe, killed illegally at White head, Saguenay county, Quebec.
Hudson's Bay Company, 3 snow buntings from Waswanipi post, Que., birds from Chimo, Que.
North West Territories and Yukon Branch, Department of the Interior, 9 skins from Charlton island, James bay, 4 skins of Canada goose, 1 hudsonian curlew (parts), 1 snow bunting, and 1 female gyrfalcon, from Keewatin district, collected by A. E. Porsild; 1 goose (part) from Richardson river, Mack., collected by Major L. T. Burwash, 170 skins from southwestern Baffin island collected by J. D. Soper.
Anonymous, 1 female wood duck in the flesh, shot by mistake near Buckingham, Que.

By Purchase:

Alfred M. Bailey, Chicago, 6 skins of Ross' rosy gull, in different phases of plumage, from point Barrow, Alaska.
Wm. Bodin, Wilson point, Miscou island, N.B., 1 Holbœll's grebe.

AMPHIBIANS AND REPTILES:

R. M. Anderson, Creston, B.C.	1
C. H. Beall, Hornby island, B.C.	11
E. R. Buckell, Nicola, B.C.	1
J. McT. Cowan, Newgate, B.C.	3
R. A. Cummings, Bootahnie, B.C.	1
W. A. Dent, Sarnia, Ont.	1
R. W. Hill, Ohsweken, Ont.	1
F. Johansen, Chatham, N.B., cape Tormentine, and Shediac, N.B., Malagash, Truro, Annapolis, Lookoff (near Canning), Berwick, and Tyne valley, N.S., Hull and Chelsea, Que.	29
Gifford Johnson, Ottawa, Ont.	1
Revell Johnson, Ottawa, Ont.	2
E. M. Kindle, Ottawa, Ont.	1
L. M. Klauber, San Diego, California	1
H. M. Laing, Newgate, B.C.	5
P. E. Levesque, Hull, Que.	1
Douglas Leechman, Kingsmere, Que.	4
E. Leith, Willows and Rockglen, Sask.	2
Edgar Lester, East Templeton, Que.	2
Richard Lewis, Ottawa, Ont.	1

D. C. Maddox, Ottawa, Ont	1
Steve A. Mann, Piapot, Sask	5
R. Owen Merriman, Kingston, Ont	2
A. Monks, Alberni, B.C	3
Wm. H. Moore, Scotch lake and Mud lake, N.B	9
Lloyd W. Patch, Edgewater, Maryland	2
David Rouleau, Ottawa, Ont	1
Harlan I. Smith, Hornby island, Courtney, and Kootenay park, B.C., Banff, Alta	18
C. M. Sternberg, Hudson Hope, B.C	1
Sam Walker, Moose Factory, Ont	13
J. C. Wilkes, Kars, Ont	1
David Williamson, Kingsmere, Que	2
Whitten Young, Norway Bay, Que	3

National Herbarium

M. O. Malte, Chief Botanist, attended the Fifth International Botanical Congress, held at Cambridge, England, August 16-23. He reports that at the congress very substantial progress was made in the matter of stabilizing international botanical nomenclature. Sub-committees, representing most countries of the world, were appointed to prepare amendments and additions to existing international botanical rules of nomenclature. Mr. Malte was elected one of three delegates to the Canadian sub-committee.

While in Europe Mr. Malte visited the herbaria of the British Museum, the Kew Gardens, the Botanical Museum of Copenhagen, Denmark, and the Botanical Museums of Lund, Stockholm, and Upsala, Sweden, for the purpose of making investigations mainly in connexion with the preparation of "The Flora of Arctic Canada."

H. M. Raup concluded a botanical survey of Wood Buffalo park, Alberta, begun in 1928. A full report, containing sections on exploratory history, topography and soils, geology and physiography, climate, a general description of the vegetation, and an annotated list of the flowering plants and ferns that are known to occur in the region, is under preparation.

Jacques Rousseau investigated the vegetation of Nova Scotia east of Halifax for the purpose of collecting data for a proposed "Flora of the Maritime Provinces.' During the year Mr. Rousseau submitted a report on his botanical investigations in Matapedia valley, Quebec, carried out in 1929.

BOTANICAL ACCESSIONS

Receipt of the following number of herbarium specimens is herewith gratefully acknowledged:

From	Mr. E. A. Moxley	8
"	Prof. M. Victorin	180
"	Mr. H. M. Laing	183
"	Dr. J. Dearness	1
"	Mr. H. Groh	1
"	Mr. D. Leechman	1
"	Prov. Museum, Victoria, B.C	2
"	Dr. H. F. Lewis	1
"	Mr. E. A. Porsild	9
"	Mr. N. Criddle	7
	Total	393

A total of 1,289 herbarium specimens was distributed.

DIVISION OF PALÆONTOLOGY (Geological Survey)

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

Collections

Collections made by C. M. Sternberg from Peace River valley near the Alberta and British Columbia boundary, include a large number of Cretaceous dinosaur tracks of exceptional interest. These range in length from 5 inches to 25½ inches and are considered to represent eight species. Two Ichthyosaur specimens were also secured from Peace River Jurassic sediments by Mr. Sternberg.

Collections from various parts of Canada by members of the staff have added to previous knowledge concerning the distribution of fossil faunas.

Additions to the lithologic collections include concretions collected by C. E. Cairnes in British Columbia and three samples of bentonite from the Trenton in New York state and at Coldwater, Simcoe county, Ontario.

Visiting Scientists

The palæontological collections of the Museum have led various scientists to spend short periods of study in the Museum during the year. Among these are Dr. E. O. Ulrich and Dr. J. B. Mertie of the U.S. Geological Survey. Dr. A. F. Foerste of Dayton, Ohio, came to the Museum to see certain Cephalopod types. Dr. C. Teichert of Germany spent some weeks studying the cephalopod types of the Museum. Dr. R. S. Lull, Director of the Peabody Museum at Yale, devoted some days to studying the dinosaur collections of the Museum. Photographs were supplied Dr. Teichert and Dr. Lull of many of the fossils with which their studies were concerned.

Museum Exhibits

A number of new exhibition cases were installed late in the year, which when filled will considerably increase the instructive value of the fossil collections on exhibition.

Vertebrate fossils that have been prepared for exhibition during the year include a skull of *Corythosaurus*, three turtles, and other material.

A *Teleoceras* skeleton and five models of Devonian fish have been obtained from the Peabody Museum by exchange. Five slabs of fossil fishes from the Green River shales of Wyoming have been acquired for the exhibit series.

Educational Collections

During the year one hundred sets of fossils were assembled for the instruction of students in the secondary schools. A museum recently established at Perth, Ontario, was supplied with a stratigraphic series of fossils. A set of thirty-six species of fossil plants was furnished to the University of Montreal.

Accessions

Important additions to the invertebrate palæontological collections include the following:

Fifty slides of foraminifera; topotype specimens from Vienna basin; forty-five lots of Tertiary mollusca from Texas; two hundred and sixty-one species of Tertiary gasteropods and pelecypods from Europe; a specimen of the pelecypod genus *Radiolites* from the Cretaceous of Nebraska; a series of Burgess shale fossils from British Columbia; some recent west coast brachiopods donated by C. L. Fenton; Conodonts from New York and Tennessee.

DONATIONS:

O. N. Brown, 1 lot of Cretaceous pelecypods, Brûlé mines, Alta.
J. Gervers, 2 lots of Tertiary plants from Kelowna, B.C.
D. Hill, a small collection of fossils from near Madeleine river, Gaspe peninsula, Que.
Col. F. E. Leech, 2 lots of Cretaceous fossils; one from Drumheller, Alberta, on Red Deer river, one from Francis lake, B.C.
C. C. MacNeil, 2 specimens, petrified wood and pelecypods from the United States.
A. E. Porsild, 6 lots of Pleistocene fossils from Baker Lake region west of Hudson bay.
J. Dewey Soper, 1 lot of Ordovician fossils from Baffin island.
S. M. Spidell, 4 lots of specimens from southern Saskatchewan.
A. Stonier, ?Triassic pelecypods from Sibola mountains, B.C.

Papers Published by Members of the Division

"The Intertidal Zone of the Wash, England." By E. M. Kindle, U.S. Nat. Research Council Reprint and Circular No. 92, pp. 1-21, 1930.
"Notes on Some Canadian Mesozoic Faunas." By F. H. McLearn. Trans. Roy. Soc., Canada, 3rd ser., vol. 24, sec. 4, pp. 1-11, 1930.
"The Gastroplites and Other Lower Cretaceous Faunas of the Northern Great Plains." By F. H. McLearn. Trans. Roy. Soc., Canada, 3rd ser., vol. 25, sec. 4, March, 1931.
"Colonization in Quebec." By E. M. Kindle. Can. Geog. Jour., vol. 1, No. 5, pp. 416-439, 1930.
"Miocene Gravels in Southern Saskatchewan." By C. M. Sternberg. Roy. Soc., Canada, 3rd ser., vol. 241, sec. 4, pp. 29-30, 1930.

DIVISION OF MINERALOGY (Geological Survey)

Eugene Poitevin, Chief of the Division, reports:

The exhibit of minerals in the National Museum is growing from year to year, but available space is so limited that only small additions can be made.

Work in connexion with the preparation and sale of educational collections increases steadily from year to year and was especially heavy this year. On one occasion five hundred collections had to be prepared within one month; this involved securing, preparing, and labelling twenty thousand specimens. A considerable revenue is derived from the sale of collections and specimens.

The systematic collection, which is still at the Mineralogical Laboratory, 227 Sparks street, has been considerably increased, mostly through the efforts of the staff of the Geological Survey and by gifts from friends of the institution.

The following are the more outstanding items of museum work performed:

(1) Preparing a large mineral collection for Prof. Gordon, Academy of Natural Sciences of Philadelphia, in return for a very fine collection of rare minerals received from him.

(2) Completing a large travelling Geological Survey exhibit.

(3) Preparing a large number of collections for the Quebec Bureau of Mines.

(4) Separating duplicate specimens from the systematic mineral collection.

(5) Incorporating in the systematic collection, a large number of specimens collected in 1930 by H. V. Ellsworth and Eugene Poitevin.

Field Work

Eugene Poitevin spent about forty days in the field continuing his study of the mineralogical problems of the Thetford Mines area, Quebec. He also collected a large suite of chromite specimens and assisted Professor Gilchrist and Mr. Miller in their geophysical studies in Thetford Mines camp.

H. V. Ellsworth spent three weeks in Parry Sound district and central Ontario in the study of rare-element mineral occurrences, examining particularly the uraninite occurrences on the properties of the Ontario Radium Corporation.

Laboratory Work

As usual, a large number of minerals were submitted to the mineralogists of the division for identification and to report on as to their commercial value. This year at least five thousand specimens were so examined and reported on; last year the total number of determinations was nearly three thousand.

Research work on special problems has been conducted in the laboratory. E. Poitevin spent considerable time in a detailed study of chromite ores and their associated ultrabasic rocks. H. V. Ellsworth made a detailed investigation of various rare-element minerals including uraninites from Parry Sound district and from southeastern Manitoba, and minerals from the Ontario Radium Corporation properties. He has also made a large number of tests identifying rare-element minerals sent in by prospectors, and supplied information as to these occurrences. In addition, he spent some time revising and bringing up to date a report on Rare Element Minerals.

During the year ended R. J. C. Fabry completed the analyses of the following rocks and minerals:

Five rocks of granite type for Dr. T. T. Quirke: the Dead Island syenite, the Dokis granite, the Bekanon batholith, the Dunlop porphyry, and a diorite from Beef Tea Creek outlet.
A massive ilmenite from Wolfe county, Que.
An altered pyroxene from Glasgow pit, Canadian Asbestos Company, Black Lake, Que.
Knebellite from Bluebell mine, Kootenay lake, B.C.
Chromite from the Bennett-Martin claim, Ireland tp., Que.
Chromite from Caribou chrome pit, Que.
Stannite (partial analysis) from Snowflake mine, Albert canyon, B.C.
Three sea-oozes, collected at the time of the Atlantic cable break off Newfoundland.

In addition, tests for vanadium in some boring samples and numerous qualitative tests and ordinary chemical routine work of the division were carried out by Mr. Fabry.

Educational Collections

More than 36,000 mineral and rock specimens assembled in 850 collections, were distributed as shown in the following table:

Province	Standard	Grade 2	Grade 3	Grade 4	Special grade 4	Mineral chips	Miscellaneous	Prospectors	
								Minerals	Rocks
British Columbia	4	0	1	0	0	0	4	37	6
Alberta	0	0	0	0	0	0	0	11	2
Manitoba	2	0	1	0	0	0	2	5	0
Ontario	4	2	50	0	0	1	52	49	11
Quebec	2	0	3	50	500	1	9	13	7
New Brunswick	0	0	0	0	0	0	0	2	0
Nova Scotia	0	0	0	0	0	0	1	1	1
Foreign	0	0	0	0	0	0	10	3	3
	12	2	55	50	500	2	78	121	30

Accessions

DONATION AND EXCHANGE

Donated by Germain Filion, Secretary Treasurer, town of Lachute, Que.; feldspar from lots 23, 24, range XXIV, Arundel tp., Argenteuil co., Que.

Presented by Professor Samuel G. Gordon, The Academy of Natural Sciences of Philadelphia, U.S.A.:

1 specimen of metavauxite and paravauxite.....Llallagua, Bolivia
1 " paravauxite..... "
1 " vauxite..... "
1 " bismuthinite..... "
1 " cassiterite..... "
1 " rhodocrosite..... "
1 " pyrite from Cerro Ubina, Bolivia.
1 " cassiterite, 1 of teallite, 1 of wurtzite, from Monserrat, Bolivia; 1 specimen of tarbuttite, 1 of calamine, 1 of pyromorphite from Broken Hill, Rhodesia; 1 specimen of descloizite from Abenab, Southwest Africa; 1 specimen of corundum from Bandolier, Kop, Transvaal; 1 specimen of corundum from Louis Trichardt, Transvaal.
2 specimens of azurite, 2 of smithsonite, 1 of silver, and 9 of cerussite from Tseumb, Southwest Africa.

Presented by Mr. Hugh Park, General Manager of Nipissing Mining Company, Limited; specimen of native gold from Tern island, Mistake bay, N.W.T., 290 miles north of Churchill, west coast of Hudson bay.

Collected by H. S. Bostock, Geological Survey: suite of 29 specimens of ore and rock samples from the Nickel Plate mine, Hedley, B.C.

Presented by Louis Reamer, Orange, N.J., U.S.A.: 1 specimen of prehnite, 1 specimen of pectolite, 1 of datolite crystals from Paterson, N.J.: 1 of bustamite from Franklin, N.J.; 1 of chalcophanite from Ogdensburg, N.J., U.S.A.

Donated by Dr. J. E. Triganne, Gen. Sales Manager, Asbestos Corporation, Thetford Mines, Que.: 1 specimen of pectolite from Beaver property, Asbestos Corporation, Thetford Mines, Que.

Collected by E. Poitevin: albite, epidesmine, prehnite, natrolite, mesolite, scolecite, and thomsonite from Thetford Mines, Que.; nemalite and pectolite from Thetford, Que.; scolecite and thomsonite from Black lake, Que.; diopside, vesuvianite, garnet, and clinochlore from various localities of the serpentine belt near Coleraine, Que.; chromite from many localities in the townships of Thetford, Coleraine, and Ireland, Megantic county, Que.; ouvarovite garnets, Ireland township, Que.; kammererite from new localities in Coleraine township, Megantic county, Que.; vanadium-bearing ilmenite, tabergite, and perovskite, Nicolet lake, Que.

Collected by H. V. Ellsworth: rare-element minerals from pegmatites in the neighbourhood of Britt in Parry Sound district and from Wilberforce-Bancroft area, central Ontario.

THE SO-CALLED AGROPYRON CANINUM (L.) BEAUV. OF NORTH AMERICA

By M. O. Malte

CONTENTS

	PAGE
Introduction	27
Species and varieties in Agropyron	30
The North American allies of Agropyron caninum (L.) Beauv.	34
Literature cited	48

Illustrations

Plate I. Sterile shoots of *Agropyron repens* (L.) Beauv., and of *Agropyron Smithii* Rydb.	49
II. Sterile shoots of *Agropyron dasystachyum* (Hook.) Scribn.[1] and of *Agropyron spicatum* (Pursh) Scribn. & Sm.	51
III. Type of *Triticum Richardsoni* Schrad.	53
IV. Type of *Triticum trachycaulum* Link	55
V. Type of *Triticum subsecundum* Link	57

INTRODUCTION

Some years ago, when the writer was in charge of the Division of Forage Plants, Central Experimental Farm, Ottawa, particular attention was paid to the development of improved strains of hay and pasture plants. Among the grasses with which considerable breeding work was undertaken was Western Rye grass, commonly known as *Agropyron tenerum* Vasey, a grass comparatively recently introduced into agriculture and now rather extensively grown in the Prairie Provinces of western Canada as a hay and pasture grass.

Western Rye grass, a native of North America, occurs in an extremely large number of more or less sharply defined forms. While studying this polymorphous grass in the field, it was discovered that self-pollination apparently takes place regularly. As related elsewhere (11[2], pages 26-27), the discovery was made in 1913 at Edmonton, Alberta, where Western Rye grass forms occur in great profusion. The writer, when collecting various different forms, observed that the blossoming presented some features that indicated a mode of pollination different from that found in most other grasses. He noticed that during the opening process of the flowering glumes, immediately before pollination, the stamens did not protrude from between the lemma and the palea, as is normally the case in grasses, but remained inside. Examination of the anthers further revealed that they were much smaller than in most other species of *Agropyron*. These peculiarities led to a closer investigation of the flowering process. In watching the blossoming with the aid of a lens, it was observed that when the flowering glumes were in the act of diverging from each other, the anthers, while inside the glumes, suddenly exploded, bursting open from one end to another, and sprinkling the pollen all over the inside of the glumes. At the time of this anther explosion the stigmas were

[1] On Plate II this is printed "Vasey", but should be "Scribn".
[2] The references by numbers are to "Literature Cited," p. 48.

enclosed within the flowering glumes and consequently caught a substantial portion of the released pollen. When, after the pollination had taken place, the glumes had closed again, one or more of the empty anthers were in many cases found hidden inside the glumes, and not uncommonly one of them was found squeezed in between their edges, but never hanging outside as is the case in most other grasses. The pollination was studied in quite a number of the Western Rye grass forms which occur in the Edmonton district and, as a result, the writer became satisfied that, in the first place, self-pollination apparently is the rule and, secondly, that the chances of the pistil of a flower being fertilized by pollen from either another flower of the same plant, or from a flower of another plant, are rather small. In other words, in the matter of pollination and fertilization Western Rye grass behaves like cultivated wheat.

After these observations it was only natural to suspect that the numerous forms of Western Rye grass might normally breed true to type. In order to ascertain whether they actually breed true, seed was collected, at Calgary, Alberta, in the autumn of 1913, from nine individual plants representing conspicuously different types. The nine plants were found growing together on a vacant lot in the outskirts of the city, so close together that the writer gathered seed from several without moving. The seed thus collected from each individual plant was sown the following spring, at the Central Experimental Farm, Ottawa, in separate pots. From the seedlings secured, quite a number were picked out at random and planted in rows some distance apart, each row representing the progeny of one single plant. A year later, when the plants had reached full development, all doubt about the various forms breeding true to type was removed. There was not the slightest variation in the progeny from any one of the nine mother plants, every row being perfectly uniform. The results obtained have since been amply substantiated, and numerous experiments on a larger scale have established the fact that the large number of forms of which the so-called *Agropyron tenerum* is composed, normally breed true to type. According to Kirk (5, page 240), who has made extensive investigations, segregation may, however, occasionally occur, indicating that some plants are heterozygous for one or more characters. Kirk, therefore, concludes that some natural crossing takes place, but the extent to which it occurs has not been determined.

Although at the time primarily interested in the awnless of short-awned *A. tenerum*, the opportunity to test the related, native, long-awned plants going under the names of *A. caninum* (L.) Beauv., *A. Richardsoni* Schrad., *A. caninoides* (Ramaley) Beal, etc., was not lost. As was expected, these also proved to be normally self-pollinated and bred true to type.

At the same time experiments were also conducted with the European *A. caninum*, seed from individual plants of which was secured through the kind co-operation of Dr. H. Witte, of the Plant Breeding Institution, Svalof, Sweden. During these experiments the observation was made that, during anthesis, the European *A. caninum* behaved conspicuously differently from its North American relatives. In the European *A. caninum* the spikelets became spreading during anthesis, forming an angle of about 45 degrees with the axis of the spike, somewhat after the fashion of *A. repens* (L.) Beauv. After flowering, the spikelets moved back towards the axis, but did not, in the forms under observation, become wholly

appressed. In the corresponding North American forms no movement, or at most a very slight one, took place. The spikelets remained closely appressed to the axis both during and after anthesis.

It was also noticed that in the European *A. caninum* the anthers are about 3 mm. long, whereas, in the North American corresponding forms and in *A. tenerum* they are at most 2 mm.

The above observations led to the suspicion that what so far has passed as *A. caninum* in North America might not be conspecific with the true *A. caninum* of Europe. At the time that the biological differences between the European and the North American plants were discovered, sufficient European material was not available to determine conclusively whether the North American forms, morphologically, were sufficiently different to deserve specific distinction. Later, however, through the kindness of Dr. G. Samuelsson, of the State Museum (Riksmuseet), Stockholm, Sweden, a much appreciated opportunity has been given to examine a large and representative collection of *A. caninum* and allied species from various parts of Europe. After comparing the European collection with so-called *A. caninum* from North America and its allies, in collections of the United States National Herbarium, Washington, D.C., the Gray Herbarium, Cambridge, Mass., the Herbarium of the New York Botanical Garden, New York—to the curators of which the writer herewith expresses his sincere thanks—as well as in the National Herbarium of Canada, Ottawa, a task that entailed an examination of nearly three thousand sheets, the conclusion was reached that the true *A. caninum* (L.) Beauv. of Europe does not exist on the North American continent, except perhaps as an accidental and rare introduction.[1]

The most conspicuous difference between the European *A. caninum* and its North American relatives is that the former has the empty glumes coarsely 3-nerved, whereas in the North American forms, including the so-called *A. tenerum*, the empty glumes, with exceedingly few exceptions, have at least 4 or 5 nerves. In the North American forms the nerves are less prominent than in *A. caninum* of Europe, a fact that, to a certain extent, at least, may be accounted for by the former having thick, firm glumes, whereas in the latter they are thin and membranous. In the European *A. caninum*, furthermore, the empty glumes have a rather broad, scarious margin which, on the external side of the glumes, is widened into a projecting edge immediately below the apex. In the North American forms the scarious margin is much narrower and in many cases obsolete. It gradually peters out upwards and does not extend below the apex.

As pointed out, the North American forms have the empty glumes normally at least 4- or 5-nerved. Among the odd three thousand specimens examined, a few—less than half a dozen—from eastern Canada and northeastern United States, have most of the empty glumes 3-nerved as in *A. caninum* of Europe, but in these cases the scarious margin is not dilated below the apex. These, at first somewhat puzzling, specimens represent starved forms, occurring on Scrub pine land, in *Thuja* swamps, and in similar, poor habitats. That they do not belong to the European *A. caninum* is furthermore evident from the size of the anthers which are about 1 mm. long when emptied.

[1]Cfr. Britton and Brown: "Illustrated Flora of the Northern United States, Canada, and the British Possessions," vol. 1, p. 285 (1913).

Judging from the descriptions of *A. caninum* in European floras, particularly the very full one given in Holmberg, Skandinaviens Flora, 1926, there are some other, minor differences which, however, are not absolutely constant. *A. caninum* of Europe is described as having the leaves very scabrous on the upper side, partly with very short scabrescence, and partly with hairs about 1 mm. long. In the North American forms the leaves are also, as a rule, scabrous on the upper surface, but real hairs about 1 mm. long are not generally present. Forms with the leaves pubescent on the upper surface exist, but are apparently rather rare. Such forms have been collected by the writer in the provinces of Alberta and British Columbia. The European *A. caninum* is also described as having the culm pubescent with retrorse hairs on and below the nodes, rarely glabrous. In the North American forms the reverse seems to be the case, at least if one is to judge from herbaria, the culm being generally glabrous on and below the nodes, rarely retrorse-pubescent.

The constancy of the characters of the empty glumes, separating the European *A. caninum* from its representatives in North America, might alone be sufficient to regard the latter as belonging to a separate species. And when thereto are added the pronounced difference in the size of the anthers, and the biological difference manifesting itself in the behaviour of the spikelets during and after anthesis, there is, it would seem, ample justification for doing so.

SPECIES AND VARIETIES IN AGROPYRON

In the study of the genus *Agropyron*, as represented in Canada, the writer has come to the conclusion that the manifestly unsatisfactory classification of its members, as reflected, for instance, in keys found in floras, is in a large measure due to the overestimation of the taxonomic importance of certain characters, particularly the presence or absence of pubescence and of awn on the lemma. The comparatively small taxonomic importance of these characters becomes evident when the many forms of *Agropyron* are compared with analogous forms in other genera of *Gramineae*. Among such analogous forms the following may be quoted.

Lemma glabrous	*Lemma pubescent*
Agrostis tenuis Sibth.	var. *setulosa* (Murb.) Holmb.
Trisetum spicatum (L.) Richt.	var. *pilosiglume* Fern.
Phippsia algida (Soland.) R. Br.	f. *vestita* Holmb.
Puccinellia retroflexa (Curt.) Holmb. f. *leioneura* Holmb.	*P. retroflexa* (Curt.) Holmb.
Festuca ovina L.	f. *hispidula* Hack.
" *rubra* L.	f. *arenaria* (Osb.) Fr. and other forms.
Bromus erectus Huds.	f. *villosus* (M. & K.) Kunth.
" *sterilis* L.	f. *hirtiflorus* Borb.
" *tectorum* L.	*B. tectorum* L.
var. *nudus* Kl. & Richt.	
Bromus secalinus L.	*f. hirtus* (F. Schultz) Asch. & Gr.
Hordeum nodosum L.	var. *marinum* Koch
Elymus virginicus L.	var. *hirsutiglumis* (Scribn.) Hitchc.
" *robustus* Scribn. & Sm.	var. *vestitus* Wieg.
" *striatus* Willd. var. *arkansanus* (Scribn. & Ball) Hitchc.	*E. striatus* Willd.
" *australis* Scribn. & Ball var. *glabriflorus* (Vas.) Wieg.	*E. australis* Scribn. & Ball.
Asperella Hystrix (L.) Humb.	var. *Bigeloviana* Fern.

In the above cases the pubescent form is universally regarded as a variety, or even merely as a forma, of the glabrous species, or the glabrous form as a variety or forma of the pubescent species, as the case may be, except in the genus *Elymus* in which the various forms by some authors are all regarded as distinct species.

Among grasses, outside of *Agropyron*, in which awned and awnless forms are found, the following may be mentioned:

Lemma awnless or nearly so	*Lemma awned*
Arctagrostis latifolia (R. Br.) Griseb.	f. *aristata* Holmb.
Agrostis stolonifera L.	var. *aristata* Hartm.
" *tenuis* Sibth.	var. *aristata* (Hartm.) Holmb.
" *canina* L. var. *mutica* Gaud.	*A. canina* L.
" *hyemalis* (Walt.) BSP.	var. *geminata* (Trin.) Hitchc.
Scolochloa festucacea (Willd.) Link	f. *aristata* Hartm.
Festuca ovina L. var. *tenuifolia* (Sibth.) Dum.	*F. ovina* L.
Festuca rubra L. var. *mutica* Hartm.	*F. rubra* L.
Festuca pratensis Huds.	f. *aristata* Holmb.
Bromus secalinus L. f. *submuticus* Rchb.	*B. secalinus* L.
Elymus virginicus L. var. *submuticus* Hook.	*E. virginicus* L.
Lolium multiflorum L. var. *muticum* DC.	*L. multiflorum* L.
" *remotum* Schrank	f. *aristatum* (Doell) Asch.

In these instances the awned form is universally considered a variety or merely a forma of the awnless species, or the awnless form a variety or forma of the awned species, except in *Agrostis hyemalis* and *Elymus virginicus* in which the awned and awnless representatives by some authors are held specifically distinct.

The variations mentioned furnish a rather striking illustration of the fact that, in *Gramineae*, the diversity of many species, belonging not only to the same genus but also to different ones, expresses itself along parallel lines. This parallelism is by no means confined to the characters of the lemma, but is found equally pronounced in others, e.g. in the shape of the inflorescence of panicle-bearing grasses, such as *Agrostis stolonifera* L., *Dactylis glomerata* L., *Poa pratensis* L., *P. palustris* L., *P. compressa L.*, *Bromus inermis* Leyss. and other species of *Bromus*, species of *Puccinellia*, *Avena sativa* L., and others, as related elsewhere (12, p. 118).

The similarity in the nature of variation of several characters is, indeed, so remarkable that one cannot but agree with Vavilov (17) that it expresses not merely simple parallelism but real homology of variation, having its basis in the phylogenetic complexion of the whole family. In other words, the parallelism is so conspicuous that it most decidedly points to a universal law of homologous variation.

The recognition of such a law gives the systematist a rather definite and solid basis to work from when the taxonomic values of the characters affected are under consideration. It simply means that, within the family of *Gramineae*, all variations of the same nature ought to be considered as equals, i.e. ought to be conceded equal taxonomic rank and value.

Applied to *Agropyron* the inference is clear. The presence or absence of pubescence and awn on the lemma cannot be considered of any greater taxonomic value in *Agropyron* than in other genera of *Gramineae.*

Whether presence or absence of pubescence and presence or absence of awn on the lemma, taking *Gramineae* as a whole, are of sufficient importance and inherent quality to justify their employment as so-called essential characters in the designation of the major divisions of a genus, or what in current terminology are called species, is a question that scarcely needs discussion. That the awn character, in particular, is an unimportant one becomes obvious from the fact that the length may vary considerably in the same spike or even in the same spikelet.

The use of the above-mentioned characters, as more or less leading ones, in keys to the species, or so-called species, of *Agropyron*, clearly demonstrates the over-estimation of their taxonomic value. Their employment may bring about the grouping together of forms which clearly are widely separated taxonomically, and the placing in different camps, as it were, of forms which manifestly are closely related. On the other hand, if such characteristics as presence or absence of pubescence and presence or absence of awn on the lemma are rated as of minor importance and their employment as more or less leading characters consequently is avoided, the multitude of existing forms may, in the writer's opinion, be arranged into more natural groups, each consisting of types that obviously are closely related morphologically and probably also phylogenetically.

The species, or so-called species, of *Agropyron* reported in floras (Gray's Manual, Britton and Brown, Ill. Fl., and Rydberg, Fl. Rocky Mts.) as occurring in Canada may be divided into two main groups.

The first main group includes a number that are characterized by having very short (1-2 mm. long) anthers. They belong to Sect. *Goularda* (Husn., Gram. France, p. 93, 1896, pro gen.) emend. Vestergren apud Holmberg, Skand. Fl., pt. 2, 269, 1926, and include types going under the names of *A. caninum* (L.) Beauv., *A. caninoides* (Ramaley) Beal, *A. Richardsoni* Schrad., *A. tenerum* Vasey, *A. biflorum* (Brign.) R. & S., *A. latiglume* (Scribn. & Sm.) Rydberg, *A. andinum* (Scribn. & Sm.) Rydb. They are all tufted grasses without creeping rootstocks[1].

The second main group consists of types having anthers 3-7 mm. long. These fall into two groups.

The first group includes species that have creeping rootstocks and form open colonies, more or less dense mats, or loose clumps. Three natural sub-groups are discernible.

The first sub-group includes *A. Smithii* Rydb. and *A. molle* (Scribn. & Sm.) Rydb. These are western forms which may be found in eastern Canada as occasional introductions only. They form dense and in many cases very extended mats, due to the presence of numerous and rather crowded sterile shoots from the rootstocks. The leaves of these shoots are erect or ascending and rather crowded, with the upper ones not much overtopping the lower. As a result, the sterile shoots have a pronounced corymbiform appearance (Plate I, figure 2). The empty glumes are faintly nerved, long-attenuate, and more than three-quarters the length of the lowest lemmas. In the writer's opinion *A. molle* is merely a variety of *A. Smithii*, differing by having pubescent lemmas.

[1]For affinity and nomenclature cfr. the chapter following.

To the second sub-group belong *A. repens* (L.) Beauv. and *A. pungens* (Pers.) R. & S. These are introduced from Europe, the former being found from the Atlantic to the Pacific, and the latter confined to sandy beaches on the coast of the Maritime Provinces. They do not form as dense mats as does *A. Smithii*, but grow either in rather open colonies or in small clumps with a few flowering stalks to each. The axis of the sterile shoots is more or less elongated, and the leaves, which on the living plant generally are spreading, in some cases almost horizontally, are fairly evenly distributed from near the base of the axis to the top. They are, so to speak, racemiformly arranged (Plate I, figure 1). The empty glumes are strongly nerved, generally acute or acuminate in *A. repens*, bluntish in *A. pungens*.

The third sub-group includes *A. dasystachyum* (Hook.) Scribn., a very diversified species. The forms intergrade in a perplexing manner, the intergradations strikingly illustrating the taxonomic unimportance of such characters as presence or absence of pubescence and awn on the lemma. Series of forms may be found, in surprisingly small areas, with densely hirsute to glabrous lemma, and with perfectly awnless to long-awned lemma. Thus, to mention one example, numerous combinations of various degrees of pubescence and of length of awn have been observed by the writer at Calgary, Alberta, in an area only a few square rods in size. The forms of this sub-group either form small mats or clumps of varying density. This variation in habit cannot be taken as an indication of specific differences. It may very well be, and likely is, on a par with the variation in habit encountered in *Festuca rubra* L. and which, as has been experimentally proved, often is due to variation in the character of the soil. Thus a number of forms of *Festuca rubra* were, years ago, collected by the writer on a sandy and gravelly beach at Victoria, Vancouver island, B.C., where they were growing in extended open stands. When propagated in comparatively rich, well-cultivated soil at the Central Experimental Farm, Ottawa, Ont., they developed into dense, well-defined, tuft-like bunches, so dense, indeed, that had it not been for the characteristic basal sheaths, they might easily be taken for forms of *F. ovina* L.

The forms of the *A. dasystachyum* sub-group all have numerous sterile shoots built after the fashion of those of *A. Smithii* (Plate II, figure 1). They differ from the latter by having strongly nerved, acute, empty glumes which generally are from one-half to two-thirds the length of the lowest lemmas.

The second group of the second main group includes densely tufted forms without creeping rootstocks. Here belong *A. spicatum* (Pursh) Scribn. & Sm. and *A. inerme* (Scribn. & Sm.) Rydb. In these, the axis of the sterile shoots is elongated and their leaves arranged racemiformly as in *A. repens* (Plate II, figure 2). The empty glumes are strongly nerved and in shape and length much like those of the *A. dasystachyum* group. In herbaria, forms of the latter group with glabrous lemma may, therefore, easily be confused with forms of the *A. spicatum* group if the specimens are poorly and incompletely collected. In the field, however, the habit of growth and the construction of the sterile shoots make confusion impossible. To the writer's opinion *A. inerme* is a mere unawned variety of *A. spicatum*.

Basing the leading key characters on the above remarks, the Canadian forms of *Agropyron* may be arranged as follows:

1. Anthers at most 2 mm. long.....*A. "caninum"* and allies
1. Anthers 3 mm. long or longer
   2. Creeping rootstocks present; plants forming mats, open colonies, or loose clumps
      3. Empty glumes as a rule faintly nerved, long-attenuate; sterile shoots with corymbiformly arranged leaves.....*A. Smithii*
      3. Empty glumes as a rule strongly nerved, bluntish to acuminate
         4. Sterile shoots with racemiformly arranged leaves
            5. Empty glumes acute or acuminate.....*A. repens*
            5. Empty glumes bluntish.....*A. pungens*
         4. Sterile shoots with corymbiformly arranged leaves.*A. dasystachyum* and allies
   2. Creeping rootstocks absent; plants densely tufted; sterile shoots with racemiformly arranged leaves.....*A. spicatum*

That this arrangement is more natural than one based on presence or absence of pubescence and awn on the lemma seems substantiated by the number of chromosomes found in the various groups. According to Peto (14, page 441) the number of somatic chromosomes are as follows:

A. caninum, *A. Richardsoni*, *A. tenerum*, 28; *A. Smithii*, 56; *A. repens* and *A. pungens*, 42; *A. dasystachyum*, 28; *A. spicatum*, 14.

THE NORTH AMERICAN ALLIES OF AGROPYRON CANINUM (L.) BEAUV.

The most important paper on this subject is that of Pease and Moore, Rhodora, 12, pages 61-77, 1910, entitled *"Agropyron Caninum and Its North American Allies."* Pease and Moore deal with this group of *Agropyron* in a rather broad manner and recognize, besides *A. caninum* (L.) Beauv., the following varieties and forms: *A. caninum* f. *pubescens* (Scribn. & Smith) Pease & Moore, *A. caninum* f. *glaucum* Pease & Moore, *A. caninum* var. *tenerum* (Vasey) Pease & Moore, *A. caninum* var. *tenerum* f. *ciliatum* (Scribn. & Sm.) Pease & Moore, *A. caninum* var. *tenerum* f. *Fernaldii* Pease & Moore, *A. caninum* var. *latiglume* (Scribn. & Sm.) Pease & Moore, *A. caninum* var. *Hornemanni* (Koch) Pease & Moore, *A. caninum* var. *Hornemanni* f. *pilosifolium* Pease & Moore, *A. caninum* var. *andinum* (Scribn. & Sm.) Pease & Moore, *A. caninum* var. *Gmelini* (Ledeb.) Pease & Moore, *A. caninum* var. *Gmelini* f. *Pringlei* (Scribn. & Sm.) Pease & Moore, *A. caninum* var. *unilaterale* (Cassidy) Vasey, *A. caninum* var. *unilaterale* f. *ciliatum* (Scribn. & Sm.) Pease & Moore.

Of the above varieties and forms the var. *Gmelini* and its f. *Pringlei* deserve a few words of comment. The name *Gmelini* first appears in Ledebour, Flora Altaica, 1829, as a varietal name under *Triticum caninum*. The variety, however, was not described there, but a reference was made by Ledebour to tab. 248 of his Icones Pl. Fl. Ross. There, accompanying the plate, a description was given by Griesbach, 1831, as follows:

"Triticum caninum var. *Gmelini Tab. CCXLVIII*

"T. caducei linearis axi continuo, spiculis sub-5-floris, glumis aequalibus concavo-lanceolatis 5-nervibus acutis flosculis praelonge subuliferis dimidio brevioribus, radice fibrosa vel subrepente."

The first reference to the var. *Gmelini* made in North American literature is probably one by Vasey who, describing *Agropyron Scribneri* in Bul. Torr. Bot. Cl. X, p. 128, 1883, says that this species "is perhaps *A. caninum* var. *Gmelini*, Led.," a combination, by the way, which, as Pease and Moore point out (13, page 66), was not made by Ledebour.

Later, in U.S. Dept. Agr., Div. Agrost., Bull. No. 4, pages 30-31 (1897), Scribner and Smith describe *A. gmelini* as a species occurring from Washington to western Nebraska, stating that "this plant agrees with the figure and description of *Triticum caninum gmelini* Griseb. in Ledeb. Icon. Fl. Ross, t. 248."

On the strength of this assertion Pease and Moore (13, page 75) use the name *Gmelini* (Ledeb.) Pease & Moore for one of the varieties of *A. caninum*, thus admitting Ledebour's var. *Gmelini* as a plant occurring in North America.

Recently, however, Hultén (4, page 151) has questioned the identity of the Asiatic var. *Gmelini* and Scribner and Smith's *A. gmelini*, pointing out that the description of the latter does not fit the Asiatic plant. He, therefore, hesitates to identify the American plant with the Asiatic, and considers the latter a species of its own, calling it *A. Turczaninowii* Drobov.

An examination of specimens of *A. Turczaninowii* cited by Hultén and kindly placed at the writer's disposal by Dr. Samuelsson, Stockholm, has revealed that the Asiatic plant certainly is very different from what Scribner and Smith named *A. Gmelini*. In the first place, the Kamchatka plant has pronounced rootstocks. One of the specimens, No. 2946a, has a rootstock with two internodes, one of which is about 1 cm. long and the other 2 cm. long. This characteristic at once separates *A. Turczaninowii* Drobov from *A. gmelini* of Scribn. and Smith, which latter the authors, in their analytical key to the species of *Agropyron* (16, pages 25-26), describe as caespitose with intravaginal innovations. There are also differences in some characters of the spikelets, which made it quite clear that the two plants belong to different species. Thus, for instance, *A. Turczaninowii* has the empty glumes as well as the lemma very strongly scabrous, a character beautifully illustrated on Ledebour's tab. 248, a photograph of which has been procured through the kind assistance of Prof. Fernald, whereas in Scribner and Smith's *A. Gmelini* the lemma is smooth or finely scabrous, as in the plant commonly known as *A. Richardsoni* Schrad. In fact, most of the specimens cited by Scribner and Smith represent typical *A. Richardsoni* or forms thereof, as the writer has ascertained through an examination of the material in the United States National Herbarium, kindly loaned by Prof. Hitchcock.

A. caninum var. *Gmelini* f. *Pringlei* (Scribn. & Sm.) Pease & Moore was originally placed by Scribner and Smith as a variety of their *A. gmelini*, which, in turn, as mentioned above, was based on *Triticum caninum* var. *Gmelini* Griseb. apud Ledeb. Even a most cursory comparison between Ledebour's tab. 248 of var. *Gmelini* and Scribner and Smith's type of *A. gmelini* var. *Pringlei* makes it abundantly clear that the two belong to different species. The latter is a high-alpine grass of low stature with a tufted habit and the culms geniculate at base. The short leaves are smooth underneath and the lemma is glabrous except for the minutely scabrous tip.

There appears to be no difference between *A. Gmelini* var. *Pringlei* Scribn. & Sm. and *A. Scribneri* Vas., except that in the former the leaves are strigose above, a trivial character which at the very most may be employed as a varietal one. The two constitute an apparently good species, totally different from Ledebour's *Triticum caninum* var. *Gmelini* and also different from the so-called *A. caninum* of North America. From the latter they differ by having the anthers much longer, about 2·4 mm.

Pease and Moore further include var. *latiglume*, var. *andinum*, var. *Hornemanni* and its f. *pilosifolium*.

Concerning var. *latiglume*, originally described as a variety of *violaceum* Vasey by Scribner and Smith (16, page 30), it is a plant having "empty glumes oblanceolate, acute, with broad, scarious margins, short-awned or awnless, becoming flat with age; flowering glumes rounded on the back, densely pubescent." The oblanceolate, or even obovate, broadly scarious-margined, 3-5 nerved empty glumes, which are abruptly contracted toward the apex, are very characteristic features, although it must be admitted that, particularly in Gaspe peninsula, Quebec, forms occur in which they are less pronounced. These forms, as Pease and Moore point out (13, page 66), appear to connect *latiglume* with *A. tenerum* Vas. They have the empty glumes narrower, less abruptly contracted toward the apex, and with a narrower scarious margin. Nevertheless, the writer is inclined to consider *latiglume* a species of its own, distinct from other members of the *caninum* group. It is chiefly arctic-alpine, occurring, outside of North America, in Greenland, northern Scandinavia, northern Russia, and Siberia. As amended by Vestergren apud Holmberg (3, page 272), *A. latiglume* (Scribn. & Sm.) Rydb. includes forms having the lemma either glabrous or pubescent. It also includes long-awned forms, one of the latter with glabrous lemma being var. *andinum*.[1] The forms appearing to connect *latiglume* with *tenerum* in Gaspe peninsula are apparently analogous to *A. latiglume* subsp. *subalpinum* (Neum.) Vestergren apud Holmberg, a plant less alpine in character than *latiglume* itself.

What the variety *Hornemanni* is, is a somewhat involved question. When Koch described it, as a variety of *Triticum biflorum* (6, page 953), he cited, as a synonym, *T. violaceum* Hornem. fl. dan. t. 2044, saying also that it is a variety found "in regionibus maxime borealibus." There is, therefore, no doubt but that Koch's *Hornemanni* is a Greenland plant. Ascherson and Graebner (1, page 654), giving a fuller description of Koch's *Hornemanni*, state that it is not identical with Hornemann's *T. violaceum* in Flora Danica. On the other hand, however, they quote as a synonym *Agropyrum violaceum* Lange, Consp. Fl. Groenl. (1880). Pease and Moore quote, among other synonyms of var. *Hornemanni*, *Triticum violaceum* Hornem. and *Agropyrum violaceum* (Hornem.) Lange. Vestergren in Holmberg (3, page 272) cites *Triticum biflorum* var. *Hornemanni* of Koch and Ascherson and Graebner as a synonym of *A. latiglume*, asserting at the same time that the latter is *A. violaceum* Lange apud Rink (1857), ex parte.

---

[1] **A. latiglume** var. **andinum** (Scribn. & Sm.) n. comb.

A. violaceum (Horn.) Lge. var. *andinum* Scribn. & Sm., U.S. Dept. Agr. Div. Agrost. Bull. 4, 30 (1897).
A. biflorum (Brign.) R. & S. subsp. *andinum* (Scribn. & Sm.) Piper, Bull. Torr. Bot. Club XXXII, 547 (1905).
A. andinum (Scribn. & Sm.) Rydb., Fl. Colo., 54 (1906).

As Koch's var. *Hornemanni* was based on *Triticum violaceum* Horn., it is obvious that, in order to come to an understanding of what var. *Hornemanni* really is, it is primarily necessary to investigate the identity of Hornemann's *T. violaceum*. There is no material designated as the type of this species, but it is explicitly stated, in the explanation of the plate in Flora Danica, that it is based on material collected by J. Vahl in southern Greenland. Now, there are, in the herbarium of the Botanical Museum, Copenhagen, Denmark, two collections of *Agropyron* by J. Vahl, from southern Greenland, made prior to 1832, the year *T. violaceum* was published, one from 1828 and another from 1829.

The 1828 collection, from latitude 60° 54′, consists of three sheets with a total of five specimens. In all the specimens, which have more or less purplish spikes, the empty glumes are broadly oblanceolate or even obovate, abruptly contracted toward the apex, 3-nerved or occasionally 4-nerved, and with a broad, hyaline margin. All five specimens have the lemma more or less pubescent. None of them agrees with the description of *T. violaceum* which says that the empty glumes are 5-nerved. Neither does any of them agree with the figure of the spike in Flora Danica. One of them, however, agrees perfectly with the detail of the figure of the flower, having a lemma that is glabrous in the upper part and pubescent at the base, exactly as pictured. All the specimens of the 1828 collection belong to *A. latiglume* (Scribn. & Sm.) Rydb.

The 1829 collection, from latitude 60° 13′, consists of two sheets with one specimen each. Both have green spikes. The empty glumes are lanceolate, gradually contracted toward the apex, 4-6-nerved, and without a conspicuous, broad, hyaline margin. The lemma is glabrous throughout and not at all pubescent at the base, as figured in Flora Danica. These specimens agree, as to the general appearance of the spike, with the figure in Flora Danica, but the spike is green and not purple, as figured. The empty glumes also agree with the figure as well as with the description. This collection represents a species different from *A. latiglume*.

Considering the characteristics of the two collections just mentioned, in comparison with the figure of *T. violaceum*, one cannot but gain the impression that the latter is a composite one, the lemma, with its peculiar distribution of pubescence, and the colour of the spike, being taken from the 1828 collection, the general appearance of the spike, including the shape of the empty glumes, from the 1829 collection. This is, indeed, most probably the case as Hornemann, who had both collections before him, did not realize that they represented two different species. If the assumption is correct, the name *T. violaceum* Horn. should as a *nomen confusum* be rejected in accordance with Art. 51, sexies, of the International Rules of Nomenclature, as approved by the Fifth International Botanical Congress at Cambridge, England, 1930.

Concerning *Agropyron violaceum* Lange (7, page 155), it should be recalled that this is based on Hornemann's *Triticum violaceum*. Lange, however, modified Hornemann's original description, applying the name to a plant "palea inf. abrupte (nec sensim) in aristam excurrente," thus making the description of his *violaceum*[1] plainly applicable to J. Vahl's

[1]Lange attributes, through modesty, the transfer from *Triticum* to *Agropyron* to Rink, though it was actually made by himself (note from Dr. Porsild).

collection of 1828 which, as already pointed out, cannot be identified with either the description or the major part of the plate of *T. violaceum* in Flora Danica.

Lange's conception of *violaceum* also becomes abundantly clear from the fact that specimens which through the courtesy of Dr. Morten Porsild, the writer has from Ikertôq near Holsteinborg,[1] latitude 66° 58′, West Greenland, and which are cited in Consp. F. l. Groenl. under *A. violaceum*, are typical *A. latiglume* (Scribn. & Sm.) Rydb. and consequently do not agree with *A. violaceum* of Flora Danica.

In the circumstances *A. violaceum* Lange must be considered a later homonym and should be rejected, according to Art. 51 bis, adopted at the Fifth International Botanical Congress.

Koch's *T. biflorum* Brign. *β Hornemanni*, based on *T. violaceum* Hornem., applies to a plant with purple spike and 3-nerved empty glumes. According to Ascherson and Graebner (1, page 654), Koch's *Hornemanni* has the empty glumes wide and abruptly contracted toward the awned apex. If so, the name *Hornemanni* applies to *A. violaceum* Lange, but not to *T. violaceum* Hornem. In other words, it refers to forms of *A. latiglume* (Scribn. & Sm.) Rydb. Pease and Moore, in the key to the varieties and forms of *A. caninum* (13, page 69), separate var. *latiglume* and var. *Hornemanni*, on the presence or absence of pubescence on the lemma, the former having "glumes with a fine pubescence," and the latter having "glumes minutely ciliate on the margins, not pubescent." They cite, under var. *Hornemanni*, among others, one specimen in the National Herbarium of Canada, No. 26026, from Chilliwack valley, British Columbia. This is *A. latiglume* with glabrous flowering glumes.

In the preceding it has been pointed out that J. Vahl's collection of 1828 represents *A. latiglume* and that the collection from 1829 with green spikes represents another species. This green-spiked species was separated by Lange from his *A. violaceum* as *β virescens*. Through the courtesy of Dr. Porsild, the writer has before him a specimen from Kugssuaq in Tasermiut-fiord[2] 60° 13′ north, collected by J. Vahl, August, 1829, which has belonged to the herbarium of Lange and which is cited by him under *A. violaceum β virescens*. This, J. Vahl, according to information kindly supplied by Dr. Porsild, later identified with "*Tr. biflorum.*" *T. biflorum*–*A. biflorum* (Brignoli) R. & S.—however, has nothing to do with the Greenland plant; neither does it belong to the North American continent. It is, as the writer has satisfied himself from examination of authentic specimens, kindly loaned by Dr. G. Samuelsson, Stockholm, a nearly awnless variety of the true *A. caninum* of Europe, *A. caninum* var. *biflorum* (Brign.) Richter.

The late Tycho Vestergren considered *A. violaceum* (Horn.) Lge. *β virescens* Lge. a distinct species. On the folder originally marked *β virescens* in the herbarium of the Botanical Museum, Copenhagen, he has made the following note (unpublished): "With the exception of the uppermost specimen, all is *A. mutabile* Drob., which appears to occur on the southern tip of Greenland (about latitude 60-61), and is the same as Lange's *β virescens.*" *A. mutabile*, however, is apparently not identical with the Greenland plant. It is a species of northern Fenno-Scandia, northern

[1] Ikertok-Fjord v. Holstenborg, as Lange's writing reads.
[2] Korsoak i Tasermiut-Fjord, according to Lange's spelling.

Russia, and Siberia, characterized by prominently scabrous- or hispid-nerved, empty glumes. The lemma is scabrous or scabrous-hispid on the nerves above and generally, though less conspicuously so, also between the nerves. The anthers are 2-2·2 mm. long. According to oral information from Dr. Samuelsson, it is not at all densely tufted, but grows in large patches reaching several square meters in size. *A. violaceum β virescens*, on the other hand, has smooth, empty glumes, with the nerves smooth or nearly so, and a glabrous lemma. The anthers are 1·4-1·6 mm. long. It does not form extended patches, but grows in distinct tufts. It belongs to the polymorphous group represented by the so-called *A. tenerum* Vas. and *A. Richardsoni* Schrad, but, as no type exists, it is impossible to say what particular form it is. The plant from Lange's herbarium, referred to above, cannot be considered the type, as it is just one of several collections made in Tasermiut-fjord. It belongs to *A. trachycaulum* (Link) sensu ampl.

AGROPYRON TRACHYCAULUM (Link)

The North American forms listed by Pease and Moore under the names of *A. caninum* (L.) Beauv., *A. caninum* f. *pubescens* (Scribn. & Sm.) Pease & Moore, *A. caninum* f. *glaucum* Pease & Moore, *A. caninum* var. *tenerum* (Vasey) Pease & Moore, *A. caninum* var. *tenerum* f. *ciliatum* (Scribn. & Sm.) Pease & Moore, *A. caninum* var. *tenerum* f. *Fernaldii* Pease & Moore, *A. caninum* var. *unilaterale* (Cassidy) Vasey, *A. caninum* var. *unilaterale* f. *ciliatum* (Scribn. & Sm.) Pease & Moore, and others described in the following, constitute a natural group.

As has been stated in the preceding, a large number of forms varying from awnless so-called *tenerum* to long-awned so-called *Richardsoni* (*caninum* var. *unilaterale* of Pease and Moore) have been grown experimentally. Without exception, all these forms were fertile, thus substantiating the belief that the two extremes mentioned belong to the same Linneon. Recently, however, Peto (14, page 433) has asserted that artificial crosses between *tenerum* and *Richardsoni* made by W. Robinson at the University of Alberta, Edmonton, Canada, proved to be sterile, a fact indicating that the two parent forms should be considered belonging to different Linneons. Through the kindness of Professor J. R. Fryer, University of Alberta, the information has been gleaned, however, that the sterility is only partial as "some of the spikes from one of the plants (Mr. Robinson secured only two plants of the cross) are apparently fertile." Professor Fryer has also kindly supplied some spikes of the Robinson crosses. Several of these contained anthers which were located at the very bottom of the florets and apparently never opened. The anthers were filled with what at first glance appeared to be hybrid pollen. A closer examination, however, revealed that, although the pollen apparently was impotent, yet it was not like typical hybrid grass pollen. Most of the grains were angular. The protoplasm was translucent and yet granular, and harboured in most cases one nucleus, but in some two. These grains bore a most striking resemblance to those of certain strains of Maize figured by Eyster (1a, page 118) and are, like them, strictly speaking no pollen grains at all, but microspores stayed in their development before reaching the pollen stage. Such "pollen" is not viable and the result is male sterility. Such sterility, according to Eyster, is common in pedigreed

cultures of Maize where, of course, it does not signify hybridity between different Linneons. Consequently, the fact that male sterility of the kind described is found in artificial crosses between *A. tenerum* and *A. Richardsoni* does not necessarily mean that the two belong to different Linneons. This, furthermore, is evidenced by the results obtained from examination of the pollen of a large number of specimens in the National Herbarium of Canada. The facts brought out are as follows:

In some intermediates between so-called *A. tenerum* and *A. Richardsoni* the anthers do not open and contain the same kind of impotent "pollen" as the Robinson crosses do. In other intermediates the anthers open and contain normal pollen. The most interesting facts brought to light, however, are that some specimens of typical *Richardsoni*, with an awn about 3 cm. long, have "pollen" exactly like that of the Robinson crosses, and that specimens of typical *tenerum*, with no awn at all, were found in which more than 50 per cent of the pollen is of the same type.

Now, as total, or partial, male sterility is found in typical *tenerum* and in typical *Richardsoni*, as well as in some intermediates, but not in all, and as the male sterility, judging from the nature of the "pollen," is of the same kind as that found in Maize, its presence cannot very well be used as an argument supporting the contention that *tenerum* and *Richardsoni* belong to different Linneons.

Owing to the peculiar mode of pollination, described in the preceding, which prevents, rather effectively, the carrying of normal pollen from one spike to another, or from one plant to another, it follows that the ovules of florets in which male sterility is found to a great extent remain unfertilized. The result, of course, is that little or no seed is being developed.

The writer has, therefore, come to the conclusion that the multitude of forms that make up the *tenerum-Richardsoni* complex constitute a much diversified Linneon, or species in a wide sense. This species is confined to North America and Greenland.[1]

The oldest name for any member of the species is *A. Richardsonii*, which appears in Ind. sem. H. Berol., 1832. According to Pease and Moore (13, page 67, footnote) who state that A. H. Moore has seen a copy of Ind. H. Berol. of 1832 the name is a *nomen nudum*.

The next time the name appears is in Linnaea, XII, page 467 (1838), where a description is given, in a posthumous paper by Schrader, under *Triticum*, as follows:

> "*T. Richardsoni*. Agropyr. Richardsonii Ind. sem. H. Berol. 1832.—America borealis arctica?—A. Trit. repente vulgari differt foliis firmioribus serius involutis; spica graciliori; spiculis minus distichis paucifloris, floribus longius aristatis."

There can be no doubt about *T. Richardsoni* Schrad.[2] belonging to the Linneon under discussion. The type, from Schrader's herbarium (Plate III), is a plant nearly 1 m. high—the lowermost part is cut off—with glabrous sheaths, blades, and nodes. The empty glumes are 3-5 nerved and tipped with an awn 2–3 mm. long. The lemma is glabrous, with the

---

[1]The Linneons allied to it have a distribution as follows: *A. caninum* (L.) Beauv. Europe and western Asia; *A. mutabile* Drobov, northern Fenno-Scandia, northern Russia, Siberia; *A. latiglume* (Scribn. & Sm.) Rydb., North America, chiefly northern and western, Greenland, northern Fenno-Scandia, northern Russia, Siberia.

[2]There is no evidence that Trinius, as may be inferred from Scribner and Smith's (16, page 29) citation of the name, had anything to do with the naming of the plant.

nerves in the upper part minutely scabrous, lanceolate in outline, gradually tapering from below the middle toward the apex, and 7-10 mm. long exclusive of the awn which in the lowermost florets may reach 24 mm. in length.[1]

Prior to 1838, however, Link, in Hortus Reg. Bot. Berol., II, pages 189-190 (1833), described two species collected by Richardson in North America, viz. *Triticum trachycaulum* and *T. subsecundum*, as follows:

"28 *Tr. trachycaulum.* Folia plana rigidiuscula stricta scaberrima. Spica longiuscula, spiculae 5-7 *florae.* Valvae septemnerviae *acutatae.* Valvula ext. aristato *acutata*—Semina ex itinere in Americam borealem occidentalem attuit clar. Dr. Richardson nobisque dedit.

T. Gramen ad 4 pedes in horto altum. Caulis superne pilis brevibus rigidis asperrimus. Vaginae scabrae striatae, ligula vix nulla sed auricula ad oram vaginae; lamina ped. circiter longa sulcata asperrima 3 lin. lata. Spica ad ped. longa; spiculae 8 lin. longae; valvae valvulis parum breviores; valvulae exter. laeves superne in nervis aristaque asperae, arista lin. longa." (Plate IV).

"29. *Tr. subsecundum.* Folia plana striata scabra. Spica longa, spiculae subsecundae *triflorae, flosculo tertio* pedicellato. Valvae multinerviae aristatae *valvulis* (arista excepta) *longiores.* Valvula ext. *longe aristata*—Semina quoque ex itinere in Americam borealem occidentalem attuit cl. Dr. Richardson nobisque dedit. T. Gramen 4-5 ped. altum. Vaginae laeves, ligula brevis truncata, lamina longiuscula ad 4 poll. longa ad 3 lin. lata sat scabra. Spica 5-6 poll. longa; spicae approximatae appressae, ita conversae, ut aristae in uno latere emineant, ceterum appressae; flosculus tertius abortiens, pedicello 2–3 lin. longo tenui incluso. Valvae ad lin. longae valde scabrae, aristae 3 lin. longae. Valvula externa parum ultra 2 lin. longa, arista poll. longa; valvula interior longitudine exterioris (exc. arista) obtusa apice hirta, nervo submarginali ciliato. Parapetala ex ovato lanceolata obtusiuscula glabra. Germen apice hirtum. An genere distinguendum? Tunc *Crithopyrum* vocaverim."[2] (Plate V).

Through the kindness of Dr. L. Diels, Director of the Botanic Garden and Museum, Berlin-Dahlem, the author has had an opportunity to examine the types of the two species. *Triticum trachycaulum* Link is identical with what is generally known as *Agropyron tenerum* Vas., i.e. it is a plant with glabrous sheaths, green spikes and foliage, very short-awned lemma, the awn ranging from 1-2 mm., and with the nerves of the lemma minutely scabrous toward the apex. In the description the empty glumes are said to be 7-nerved, but in the type at Berlin they are as often 5-6-nerved. In any event, the exact number of nerves is varying, and may be influenced by soil and other conditions. Thus, as mentioned in the preceding, while in specimens of *A. tenerum* in the wild state the nerves of the empty glumes normally are at least 4 or 5, starved specimens may occasionally have only 3. On the other hand, cultivated specimens grown under more favourable conditions may often display an unusually great number of nerves on the glumes. Through the courtesy of Mr. R. I. Hamilton, the writer has had the opportunity to examine a large number of pure-bred strains of *A. tenerum* grown at the Central Experimental Farm, Ottawa. This examination has revealed the presence of a larger number of nerves than is normally found in specimens growing in their natural habitat. Thus 7-nerved glumes are frequently found, and occasionally even 8-nerved.

Triticum subsecundum Link is identical with *T. Richardsoni* Schrad. The type is a plant with glabrous sheaths, green spikes and foliage, and an awned lemma, the awn in the upper spikelets reaching a length of 20-30 mm. The anthers are about 1 mm. long when empty.

---

[1]The writer is greatly indebted to Dr. A. W. Hill, Director, Royal Botanic Gardens, Kew, for a detailed description of the type which is preserved in the Herbarium of the Botanic Garden, Leningrad.

[2]The writer is indebted to Professor Fernald for copies of the descriptions.

Either *T. trachycaulum* or *T. subsecundum*, being published simultaneously, could be taken up as a name for the Linneon under discussion. The writer prefers the former, because the description of *T. subsecundum* contains an obvious, though no doubt accidental, contradiction. In the brief diagnosis the empty glumes and lemma are described as follows: "Valvae multinerviae aristatae *valvulis* (arista excepta) *longiores*," whereas in the following full description it reads: "Valvae ad lin. longae..... Valvula externa parum ultra 2 lin. longa....." From the latter description it would appear that the empty glumes are at most half as long as the lemma, which is contradictory to what is said in the preceding diagnosis. Obviously, in the wording "Valvae ad lin. longae" a figure has through an oversight been omitted.

Agropyron trachycaulum (Link) n. comb., emend. nova, adjectis formis glumellis exterioribus longiaristatis pubescentibusque.

Triticum trachycaulum Link, Hort. Reg. Bot. Berol., II, p. 189 (1833), sens, ampl.

A. violaceum (Hornem.) Lange *β virescens* Lange, Consp. Fl. Groenl., 155 (1880).

Perennis, caespitosus radice fibrosa. Caulis saepissime erectus, ad supra 1 m. altus, viridis vel glaucus, glaber vel infra spicam scabriusculus. Folia plana, 2-8 mm. lata, rigidiuscula vel laxa, asperrima vel leves, viridia vel glauca, interdum superne pilosa. Vaginae leves vel pilosae. Spica 5-20 cm. longa, recta vel apice plus minusve curvata, concinna vel unilateralis. Spiculae semper adpressae, 1-2 cm. longae, 3-7-florae. Glumae glumellis exterioribus infimis parum breviores, lanceolatae, glaberrimae vel scabriusculae vel pilosae, (3-) 4-7 (-8)-nerviae, sensim acutatae vel breviter aristatae. Glumella exterior mutica vel arista longitudine ad 3-4 cm. instructa, glabra vel plus minusve scabriuscula vel pilosa. Antherae 1-2 mm. longae. Caryopsis apice plana.

Perennial. Caespitose with numerous sterile basal shoots or, in shade, sometimes with isolated culms, without creeping rootstocks. Culms generally erect, up to 1 m. high or more, green or glaucous, glabrous, sometimes minutely scabrous below the spike, and sometimes pubescent with short, retrorse hairs on and immediately below the nodes. Leaves 2-8 mm. wide, firm to rather lax, green or glaucous; the blades scabrous or smooth, and sometimes pubescent above; the sheaths glabrous or, particularly the lower, retrorse-pubescent. Spikes 5-20 cm. long, straight or more or less curved at the top, symmetrical or unilateral. Spikelets, exclusive of awns when such are present, 1-2 cm. long, 3-7-flowered, erect, appressed to the rhachis, even during anthesis. Empty glumes at least two-thirds as long as the lowest lemmas, firm in texture, lanceolate, broadest at or below the middle, glabrous to finely scabrous or pubescent, (3-)4-7 (-8)-nerved, narrowly to obsoletely scarious-margined, the margin gradually petering out towards the acute to short-awned apex. Lemma awnless or with scabrous awn up to 3-4 cm. long, glabrous or more often finely scabrous, particularly on the nerves and in the upper part, or sometimes pubescent. Anthers 1-2 mm. long. Caryopsis flattened at the apex.

North America: Newfoundland to British Columbia and Yukon territory; south to Tennessee, Iowa, and Colorado; also in southern Greenland.

Agropyron trachycaulum, thus amended, constitutes a unit composed of a very large number of biotypes, most of which, judging from observations so far, are homozygous and thus breed true to type. To describe and classify the multitude of the biotypes is at present out of the question, as to do so properly it would be necessary to study them in the field much more extensively than has been done so far, and also to follow up the field study with investigations in gardens or other experimental grounds where they could be grown together under identical conditions. It is feasible, however, and seems desirable, to arrange the biotypes into certain groups according to the most conspicuous morphological characters. These characters are presence or absence of pubescence on the lemma, presence or absence of awn on the lemma, presence or absence of pubescence on the leaf-sheaths, and presence or absence of glaucescence on the culm and foliage. The groups thus segregated are here termed varieties. These varieties, it should be emphasized, are by no means mono-typic. Within some of them at least may be found a large number of biotypes, differing from each other, for instance, in the relative length of awn, the relative degree of pubescence on the leaf-sheaths, the relative degree of scabrousness on the lemma, the relative width, rigidity, and roughness of the leaves, the colour of the foliage, in presence or absence of pubescence on the upper surface of the leaves, in presence or absence of pubescence on the nodes, in earliness and lateness of flowering and ripening, etc.

Key to the Varieties of A. trachycaulum [1]

1. Lemma glabrous or more or less scabrous
   2. Awn wanting or at most about half as long as the lemma
      3. Sheaths glabrous
         4. Plant green ..... var. *tenerum*
         4. Plant glaucous ..... var. *glaucescens*
      3. Some or all of the sheaths pubescent
         4. Plant green ..... var. *trichocoleum*
         4. Plant glaucous ..... var. *Fernaldii*
   2. Awn longer than the body of the lemma
      3. Sheaths glabrous
         4. Plant green ..... var. *unilaterale*
         4. Plant glaucous ..... var. *caerulescens*
      3. Some or all of the sheaths pubescent
         4. Plant green ..... var. *ciliatum*
         4. Plant glaucous ..... var. *glaucum*
1. Lemma pubescent
   2. Sheaths glabrous ..... var. *pilosiglume*
   2. Lower sheaths pubescent ..... var. *hirsutum*

[1]Recently, Hitchcock (2, p. 159) has transferred *Elymus vulpinus* Rydb. to *Agropyron* under the name of *A. richardsonii vulpinus*. Rydberg (15, pp. 540-541), when describing *Elymus vulpinus*, says: "This is one of the species connecting the genera *Elymus* and *Agropyron*. The type was originally named *Agropyron caninum unilaterale* (Cassidy) Vasey, which is the same as *A. Richardsonii*. J. G. Smith in his revision referred it to *A. Gmelini*. It resembles both a great deal in habit, but is distinguished by the hispidulous floral glumes and by the empty glumes, which are attached more or less obliquely, a character which would place the species in *Elymus* rather than in *Agropyron*."

Through the courtesy of Dr. Rydberg the writer has had the opportunity to examine the type of *Elymus vulpinus*. Superficially it resembles *A. Richardsoni* (*A. trachycaulum* var. *unilaterale* of the key), but differs in having the anthers about 2·4 mm. long, whereas in the latter they are at most 2 mm. The anthers of *Elymus vulpinus* are furthermore conspicuously narrow and shrunken, and the pollen is practically to 100 per cent sterile, with the grains very irregular in size, malformed, transparent, and void of normal, granular protoplasm. This is the kind of pollen that, according to Vestergren (18, p. 270), is found in *Agropyron* hybrids. Furthermore, as *Elymus vulpinus* morphologically appears to connect *Agropyron* and *Elymus*, it may very well be a hybrid between two species of the two genera.

A. trachycaulum var. **tenerum** (Vas.) n. comb.

Triticum trachycaulum Link, Hort. Reg. Bot. Berol. II, 189 (1833).
A. tenerum, Vasey, Bot. Gaz. 10, 258 (1885).
A. repens (L.) Beauv. var. *tenerum* (Vas.) Beal, Grasses N. Am., 2, 637 (1896).
A. tenerum longifolium Scribn. & Sm., U.S. Dept. Agr., Div. Agrost. Bul. 4, 30 (1897).
A. pseudorepens Scribn. & Sm., U.S. Dept. Agr., Div. of Agrost., Bul. 4, 34 (1897)[1].
A. pseudorepens magnum Scribn. & Sm., U.S. Dept. Agr., Div. of Agrost., Bul. 4, 34 (1897).
A. novae-angliae Scribn. apud Brainerd, Jones and Eggleston, Contr. Bot. Vt. 8, 9, 103 (1900).
A. tenerum magnum (Scribn. & Sm.) Piper, Bul. Torr. Bot. Club, 32, 546 (1905).
A. caninum (L.) Beauv., var. *tenerum* (Vas.) Pease & Moore, Rhodora, 12, 71 (1910).

Lemma glabrous or finely scabrous, awnless or with an awn not exceeding half the length of the body of the lemma. Leaf sheaths glabrous. Whole plant green.

This is western rye grass, in the strict sense of the word, which in western Canada is cultivated as a hay and pasture grass. It is composed of a very large number of more or less distinct biotypes, differing from each other, for instance, in leafiness and resultant yield of hay, width and degree of scabrousness and laxness of the leaves, length and comparative density of the spikes, size and number of florets of the spikelets, and many other characters.

Among the specimens in the National Herbarium of Canada the following may be cited: NEWFOUNDLAND—No. 99331, Grand Falls, valley of Exploits river, July 22, 1911 (*M. L. Fernald* and *K. M. Wiegand*); PRINCE EDWARD ISLAND—No. 113146, Bloomfield, Aug. 7, 1912; No. 113147, Dundee, Aug. 26, 1912 (*M. L. Fernald, B. Long*, and *H. St. John*); NOVA SCOTIA—No. 111103, Great Bras d'Or, Grand Narrows, Aug. 30, 1920 (*M. L. Fernald* and *B. Long*); No. 111102, Eel lake, July 27, 1920 (*M. L. Fernald, R. C. Bean*, and *D. White*); NEW BRUNSWICK—No. 119248, Dalhousie, Aug. 10, 1926 (*M. O. Malte*); QUEBEC—No. 115324, Alright island, Magdalen islands, Aug. 21, 1912 (*M. L. Fernald, B. Long*, and *H. St. John*); No. 67182, Mount Ste. Anne, Percé, July 24, 1905 (*J. F. Collins* and *M. L. Fernald*); No. 66051, Little Cascapedia river, July 29-30, 1904 (*J. F. Collins, M. L. Fernald*, and *A. S. Pease*); No. 66201, Bic, July 15-18, 1904 (*J. F. Collins* and *M. L. Fernald*); No. 119241 Perkins, July 14, 1923;

---

[1]A. *pseudorepens* is listed as a synonym of *A. trachycaulum*, although it was described as having creeping rootstocks. The fact is that, judging from the specimens cited by Scribner and Smith, it was founded on two distinct elements. The first specimen cited is one from Texas, collected by Nealley, 1889. This specimen is *A. Smithii* Rydb. None of the specimens cited is designated as the type and, if the Nealley specimen is considered as such on the ground that it is the first one cited, *A. pseudorepens* Scribn. & Sm. will stand as a good species and *A. Smithii* Rydb., as published later, will have to be relegated to synonymy. There is, in this case, however, good reason for considering another of the specimens cited by Scribner and Smith as the type. This is No. 2018, collected by Rydberg at Kearney, Nebraska, 1895. Scribner himself apparently considered Rydberg's 2018 the most representative one, for this is the specimen from which his figure 592 in American Grasses, illustrating *A. pseudorepens*, is drawn. Taking this into consideration, the writer would consider Rydberg's No. 2018 as the type of *A. pseudorepens*. This specimen is *A. trachycaulum* var. *tenerum*.

The writer is indebted to Prof. Hitchcock for an opportunity to examine the specimens referred to.

ERRATUM

A. trachycaulum, p. 47, should read *A. trachycaulum* var. *ciliatum*, p. 47.

No. 119240, Wakefield, July 12, 1922 *(M. O. Malte);* ONTARIO—No. 119242, Britannia, July 13, 1923 *(M. O. Malte);* No. 21910, Catfish lake, Algonquin park, July 23, 1900 *(J. Macoun);* No. 107867, peninsula, north shore of lake Superior, July 16, 1915 *(M. O. Malte);* No. 30318, Spikes point, lake Nipigon, July 8, 1884 *(J. Macoun);* No. 107789, Keewatin, July 20, 1916 *(M. O. Malte);* MANITOBA—No. 30275, Emerson, July 23, 1887 *(Fowler);* No. 108420, Winnipeg, July 15, 1911 *(M. O. Malte);* No. 12975, Brandon, July 18, 1896 *(J. Macoun);* SASKATCHEWAN—No. 30268, Touchwood hills, Aug. 12, 1872 *(J. Macoun);* No. 72894, Saskatoon, July 27, 1906 *(J. Macoun* and *W. Herriot);* No. 108432, Regina, July 23, 1911 *(M. O. Malte);* ALBERTA—No. 10430, Waterton mill, July 31, 1911; No. 108457, Porcupine hills, Aug. 18, 1915; No. 108336, Livingston valley at the Gap, Aug. 16, 1915; No. 108427, Calgary, Sept. 5, 1911; No. 119485, Banff, July 9, 1918 *(M. O. Malte);* No. 92711, Red Deer, July 22, 1917 *(C. H. Young);* No. 107812, Edmonton, July 26, 1918 *(M. O. Malte);* No. 98045, Cabin creek, Jasper park, July 29, 1918 *(J. M. Macoun);* No. 106932, Beaverlodge, July 17, 1921 *(M. O. Malte);* No. 59546, Dunvegan, July 28, 1903 *(J. M. Macoun);* No. 92014, Salt River region, Aug. 20, 1916 *(Charles Camsell);* BRITISH COLUMBIA—No. 108388, Sinclair's hot springs, Aug. 2, 1915 *(M. O. Malte);* No. 29760, Deer park, Lower Arrow lake, June 12, 1890 *(J. Macoun);* No. 106784, Vernon, July 12, 1918; No. 108447, Summerland, Aug. 31, 1911 *(M. O. Malte);* Lillooet, July 7, 1916 *(J. M. Macoun);* No. 108325, Victoria, June 26, 1914 *(M. O. Malte).*

A. trachycaulum var. **glaucescens** n. var.

Planta glauca. Glumella exterior glabra vel scabriuscula, mutica vel arista glumella maxime dimidio breviore instructa. Vaginae glabrae.

Plant glaucous. Lemma glabrous or finely scabrous, awnless or with an awn not exceeding half the length of the body of the lemma. Sheaths glabrous.

Specimens in the National Herbarium of Canada: QUEBEC—No. 68979, Cap à l'Aigle, Aug. 8, 1905 *(J. Macoun);* SASKATCHEWAN—No. 106843, Indian Head, July 21, 1917 (type!) *(M. O. Malte);* BRITISH COLUMBIA—No. 119494, Comox, July 22, 1915 *(M. O. Malte).*

A. trachycaulum var. **trichocoleum** (Piper) n. comb.

A. tenerum Vasey var. *ciliatum* Scribn. & Sm., U.S. Dept. of Agr., Div. Agrost., Bul. 4, 30 (1897), not *A. trachycaulum*, p. 47.

A. tenerum trichocoleum Piper, Bul. Torr. Bot. Club, 32, 546 (1905).

A. caninum (L.) Beauv. var. *tenerum* (Vasey) Pease & Moore f. *ciliatum* (Scribn. & Sm.) Pease & Moore, Rhodora, 12, 72 (1910).

Plant green. Lemma glabrous or finely scabrous, awnless or with an awn not exceeding half the length of the body of the lemma. At least the lowest sheaths pubescent.

Specimens in the National Herbarium of Canada: QUEBEC—No 115323, Grosse isle, Magdalen islands, Aug. 16, 1912 *(M. L. Fernald, B Long,* and *H. St. John);* No. 68981, Cap à l'Aigle, Aug. 8, 1905 *(J. Macoun);* No. 119239, Wakefield, June 12, 1922 *(M. O. Malte);* ALBERTA—Nos. 107783-107785, Edmonton, July 25, 1916, Nos. 107819, 108147, Edmonton, July 26-28, 1918 *(M. O. Malte);* BRITISH COLUMBIA—No. 91632, Lillooet, July 8, 1916 *(J. M. Macoun).*

A. trachycaulum var. **Fernaldi** (Pease & Moore) n. comb.

A. caninum (L.) Beauv. var. *tenerum* (Vasey) Pease & Moore f. *Fernaldii* Pease & Moore, Rhodora, 12, 73 (1910).

Plant glaucous. Lemma glabrous or finely scabrous, awnless or with an awn not exceeding half the length of the body of the lemma. At least the lowest sheaths pubescent.

Specimens in the National Herbarium of Canada: NEW BRUNSWICK—No. 119247, Dalhousie, Aug. 10, 1926 *(M. O. Malte);* QUEBEC—No. 115322, Grosse isle, Magdalen islands, Aug. 16, 1912 *(M. L. Fernald, B. Long,* and *H. St. John);* No. 68978, Cap à l'Aigle, Aug. 24, 1905 *(J. Macoun).*

A. trachycaulum var. **unilaterale** (Vasey) n. comb.

A. caninum Am. auth., not *A. caninum* (L.) Beauv. Agrost., 146 (1812).

Triticum subsecundum Link, Hort. Reg. Bot. Berol., II, 190 (1833).

A. Richardsoni Schrad., Linnaea, XII, 467 (1838).

A. unilaterale Cassidy, Colo. State Agr. Coll. Exp. Sta. Bul. 12, 63 (1890), not *A. unilaterale* Beauv., Agrost., 102 (1812).

A. caninum (L.) Beauv. var. *unilaterale* (Cassidy) Vasey, Contr. U.S. Nat. Herb. I, 279 (1893).

A. caninum (L.) Beauv. f. *violascens* Ramaley, Geol. Nat. Hist. Surv. Minn.—Minn. Bot. Studies, Bul. 9, 107 (1894).

A. violaceum (Hornem.) Lange f. *caninoides* Ramaley, Geol. Nat. Hist. Surv. Minn.—Minn. Bot. Studies, Bul. 9, 108 (1894).

A. violascens (Ramaley) Beal,[1] Grasses N. Am., II, 635 (1896).

A. caninoides (Ramaley) Beal, Grasses N. Am., II, 640 (1896).

Lemma glabrous or finely scabrous, bearing an awn longer than its body. Sheaths glabrous. Whole plant green.[2]

Among the specimens in the National Herbarium of Canada the following may be cited: NEWFOUNDLAND—No. 99329, Stephenville, region of St. George bay, Aug. 15, 1910 *(M. L. Fernald* and *K. M. Wiegand);* NOVA SCOTIA—No. 119525, Weymouth, Aug. 25, 1913 *(M. O. Malte);* No. 103756, Bridgewater, Aug. 16, 1921 *(M. L. Fernald* and *B. Long);* NEW BRUNSWICK—Nos. 119249-119252, at the junction of Restigouche and Matapedia rivers, Aug. 7, 1926 *(M. O. Malte);* QUEBEC—Nos. 73562-73563, Ste. Anne des Monts river, Aug. 16, 1906 *(M. L. Fernald* and *J. F. Collins);* No. 68982, Port à Persis, 20 miles below Cap a l'Aigle, Aug. 19, 1905 *(J. Macoun);* No. 121174, La Trappe, Aug. 3, 1926 (frère *Louis-Marie);* ONTARIO—No. 119243, Kemptville, July 20, 1923 *(M. O. Malte);* No. 30298, Niagara Falls, July 5, 1882 *(J. Macoun);* No. 26023, Sarnia, Aug. 16, 1910 *(J. Macoun);* No. 116344, Timagami Forest Reserve, July 17, 1922 *(W. R. Watson);* MANITOBA—No. 108419, Winnipeg, July 15, 1911; No. 108418, Brandon, July 19, 1911 *(M. O. Malte);* SASKATCHEWAN—No. 13130, north of Prince Albert, July 4, 1896; No. 12966, Moose Jaw, Aug. 13, 1895 *(J. Macoun);* ALBERTA—No. 13121, Cardston, July 25, 1895; Calgary, July 21, 1897; No. 64790, Hector, Aug. 4, 1904 *(J. Macoun);* Nos. 106847-

[1]Beal describes this as having the awn of the lemma "about 2 mm. long." This evidently is a misprint, as the species is the same as *A. unilaterale* Cassidy, which originally was described as having the awn 2 inches long.

[2]Too much stress has apparently by some authors been laid on the unilateral appearance of the spike. It is true that, when well developed, it is a rather striking character, but it not infrequently happens that both unilateral and symmetric spikes are found in the same plant. This is also the case in var. *tenerum.*

106849, Edmonton, July 26, 1917; No. 108035, Jasper, July 31, 1917; Nos. 106913, 106914, Beaverlodge, July 18, 1921 *(M. O. Malte);* Nos. 92012, 92013, Salt River region, Aug. 20, 1916 *(Charles Camsell);* BRITISH COLUMBIA—No. 108344, Invermere, July 31, 1915; Nos. 106783, 106778, Vernon, July 12, 1918 *(M. O. Malte);* YUKON TERRITORY—No. 106842, Whitehorse rapids, Yukon river, Sept. 2, 1902 *(J. Macoun);* No. 106842, Dawson, Aug. 10, 1916 *(M. O. Malte).*

A. trachycaulum var. **caerulescens** n. var.

Planta glauca. Glumella exterior glabra vel scabriuscula, arista glumella longiore instructa. Vaginae glabrae.

Glaucous. Lemma glabrous or finely scabrous, bearing an awn longer than its body. Sheaths glabrous.

Specimens in the National Herbarium of Canada: ALBERTA—No. 108310, Banff, Aug. 5, 1915 *(M. O. Malte);* BRITISH COLUMBIA—No. 107855, Comox, Vancouver island, July 22, 1915 (type!) *(M. O. Malte.)*

A. trachycaulum var. **ciliatum** (Scribn. & Sm.) n. comb.

A. Richardsoni Schrad. var. *ciliatum* Scribn. & Sm., U.S. Dept. Agr., Div. Agrost. Bul. 4, 29 (1897).

A. caninum var. *pubescens* Scribn. & Sm., U.S. Dept. Agr., Div. Agrost., Bul. 4, 29 (1897).

A. caninum (L.) Beauv. var. *unilaterale* (Cassidy) Vasey f. *ciliatum* (Scribn. & Sm.) Pease & Moore, Rhodora, 12, 76 (1910).

A. caninum (L.) Beauv. f. *pubescens* (Scribn. & Sm.) Pease & Moore, Rhodora, 12, 71 (1910).

Plant green. Lemma glabrous, bearing an awn longer than its body. At least the lower sheaths pubescent.

Of specimens in the National Herbarium of Canada, the following may be cited: QUEBEC—No. 85659, Beaver meadow, Hull, June 30, 1911 *(J. Macoun);* ONTARIO—No. 119245, Lemieux island, Ottawa, Aug. 9, 1923 *(M. O. Malte);* No. 30299, near Shannonville, June 14, 1866 *(J. Macoun);* MANITOBA—No. 106686, Brandon, Aug. 2, 1918 *(M. O. Malte);* SASKATCHEWAN—No. 12962, Prince Albert, July 13, 1896 *(J. Macoun);* ALBERTA—No. 18595, Crowsnest pass, July 29, 1897 *(J. Macoun);* No. 107813, Edmonton, July 26, 1918 *(M. O. Malte);* BRITISH COLUMBIA—No. 30296, Golden, July 10, 1885 *(J. Macoun);* No. 101852, Little Shuswap lake, June 18, 1889 *(J. Macoun)*[1].

A. trachycaulum var. **glaucum** (Pease & Moore) n. comb.

A. caninum (L.) Beauv. f. *glaucum* Pease & Moore, Rhodora 12, 71 (1910).

Plant glaucous. Lemma glabrous or finely scabrous, bearing an awn longer than its body. At least the lower sheaths pubescent.

Specimens in the National Herbarium of Canada: NOVA SCOTIA—No. 111101, Great Bras d'Or, Kidstone island, Aug. 28, 1920 *(M. L. Fernald* and *B. Long);* ALBERTA—No. 107776, Edmonton, July 25, 1916; No. 108465, Edmonton, July 25, 1921 *(M. O. Malte).*

[1]This is the specimen upon which *A. caninum* (L.) Beauv. var. *pubescens* Scribn. & Sm. is based. It is an extreme form of their *A. Richardsoni* Schrad. var. *ciliatum* with both sheaths and blades densely pubescent. According to the inscription on the label it was collected at "Chase Lake s. of Kamloops." According to information secured from the late Senator the Hon. Hewitt Bostock, Chase lake is the same as what is now officially known as Little Shuswap lake. Scribner and Smith give the locality as "Little Sheisemp Lake," which is obviously an orthographic error.

A. trachycaulum var. **pilosiglume** n. var.

Planta viridis. Glumae glumellaeque exteriores pubescentes. Glumella exterior aristata, arista glumella saepissime longior. Vaginae glabrae.

Plant green. Empty glumes and lemma pubescent, the latter with an awn generally longer than its body. Sheaths glabrous.

Specimen in the National Herbarium of Canada: BRITISH COLUMBIA —No. 108309, Victoria, Vancouver island, June 14, 1914 (type!) *(M. O. Malte).*

A. trachycaulum var. **hirsutum** n. var.

Planta viridis. Glumae glumellaeque exteriores pubescentes. Glumella exterior aristata, arista glumella brevior vel subaequalis. Vaginae inferiores pubescentes.

Plant green. Empty glumes and lemma pubescent, the latter with an awn varying from much shorter than to subequal to its body. Lower sheaths (and also upper side of lower blades) pubescent.

Specimen in the National Herbarium of Canada: BRITISH COLUMBIA —No. 88698, Beacon hill, Victoria, Vancouver island, July 16, 1913 (type!) *(J. Macoun).*

LITERATURE CITED

1. Ascherson, P., and Graebner, P.: "Synopsis der Mitteleuropäischen Flora"; Bd. 2, Leipzig, 1898-1902.
1a. Eyster, W. H.: "Heritable Characters of Maize"; Journal of Heredity, vol. 22, pp. 117-119 (Baltimore, Md., 1931).
2. Hitchcock, A. S.: "New Species of Grasses from the United States"; Proc. Biol. Soc. Washington, vol. 41, pp. 157-163 (1928).
3. Holmberg, O. R.: Skandinaviens Flora, pt. 2, Stockholm, 1926.
4. Hultén, E.: "Flora of Kamtchatka and the Adjacent Islands"; pt. I, Kungl. Svenska Vetensk.—Akad. Handl., tredje ser, bd. 5, No. 1 (Stockholm, 1927).
5. Kirk, L. E.: "The Improvement of Western Rye Grass, *Agropyron tenerum* Vasey"; Sci. Agriculture, Ottawa, vol. 10, pp. 239-250 (1929).
6. Koch, W. D. J.: "Synopsis Florae Germanicae et Helveticae"; Ed. II, Francofurti ad Moenum, 1843.
7. Lange, Joh.: "Conspectus Florae Groenlandicae"; Kjobenhavn, 1880.
8. Ledebour, C. F.: "Flora Altaica"; vol. I, Berolini, 1829.
9. Ledebour, C. F.: Icones Pl. Nov. imperf. cogn. Flor. Ross, vol. III (Rigae, 1831).
10. Link, J. H. F.: Hort. Reg. Bot. Berol., 1833.
11. Malte, M. O.: "Breeding Methods in Forage Plants"; Sci. Agriculture, vol. I (Gardenvale, Quebec, 1921).
12. "Commercial Bent Grasses (Agrostis) in Canada"; National Museum of Canada, Ann. Rept. 1926, pp. 105-126 (Ottawa, 1928).
13. Pease, A. S., and Moore, A. H.: "Agropyron Caninum and Its North American Allies"; Rhodora, vol. 12, pp. 61-77 (Boston, Mass., 1910).
14. Peto, F. H.: "Cytological Studies in the Genus Agropyron"; Can. Jour. of Research, vol. 3, pp. 428-448 (Ottawa, 1930).
15. Rydberg, P. A.: Studies on the Rocky Mountain Flora XIX, Bul. Torr. Bot. Club, vol. 36, pp. 531-541 (New York, 1909).
16. Scribner, F. Lamson, and Smith, J. F.: "Native and Introduced Species of the Genera Hordeum and Agropyron"; U.S. Dept. Agr., Div. Agrost., Bull. 4, pp. 23-36 (Washington, 1897).
17. Vavilov, N. I.: "The Law of Homologous Series in Variation"; Jour. of Genetics, vol. 12, pp. 47-89 (Cambridge, 1922).
18. Vestergren, T.: "Agropyron littorale (Host) Dum. En mediterran atlantisk art vid Nordeuropas kuster"; Svensk Bot. Tidskr., vol. 19, pp. 263-288 (Stockholm, 1925).

PLATE I

Figure 1. Sterile shoots of *Agropyron repens* (L.) Beauv. Scale 7/64.
Figure 2. Sterile shoots of *Agropyron Smithii* Rydb. Scale 7/64.

PLATE II

Figure 1. Sterile shoots of *Agropyron dasystachyum* (Hook.) Vasey. Scale 7/64.
Figure 2. Sterile shoots of *Agropyron spicatum* (Pursh) Scribn. et Sm. Scale 7/64.

PLATE III

Type of *Triticum Richardsoni* Schrad. Courtesy of Dr. A. W. Hill, Kew, England.

PLATE IV

Type of *Triticum trachycaulum* Link. Courtesy of Dr. A. W. Hill, Kew, England.

PLATE V

Type of *Triticum subsecundum* Link. Courtesy of Dr. L. Diels, Berlin, Germany.

DINOSAUR TRACKS FROM PEACE RIVER, BRITISH COLUMBIA

By C. M. Sternberg

CONTENTS

	Page
Introduction	59
Age and environment	60
Systematic descriptions	61

Illustrations

Plate I.	Trackways of *Irenesauripus mclearni*	77
II.	*Irenesauripus mclearni*	79
III.	1. *Irenesauripus occidentalis*	81
	2. *Irenesauripus acutus*	81
	3. *Columbosauripus ungulatus*	81
IV.	1. *Gypsichnites pacensis*	83
	2. Cast of *Amblydactylus gethingi*	83
V.	1. Trackways of *Tetrapodosaurus borealis*	85
	2. Cast of *Tetrapodosaurus borealis*	85
Figure 1.	*Irenesauripus mclearni*	63
2.	*Irenesauripus acutus*	64
3.	*Irenesauripus occidentalis*	66
4.	*Columbosauripus ungulatus*	67
5.	*Irenichnites gracilis*	69
6.	*Gypsichnites pacensis*	70
7.	*Gypsichnites pacensis*	71
8.	*Amblydactylus gethingi*	73
9.	*Tetropodosaurus borealis*	75

INTRODUCTION

The first dinosaur track to be observed in North America, and probably the first observed anywhere, was ploughed up by Pliny Moody, near South Hadley, Mass., in 1800.[1] Dinosaurs were unknown at that time and young Moody regarded the impression as representing the track of Noah's raven. The earliest scientific description of dinosaur tracks in North America was published by Prof. Edward Hitchcock, in 1836[2], when he described and figured a number of imprints from Triassic rocks of the Connecticut valley, as *Ornithichnites* or stony bird tracks. The first discovery of Canadian dinosaur tracks was made in 1922, in Peace River canyon, B.C., by F. H. McLearn, and was mentioned by him in the Summary Report of the Geological Survey, Canada, for that year (part B, page 5). These are the most northerly dinosaur tracks known to the writer. The only dinosaur tracks in Canada that have been fully described are from the Edmonton formation of Alberta, described by the writer[3] as *Ornithomimipus angustus*.

[1]The Hitchcock Lecture upon Ichnology by N. M. Grier, Am. Mid. Nat., vol. X, No. 7.
[2]Am. Jour. Sci. and Arts, vol. 29, pp. 307-340 (1836).
[3]Sternberg, C. M.: Geol. Surv., Canada, Bull. 44, pp. 85-87, Pl. XVIII.

It is puzzling why such a field as that of the Edmonton and Belly River formations, along Red Deer river, Alberta, which has yielded so many well-preserved skeletons of dinosaurs, has afforded only one specimen of tracks, whereas the Connecticut valley, from which thousands of dinosaur tracks have been collected, has yielded very few skeletal remains. In the new, Peace River field, likewise, tracks and osseous remains are not equally mingled, for though more than four hundred dinosaur tracks were observed not even a fragment of bone was found.

During the field season of 1930, the writer investigated the Peace River Canyon locality and collected specimens that would make suitable exhibits for the National Museum of Canada. In other cases plaster moulds were taken of the tracks or the trackways.

The writer is indebted to Mr. Neil Gething and his sons, of Hudson Hope, B.C., who rendered valuable assistance. Mr. Gething was with Mr. McLearn when the original discovery was made and has since located other tracks and has done valuable work in protecting them from destruction. Miss Alice E. Wilson has given valuable assistance in devising generic and specific names used in the following account and Mr. A. Miles made the drawings that illustrate it.

AGE AND ENVIRONMENT

Peace River canyon in many places has precipitous walls and the gorge is very narrow. From the head of the canyon, about 12 miles west of Hudson Hope, B.C., the river falls 272 feet before reaching the lower end of the canyon at Hudson Hope. In the upper half of the canyon the river has cut through the coal-bearing or Gething member of the Bullhead Mountain formation. The beds dip at angles of 7 to 15 degrees to the south and southwest, and as a result of their attitude and the direction followed by the river several hundred feet of the strata are visible along the floor of the canyon. These beds at times of high water are covered, but at low water they are revealed as rock shelves some of which are 100 feet or more wide. On these rock shelves more than four hundred dinosaur tracks were observed.

McLearn has correlated these beds with the lower Blairmore[1] of about middle Lower Cretaceous age. At the 1930 meeting of the Paleontological Society of America, McLearn, in a short paper on the environment of the tracks, stated: "The sandstone layers have ripple-marks, chiefly of the symmetrical (wave) type. The shale beds have mud-cracks. They are interpreted as the deposits of shallow flood-plain lakes whose bottoms were exposed as mud flats at times of low water. It was across these flats that the tracks were made." Extensive peat bogs were present and at certain periods deposition must have been very slow, for there are a number of beds of clean, semi-bituminous coal, one of which, the Grant seam, is nearly 6 feet thick.

Dinosaur tracks were observed at various horizons, from the Riverside seam[2] upward through more than 500 feet of strata, and for a distance of about 3 miles along the river. Time did not permit an examination of the

[1]McLearn, F. H.: Trans. Roy. Soc., Canada (3), vol. XXV, sec. IV, p. 6 (1931).
[2]See McLearn's section, Geol. Surv., Canada, Sum. Rept. 1922, pt. B, pp. 31-36.

upper part of the canyon. In some cases the imprints are on thin-bedded, ripple-marked sandstone, whereas in other cases they are on massive, clay-ironstone beds. In places upright stems or roots of plants are very numerous in the stratum on which the tracks are preserved. Many of the clay beds show mud-cracks. On some of the strata tracks are quite numerous, whereas at other horizons only an occasional imprint is visible, but as the exposed area of many of the horizons is small no significance may be attached to this condition. Several long trackways are visible and along some of these the character of the surface or the indicated speed of travel of the animal is quite different at the two ends of a trackway.

In the early days of the study of fossil footprints, species were sometimes described which differed from other species mainly or solely in size of imprint, length of stride, and width of trackway. Study of the Peace River tracks seems to show that these characters alone are not always diagnostic. Though a great difference in size may as a rule be sufficient reason for specific differentiation, yet the tracks of one species about to be described vary from 11 to 16 inches in length. Although a relatively long stride does, of course, indicate a long-legged animal, it is also true that the length of stride and the width of trackway have a definite relation both to the speed of travel of the animal and to the nature of the travelled surface. In several trackways at horizons below the Grant seam (Gething's mine), Peace River canyon, the mud was so soft that the dinosaur sank deeply into it and when the foot was withdrawn the mud so closed in that only saucer-like depressions remained. In these trackways the tracks are wide apart and the stride much shorter than is usual where the surface was more solid. In one trackway (*See* Figure 5) the stride progressively shortens from 31 to 27 inches. In another trackway of the same species and size of track, the stride is only 21 inches. In still another trackway, consisting of sixteen imprints, the tracks for the greater part of the trackway are in almost a direct line and the average stride is 37 inches. Three of the imprints, however, indicate a rather sudden stopping, and there the trackway is wider and the stride only 26½ inches (*See* Plate II).

SYSTEMATIC DESCRIPTIONS

Some early students attempted to correlate footprints with the osseous remains, but Hay[1] and Lull[2] study tracks without attempting to correlate species of tracks with species of animals, even where they are quite confident as to which animal made the tracks. The latter course is the better, for seldom can one be certain of the nature of the animal that made the tracks. In fact in the case of dinosaur tracks it is not always certain to which order of dinosaurs the animal that made the tracks belongs. Lull proposed (Loc. cit.) eight families to include the Connecticut Valley ichnites. It seems unwise, at this time, to propose more new families than are absolutely necessary and, therefore, in the following account most of the genera are tentatively referred to one or another of Lull's families, though it is fully recognized that in some cases they do not entirely correspond with the family characters as given by Lull.

[1]Hay, O. P.: U.S. Geol. Surv., Bull. 179, p. 538 (1902).
[2]Lull, R. S.: Mem. Boston Soc. Nat. Hist., vol. 5, pp. 461–557 (1904); State Geol., Nat. Hist. Su v., Conn. Bull 24, p. 173 (1915).

Genus, IRENESAURIPUS[1] new genus

Genotype, *Irenesauripus mclearni* new species

Generic Characters. Large; semidigitigrade; functionally tridactyle; toes well separated; heel of variable width, but always completely impressed; weight borne equally by the three toes and the metatarsal pad; phalangial pads not well defined; claws acuminate; no manus or caudal impressions.

This genus is tentatively referred to Lull's family Gigandipodidæ, though it fails to meet all the requirements as given by Lull in that there is no impression of the hallux or the tail. The hallux had probably moved up on the foot sufficiently to leave no impression. The caudal trace is not always present in the Triassic forms.

Tracks of this genus were probably made by some of the larger carnivorous forms.

Irenesauripus mclearni[2] new species

Plates I and II; and Figure 1

Type. Cat. No. 8548, Geol. Surv., Canada, consists of a slab with the last three tracks of a trackway of sixteen impressions.

Locality and Horizon. Peace River canyon, north side, about 2 miles upstream from Gething's mine, on a stratum 290 feet above Grant seam, Gething member of Bullhead Mountain formation.

Description. Tracks of this species are the most numerous of all those in Peace River canyon and were observed at various horizons from below the Grant seam to well above the horizon from which the type was collected. The tracks vary from 11 to 16 inches in length. Normally they are almost in a direct line and the stride is approximately three times the length of the track, but these characters vary with the nature of the surface and the speed of the animal.

The longest stride in the trackway of sixteen tracks, of which the type specimen is a part, was 1,065 mm. and the average 940 mm. In that part of the trackway not collected the imprints were almost in a direct line; in that part collected (the type), the animal appears to have halted rather suddenly, with the result that the stride is much shorter, the tracks are wider apart, and more weight was thrown on the heel. In this, as well as in another trackway of this species (Plate I), there is a depression at the back of the imprint that appears to have been made by the dragging of the central toe as the foot was coming to rest. In other trackways of this species this "drag" is not shown.

The weight was borne equally by the three toes and the metatarals pad or the so-called heel. The heel is moderately narrow. The toes are separated well back and there is no indication of a web or extensive pad. They taper gradually from near the proximal ends and terminate in rather sharp claws.

Greatest length of track, from posterior edge of centre of heel to tip of digit III, 380 mm.; from posterior edge of heel to tip of digit II, 292 mm; from same point to tip of digit IV, 280 mm. Greatest breadth of track 318 mm. Divarication of digits II and III, 37 degrees; of III and IV, 33 degrees.

---

[1]Saurian or lizard foot of Peace River country.

[2]This species is named in honour of Mr. F. H. McLearn, who discovered the tracks.

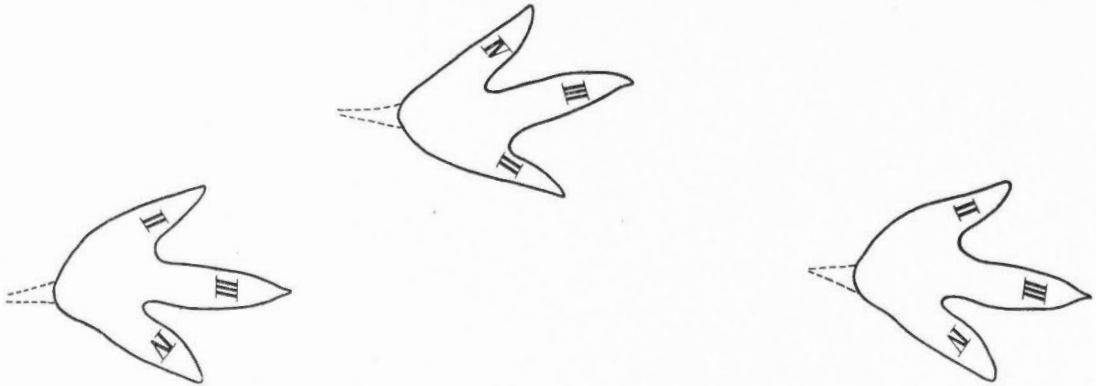


Figure 1. *Irenesauripus mclearni;* type, Cat. No. 8548, Geol. Surv., Canada; one-twelfth natural size.

Irenesauripus acutus new species

Plate III, figure 2; and Figure 2

Type. Cat. No. 8549, Geol. Surv., Canada, consists of plaster cast of right pes imprint (*See* Figure 2) from trackway of six tracks.

Locality and Horizon. Peace River canyon, north side, about 1½ miles upstream from Gething's mine, on a stratum 216 feet above Grant seam, Gething member of Bullhead Mountain formation.

Description. These tracks, the only ones observed of this species, are on a massive bed of clay-ironstone. It was not feasible to collect the original imprints, so a plaster mould was taken from which an exact reproduction of the track was made.

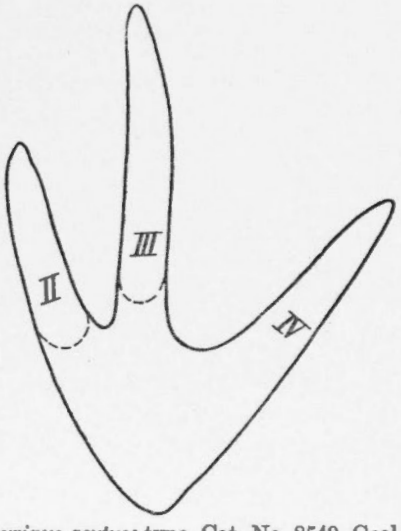


Figure 2. *Irenesauripus acutus;* type, Cat. No. 8549, Geol. Surv., Canada; one-eighth natural size.

The imprint is large; roughly triangular; the heel is very narrow; the digits are long, slender, straight, and of nearly uniform width throughout; digits II and III are quite deeply impressed. The digits are more slender, the whole track more angular, and the heel narrower than in *I. mclearni.* Digit IV is more widely separated from III than is II. The tracks are almost in a direct line and the stride is 1,730 mm., which would suggest a rather long-legged animal.

Greatest length of track, from posterior edge of centre of heel to tip of digit III, 535 mm.; from same point to tip of digit II, 405 mm.; to tip of digit IV, 415 mm. Greatest breadth, between outer edges of digits II and IV, 400 mm. Divarication of digits II and III, 18 degrees; of III and IV, 40 degrees.

Figure 2, Plate III, is from a photograph of a different track of the same trackway. The two tracks differ in the depth of the heel impression and the divarication of digits III and IV. It is quite probable that in the track of which the cast was made digit IV is spread more than is normal.

Irenesauripus occidentalis new species

Plate III, figure 1; and Figure 3

Type. Cat. No. 8550, Geol. Surv., Canada, consists of trackway of four large tracks.

Locality and Horizon. Peace River canyon, north side, about 1¾ miles upstream from Gething's mine, on a stratum 262 feet above Grant seam, Gething member of Bullhead Mountain formation.

Description. Tracks large; heel broad; toes narrow but well spread; stride short; trackway moderately broad. Greatest length of track, from centre of posterior edge of heel to tip of digit III, 500 mm., from same point to dip of digit II, 400 mm.; to tip of digit IV, 400 mm. Breadth of track, across digits II and IV, 465 mm. Divarication of digits II and III, 33 degrees; of III and IV, 40 degrees. Length of stride 960 to 1,000 mm.

These tracks are preserved on very fine-grained, thin-bedded, ripple-marked sandstone. The impressions are shallow. The shortness of the stride and the width of the trackway may be partly due to slow movement of the animal when making the tracks.

Genus, COLUMBOSAURIPUS[1] new genus

Genotype, *Columbosauripus ungulatus* new species

Generic Characters. Small; bipedal; semidigitigrade; functionally tridactyle; toes well spread and carrying the main weight; proximal ends of toes enclosed in pad or web; digit II not cut away from metatarsal pads; toes tapering and terminating in long, sharp claws; heel well rounded; phalangial pads not well shown.

This genus might be correlated with one of the smaller carnivorous forms. It is tentatively referred to the family Grallatoridæ established by Lull (Loc. cit.).

Columbosauripus ungulatus new species

Plate III, figure 3; and Figure 4

Type. Cat. No. 8551, Geol. Surv., Canada, consists of one original imprint of left (?) pes.

Locality and Horizon. Peace River canyon, north side, about 1½ miles upstream from Gething's mine, on a stratum 213 feet above Grant seam, Gething member of Bullhead Mountain formation.

Description. This imprint shows very good detail, but no distinct phalangial pads. The digits are distinctly separated in their distal halves. The pads of the proximal phalangies and the metatarsals seem to have been merged into one big pad, as there is no sign of separation between them. The heel is broadly rounded, but only faintly impressed. The

[1]This generic name signifies the foot of a saurian from British Columbia.

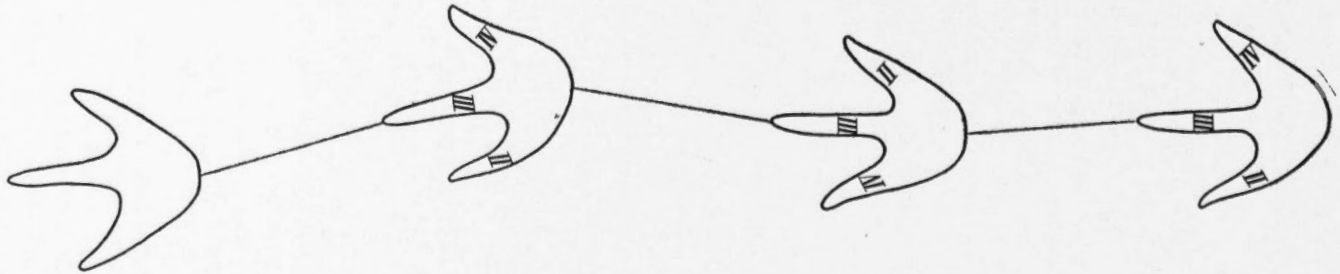


Figure 3. *Irenesauripus occidentalis;* type, Cat. No. 8550, Geol. Surv., Canada; one-twentieth natural size.

digital impressions to near their distal ends taper very gradually, beyond this they narrow abruptly and terminate in long, vertical slits, which must have been made by long, narrow claws.

The total length of the track, measured from the posterior edge of the centre of the heel to the tip of the central toe, is 125 mm.; greatest breadth, across digits II and IV, 125 mm.; centre of heel to tip of digit II, 95 mm.; same point to tip of digit IV, 100 mm. Divarication of digits II and III, 38 degrees; of III and IV, 39 degrees.

Figure 4. *Columbosauripus ungulatus;* type, Cat. No. 8551, Geol. Surv., Canada; one-half natural size.

Genus, IRENICHNITES new genus

Genotype, *Irenichnites gracilis* new species

Generic Characters. Functionally bipedal; tridactyle; digitigrade; digits well spread, not bound together by pad, and of uniform breadth throughout; claws blunt; digit II cut away from rest of foot; phalangial pads faintly shown; heel impression not complete; tracks small; stride relatively long; trackway narrow.

Because of the digitigrade pose, the blunt termination, wide divergence, and uniform breadth of the digits, this genus is tentatively referred to the family Anomoepodidæ (Lull, 1904). It is realized that the long stride, narrow trackway, and complete absence of the hallux are features of considerable importance, and in which this genus differs from Anomoepus and its allies. It cannot, however, be better referred to any other family which has yet been proposed.

Irenichnites gracilis new species

Figure 5

Type. Cat. No. 8552, Geol. Surv., Canada, consists of a trackway of five tracks. Paratype: trackway of three tracks on slab, Cat. No. 8558, Geol. Surv., Canada.

Locality and Horizon. Peace River canyon, north side, about 2 miles upstream from Gething's mine, on a stratum 290 feet above Grant seam, Gething number of Bullhead Mountain formation.

Description. The heel pad is not completely developed; the impression of digit II is separate from that of the rest of the foot; the toes are of uniform breadth and terminate in blunt claws. The tracks are relatively short and broad. One shows faint impressions of phalangial pads in digits III and IV. Tracks of this species were observed at several horizons about midway in the section of track-bearing strata, and in all cases the size and shape of the tracks were the same as of those chosen as the type. The tracks are approximately in a direct line, and the stride is relatively long. In the type the stride varies from 790 mm. to 670 mm., and in the paratype is only 535 mm. This shorter stride is longer in proportion to the length of the track than in the case of the other species here described. This would suggest a very long-legged animal. All digits terminate in blunt claws, which are not deeply impressed.

The greatest length of the track, measured from the posterior edge of the heel to tip of digit III, is 150 mm.; from same point to tip of digit II, 118 mm.; to tip of digit IV, 130 mm.; length of impression of digit II, 76 mm.; average breadth of digits, 20 mm.; greatest breadth of track, 165 mm. The divarication varies somewhat, but in the central track of the series, which shows the best detail, the divarication of digits II and III is 38 degrees, of III and IV, 40 degrees.

Genus, GYPSICHNITES [1] new genus

Genotype, *Gypsichnites pacensis* new species

Generic Characters. Bipedal; semidigitigrade; tridactyle; heel broadly rounded and complete; foot short and broad; toes broad, partly enclosed in pad or web, and terminating in bluntly pointed hoofs.

Because of the broad toes terminating in pointed hoofs, this genus is tentatively referred to Lull's family Eubrontidæ. If Lull is correct in assigning this family to the suborder Theropoda[2], the present assignment is probably not justified for, in all probability, *Gpysichnites* represents the tracks of a bipedal herbivorous dinosaur. These tracks might well have been made by a *Camptosaurus*-like form.

Tracks of this genus were observed below the Grant seam, as well as at the horizon from which the type and paratype were collected.

---

[1]The generic name signifies Cretaceous stony tracks.

[2]Lull, R. S.: Geol. and Nat. Hist. Surv., Conn., Bull. XXIV, p. 194 (1915).

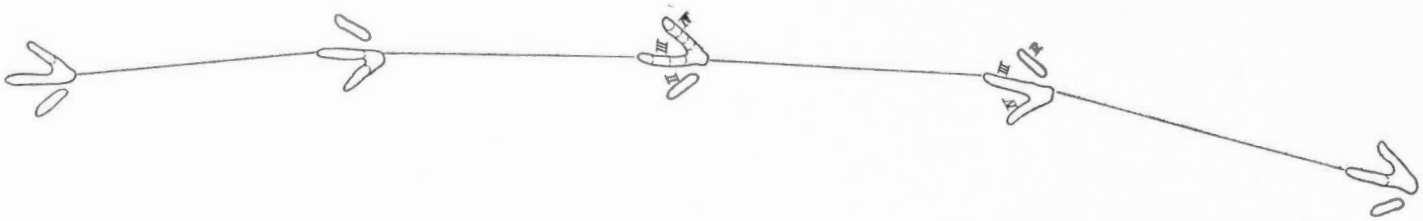


Figure 5. *Irenichnites gracilis;* type, Cat. No. 8552, Geol. Surv., Canada; one-sixteenth natural size.

Gypsichnites pacensis new species

Plate IV, figure 1; and Figures 6 and 7

Type. Cat. No. 8553, Geol. Surv., Canada, consists of one track. Paratype: Cat. No. 8554, Geol. Surv., Canada, consists of two tracks.

Locality and Horizon. Peace River canyon, north side, about 2 miles upstream from Gething's mine, on a stratum 290 feet above Grant seam, Gething member of Bullhead Mountain formation. Paratype, same locality and horizon.

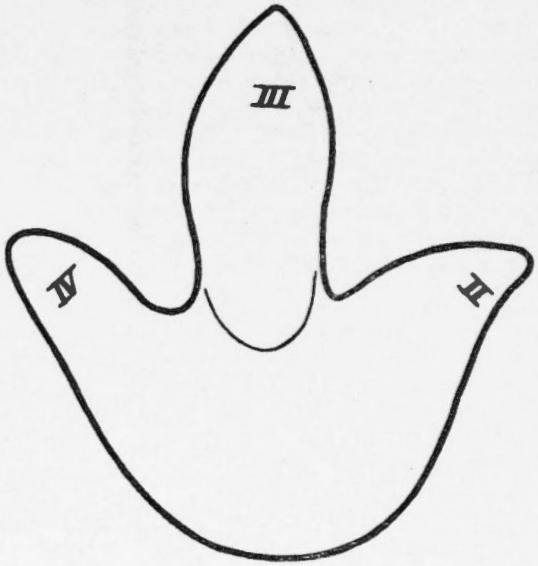


Figure 6. *Gypsichnites pacensis;* type, Cat. No. 8553, Geol. Surv., Canada; one-fourth natural size.

Description. The type (Plate IV, Figure 1, and Figure 6) shows very good outline, but no phalangial pads. All the toes are very broad and end in bluntly pointed hoofs. Digits II and IV are strongly divergent, point outward at their distal ends, but are free for only about one-half of their length. The proximal portions of the toes were doubtless enclosed in a pad or web. In the type, digit III is more deeply impressed than the others, but in the paratype the three toes seem to have carried the weight about equally. Digit III is broadest near the distal extremity, whereas the others taper gradually. In the type, a poorly preserved second track indicated a stride of 915 mm., or slightly more than three times the length of the track. In the paratype, the length of the stride relative to the length of the tracks is slightly greater. The tracks are almost in a straight line, but point slightly outward from the line of march.

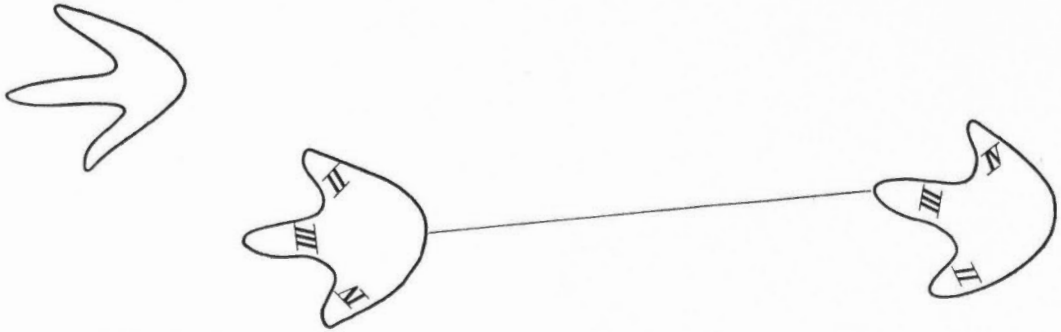


Figure 7. *Gypsichnites pacensis;* paratype, Cat. No. 8554, Geol. Surv., Canada; one-twelfth natural size.

In the case of the type: the greatest length of the track, measured from the posterior edge of the heel to the tip of digit III, is 290 mm.; the greatest breadth, across digits II and IV, is 282 mm.; the greatest breadth of digit III is 76 mm.; and that of the heel, at 40 mm. from the posterior edge, is 160 mm.; from the centre of the posterior edge of the heel to tip of digit II is 210 mm.; to tip of digit IV, 210 mm.; the divarication of digits II and III is 40 degrees, of III and IV, 44 degrees.

Genus, AMBLYDACTYLUS new genus

Genotype, *Amblydactylus gethingi* new species

Generic Characters. Very large; bipedal; tridactyle; foot very broad; toes broad and short, with proximal ends enclosed in web or pad and terminating in pointed hoofs or blunt claws.

This genus is tentatively referred to Lull's family, Eubrontidæ. It seems most likely that tracks of this genus were made by a large, bipedal, herbivorous dinosaur, though there is no known American form that would make such a track. The tracks are too large to have been made by *Camptosaurus*, and the hoofs are much too pointed for a member of the Hadrosauridæ. It more nearly resembles the tracks from the Wealdon of Europe[1], which are regarded as those of Iguanodon.[2]

Shuler has described, from the Lower Cretaceous, Glen Rose limestone of Texas, the tracks of a large, bipedal dinosaur under the name *Eubrontes* (?) *titanopelopatidus*[3]. To the writer the Texas specimens more closely resemble the genus here described than the Triassic Genus *Eubrontes*, though both the track as a whole and the toes are proportionately longer than in *Amblydactylus*.

Mr. C. N. Strevell, of Salt Lake City, Utah, has kindly sent the writer photographs of dinosaur tracks that were collected from the roof of a coal mine in Utah, and whose age is given as later Cretaceous. Mr. Strevell refers to these tracks as *Dinosauropodes*, though it is believed no description of them has been published. One of these tracks, which he refers to as *Dinosauropodes magrauii*, rather closely resembles the genotype of *Amblydactylus* in its anterior portion, but is very much longer and there is a suggestion of the presence of a fourth toe.

Amblydactylus gethingi[4] new species

Plate IV, figure 2; and Figure 8

Type. Cat. No. 8555, Geol. Surv., Canada, consists of a plaster cast of one (? right) track.

Locality and Horizon. Peace River canyon, north side, about one-fourth mile upstream from Gething's coal mine (Grant seam), Gething member of Bullhead Mountain formation.

[1]Beckles, H. S.: "Ornithichnites of the Wealdon"; Proc. Geol. Soc. London, vol. X, pp. 456-64, Pl. XIX (1856).
[2]Taylor, Alfred: "On the Footprints of Iguanodon"; Proc. Geol. Soc. London, vol. XVIII, p. 448 (1862).
[3]Shuler, E. W.: Am. Jour. Sci., vol. XLIV, pp. 294-298 (Oct., 1917).
[4]The generic name signifies blunt toed. The species is named in honour of Mr. Neil Gething.

Description. The track is deeply impressed, very large, and almost as broad as long; the toes are very broad, extend only a short distance beyond the web or pad, and terminate in pointed hoofs; there is no sign of a fourth toe; the distal half of digit III is at a higher level than the side toes and the sole of the foot; the heel is short, moderately narrow, and well impressed.

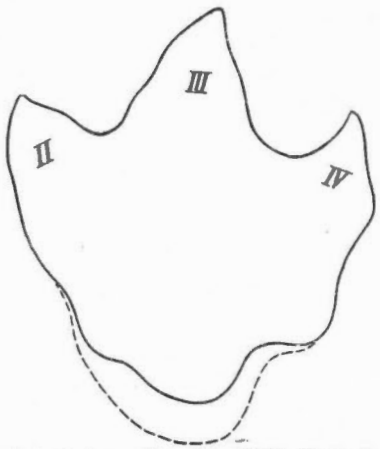


Figure 8. *Amblydactylus gethingi;* type, Cat. No. 8555, Geol. Surv., Canada; one-twelfth natural size.

There is no evidence of separate phalangial pads. Digit II is not cut away from the metatarsal or heel pad. Posterior to the depression of the heel the rock slopes upward and backward. This may represent the impression of part of the posterior edge of the metatarsals, which were not carried perpendicular above the phalangies.

Greatest length of track, from posterior edge of heel to tip of digit III, 640 mm.; greatest breadth, 590 mm.; from centre of heel to tip of digit II, 560 mm.; to tip of digit IV, 535 mm. Divarication of digits II and III, 32 degrees, of III and IV, 24 degrees.

Family, **Tetrapodosauridae** new family

Family Characters. Habitually quadrupedal; medium sized; bluntly pointed hoofs; trackway wide; stride short; no caudal impression.

Tracks of this family were doubtlessly made by quadrupedal, predentate dinosaurs.

Genus, TETRAPODOSAURUS new genus

Genotype, *Tetrapodosaurus borealis* new species

Generic Characters. Quadrupedal; toes enclosed in pad or web; manus impressions in front of and completely separated from those of the pes; manus short and broad, five toes, digitigrade; pes of medium length, semiplantigrade, with four toes.

Tracks of this genus were observed at only one horizon. They may well have been made by an ancestor of one of the Upper Cretaceous Ceratopsia.

Tetrapodosaurus[1] *borealis* new species

Plate V; and Figure 9

Type. Cat. No. 8556, Geol. Surv., Canada, consists of a cast of six tracks (two manus and two pes of left side and one each from right side).

Locality and Horizon. Peace River canyon, north side, about 1½ miles upstream from Gething's mine, on a stratum 216 feet above Grant seam, Gething member of Bullhead Mountain formation.

Description. There were fourteen tracks in this trackway (seven of manus and seven of pes), but casts were made of only six of these. Better detail is shown in the pes than in the manus.

The *manus* is ahead of and completely separated from the pes. It is very short and broad. There appear to be five toes, though in some of the tracks only three are well outlined, probably due to inequality in the length of the toes and the nature of the surface over which the animal walked. In the Upper Cretaceous Ceratopsia only the three inner toes bore hoofs, and digits IV and V probably did not appear beyond the sole pad. The outer toes of the animal that made these tracks may have been too short to make an impression if the weight were thrown on the inside of the foot. The toes were enclosed in a large pad, except for the distal extremity which was free. This pad seems to have enclosed only the digits, differing from that of the pes, in which a metatarsal pad formed the posterior portion of the track. Greatest length of manus, 215 mm.; greatest breadth, 290 mm. The divarication of the toes is much greater in the manus than in the pes, that of the outer toes being more than 180 degrees. Divarication of digits I and II, 73 degrees; of II and III, 42 degrees; of III and IV, 33 degrees; of IV and V, 50 degrees.

The *pes* is longer than broad and much of the weight was borne by the metatarsal pads. All the phalangial and metatarsal pads appear to have been fused into one mass. The toes extend only a short distance beyond the pad and terminate in small, rounded hoofs. The distal ends of most of the toes are slightly more deeply impressed than the sole of the foot, as is indicated in the drawing (Figure 9) by a dotted line. The posterior outline of the track is not well defined, but the drawing shows the writer's interpretation after a study of all the imprints of this trackway and of those of another trackway at the same horizon and locality. There are four toes, and the outer one (? IV) is more divergent than the others. At the posterior edge of some of the tracks are triangular depressions, probably made by the dragging of the hoofs as the foot was coming to rest.

Greatest length of pes, measured from the posterior edge of the heel to the tip of digit III, 338 mm.; from same point to tip of digit I, 256 mm.; to tip of II, 328 mm.; to tip of IV, 284 mm. Divarication of digits I and II, 14 degrees, of II and III, 21 degrees, of III and IV, 32 degrees. The above divarication was measured on what is regarded as the best impression. Perhaps better tracks would show a slight variation.

The trackway is 810 mm. wide. The length of step, from tip to tip of digit III of the left pes, is 1,320 mm.

---

[1] *Tetrapodichnites borealis* on Plate V should be *Tetrapodosaurus borealis*.

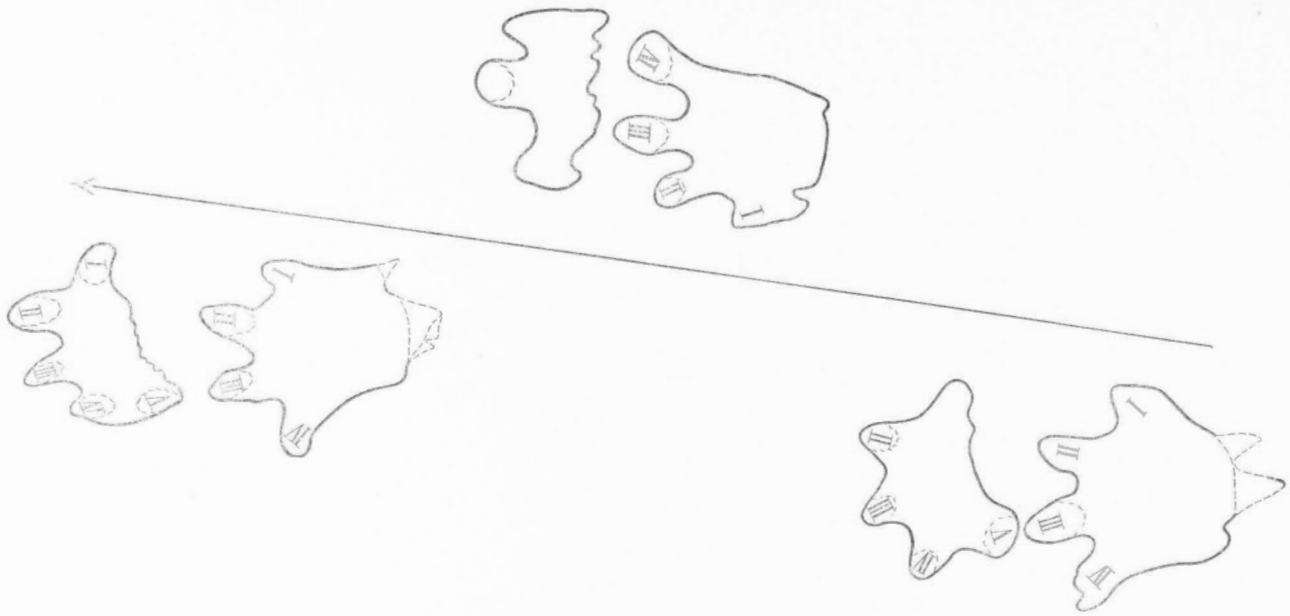
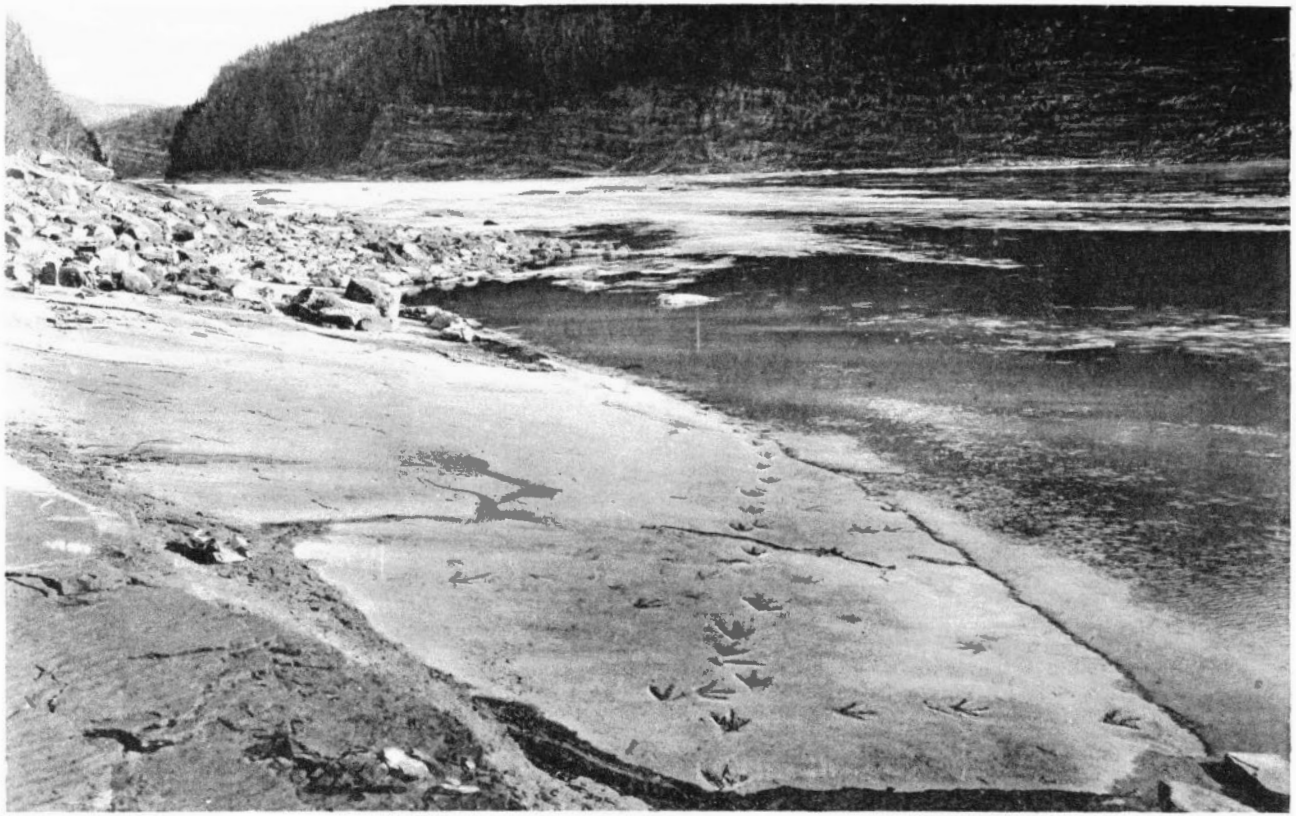
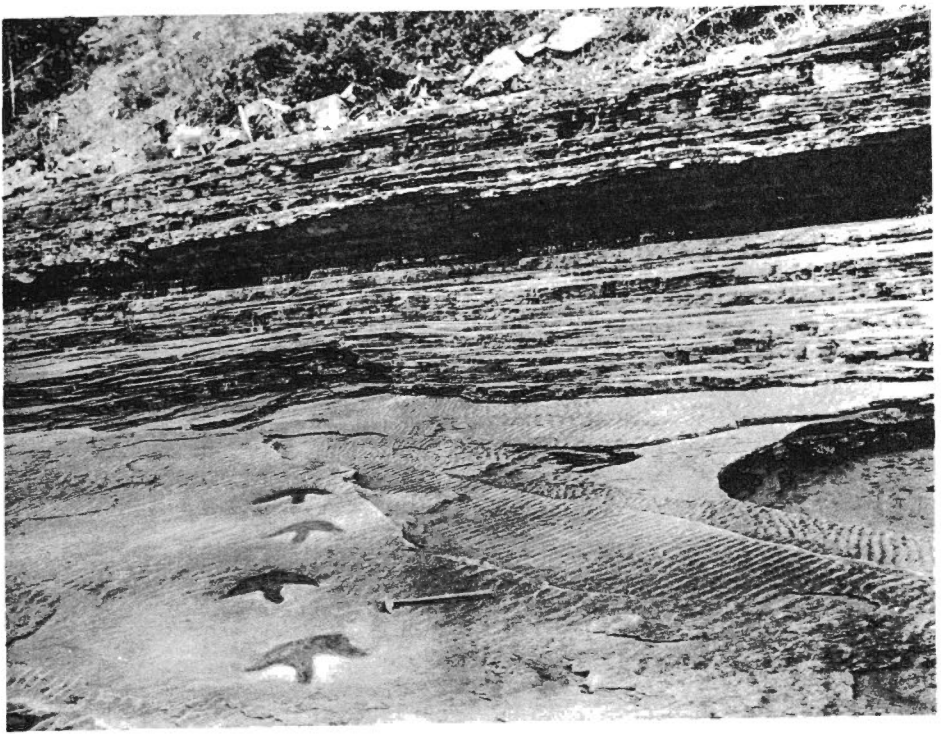


Figure 9. *Tetropodosaurus borealis;* type, Cat. No. 8556, Geol. Surv., Canada; one-twelfth natural size.



Trackways of *Irenesauripus mclearni*, Peace River canyon, B.C., about 2 miles upstream from Gething's mine. More than one hundred and sixty dinosaur tracks, including the types of three species, were observed on this rock shelf.

Irenesauripus mclearni; type, Cat. No. 8548, Geol. Surv., Canada; $\frac{1}{10}$ natural size.



1

2

3

Figure 1. *Irenesauripus occidentalis;* type, in situ, Peace River canyon. Note the thin-bedded, ripple-marked sandstone.
Figure 2. *Irenesauripus acutus,* photographed from type trackway; ⅛ natural size.
Figure 3. *Columbosauripus ungulatus;* type, Cat. No. 8551, Geol. Surv., Canada; ⅛ natural size.

1

2

Figure 1. *Gypsichnites pacensis;* type, Cat. No. 8553, Geol. Surv., Canada; ¼ natural size.

Figure 2. Cast of *Amblydactylus gethingi;* type, Cat. No. 8555, Geol. Surv., Canada; ⅛ natural size.

PLATE V

1

2

Figure 1. Trackways of *Tetrapodichnites borealis*, Peace River canyon, about 1½ miles above Gething's mine. The trackway on the left is the type; that on the right is another trackway of the same species. The tracks marked with x are those from which the cast was made.

Figure 2. Cast of *Tetrapodichnites borealis*; part of trackway of type showing detail of left manus and pes; ⅓ natural size.

A NEW SUBSPECIES OF WILLOW PTARMIGAN FROM THE ARCTIC ISLANDS OF AMERICA

Lagopus lagopus leucopterus, subsp. nov.

(The White-shafted Ptarmigan)

By P. A. Taverner

Type. Nat. Mus. of Canada, No. 24437, ♂, changing from winter to spring plumage. May 28, 1928, Camp Kungovik, west coast Baffin island, latitude 65° 35′ north. Collector, J. D. Soper.

Subspecific Characters. Like *Lagopus lagopus lagopus* (Linnaeus), except the shafts of the primaries pure or nearly pure white instead of black. The first (outermost) primary shaft almost always immaculate, the second often more or less clouded; the remainder (innermost) have the colour entirely absent or greatly reduced.

Range. The Arctic islands of North America from southern Banks island and the mainland adjacent to Dolphin and Union straits to Southampton[1] and southern Baffin islands, indefinitely northward.

These conclusions are based upon the collections in the National Museum of Canada, consisting of one hundred and forty pertinent specimens taken at various seasons of the year and in which the distinction holds with convincing consistency. A few mainland birds have more or less pale or washed out primary shafts, but in no case seen are the shafts pure white. Occasional island birds have lightly coloured primary shafts, but never approaching black. These few exceptions can be satisfactorily accounted for by intergradation and the migrational invasion of northern forms into southern territory.

As it does not appear that the type form of northern Europe or *Lagopus lagopus birulai* Sserebrowsky described from islands north of Siberia[2], have white primary shafts, it seems that it is the bird so characterized that requires naming. Therefore, the material under review divides as follows:

Lagopus lagopus leucopterus (the White-shafted Ptarmigan)

12	Camp Kungovik, southwestern Baffin island (*type locality*)
10	Dehaven point and Taylor island, southeast Victoria island
5	Cape Kellet, eastern Banks island
1	Melville island
5	Point Cockburn and Bernard harbour, south side Dolphin and Union strait
33	

[1]The writer is indebted to the courtesy of Mr. G. M. Sutton for the information that the willow ptarmigan of Southampton island has white primary shafts.

[2]Jour. für. Ornith., LXXIV, 5-13 (1926).

Lagopus lagopus lagopus (the Black-shafted Ptarmingan)

17	Bonne Esperance, north shore gulf of St. Lawrence near the strait of Belle Isle
1	Great Whale river, east side Hudson bay
1	Belcher islands, east side Hudson bay
37	Churchill, Manitoba, west side Hudson bay
1	Maniwaki, Quebec, 85 miles north of Ottawa, Ontario
3	Great Bear lake, Mackenzie
2	Mount Clark, Mackenzie basin, above Norman
5	Jasper park, Alberta
9	Teslin lake, southern Yukon territory
1	141st meridian, north of mount Natazhat, Yukon territory
1	Alaska-Yukon boundary and Arctic Circle
12	Collinson point, north Alaskan coast
10	Sadlerochit river, north Alaskan coast
7	Hulahula river, Endicott mountains, north Alaska
107	

A NEW HYBRID GROUSE

Lagopus lagopus (Linnaeus) X *Canachites canadensis* (Linnaeus)

By P. A. Taverner

Illustration

PAGE
Plate I. Hybrid grouse..... 91

By hand of Mr. B. C. Lloyd the National Museum has lately received a most interesting hybrid grouse specimen from the Ven. Archdeacon R. Faries of York Factory, Hudson bay, Manitoba. The following information was furnished by Mr. Faries:

"The hybrid partridge was shot by a young half-breed on February 16 [1931], in a swamp about 2 miles back of the settlement of York Factory. It was with a covey of willow ptarmigan feeding on the little black willows which grow on muskeg land.

A year ago I heard of a spruce partridge that was *white* with grey and black spots, having been shot by an Indian near cape Tatnam, but was not able to secure the bird for examination. Evidently that was also a hybrid between a spruce partridge and a ptarmigan."

The specimen was in flat skin, but made up into a most beautiful specimen. Its general characters are so completely those of *Canachites* that were it not for its heavily feathered, completely typically ptarmigan feet it would easily pass as a partial albino male spruce grouse. As it is there can be no question as to its identity. The coloured portions are pure black and a fine slate grey with the slightest suggestion of light brownish in the semi-concealed feather bases. The illustration shows it in almost natural colours. The similarly described bird taken a year previous was probably a nest mate of this one and suggests that a more or less full brood of this character was raised.

PLATE I

Hybrid Grouse
Lagopus lagopus × *Canachites canadensis*
Willow Ptarmigan × Spruce Partridge
Adult winter male
York Factory, Manitoba, February 16, 1931