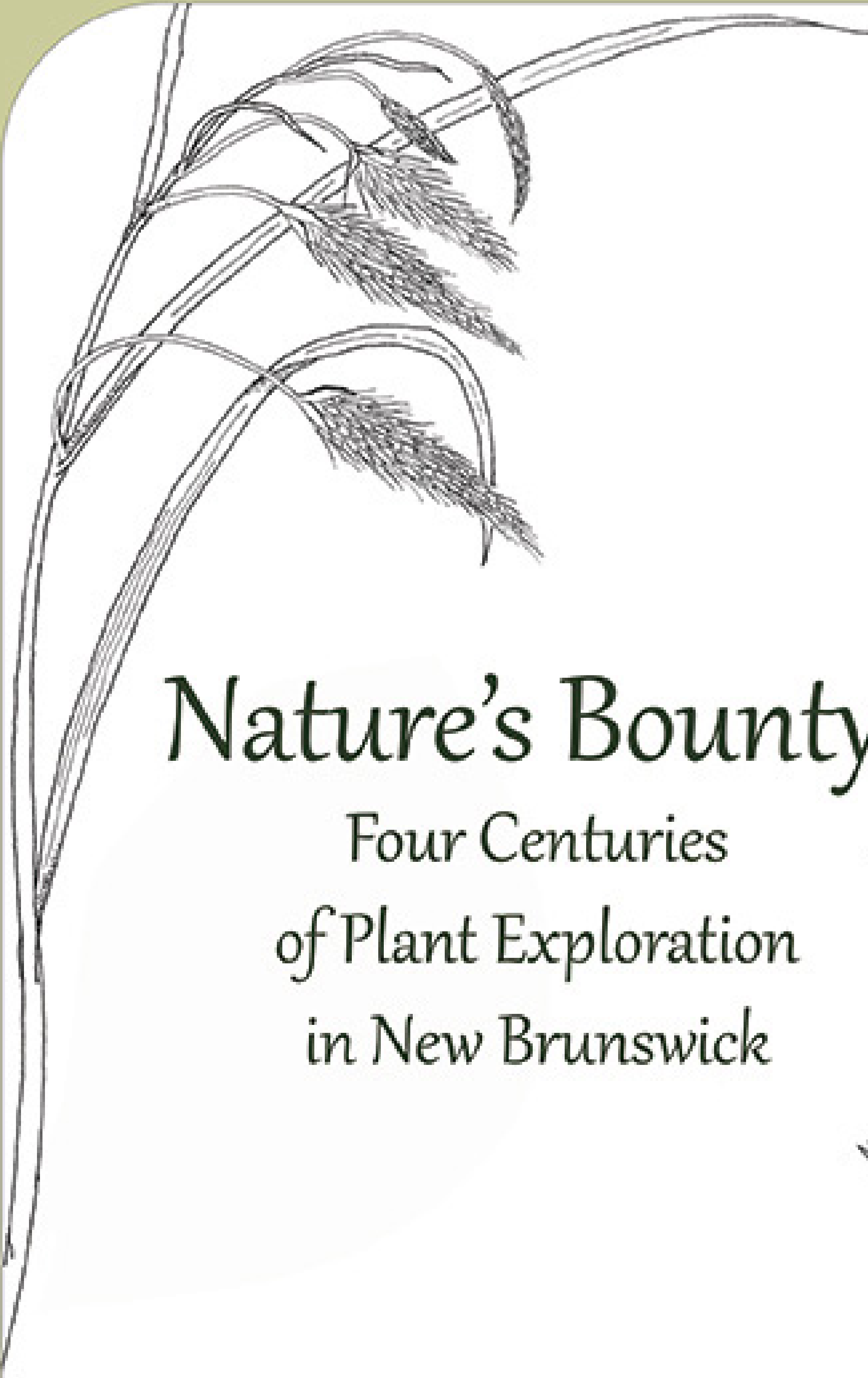
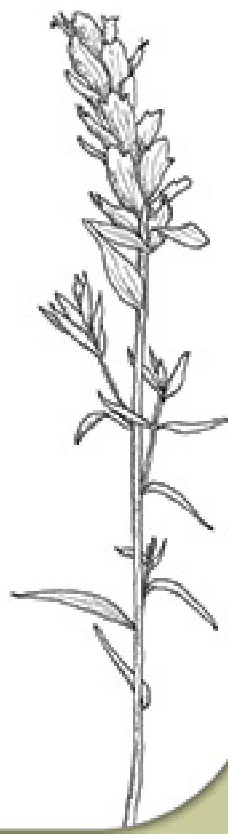


Nature's Bounty:

Four Centuries of Plant Exploration in New Brunswick



C. Mary Young

[page left intentionally blank]

Nature's Bounty

Carrion-flower, *Smilax herbacea* L.

Nature's Bounty:
Four Centuries of Plant Exploration in New Brunswick

C. Mary Young

UNB Libraries
University of New Brunswick
Fredericton, NB

C. Mary Young: Note on the Author

First published 2015

by UNB Libraries

University of New Brunswick

Fredericton, NB

Canada

ISBN: 978-0-9811126-1-9 (Electronic Version)

Young, C. Mary.

Nature's Bounty: Four Centuries of Plant Exploration in New Brunswick

http://naturesbounty.lib.unb.ca

Plant Illustrations and Maps by C. Mary Young

Cover design by Monica Fitzpatrick

Abstract

Four centuries ago, European explorers intent on reaching the riches of the Far East sailed westward, encountering North America. Arriving on "Canadian" shores, they were appalled by the dismal and forbidding forests. They knew nothing of the local plants; which ones were useful as a food source or had medicinal value and which were poisonous? While native people willingly shared their knowledge, the Maliseet and Mi'kmaq names were difficult for European tongues. They then sent plant samples to European plant enthusiasts who identified them according to European botanical ideas and systems of plant naming. These early explorers and settlers were followed by entrepreneurs and traders who exploited the natural resources and stripped the forests of the white pine to provide spars and masts for the Royal Navy.

This study of plant exploration in New Brunswick from 1604 to 2000 is placed firmly within a regional framework. It encompasses short biographical sketches and tells the stories of naturalists and botanists in the light of the times in which they lived. The account illustrates the development of the science of botany and shows how, as museums and learning centres were established in the new land, North Americans became masters in their own house, taking over the botanical enquiry that had previously been the prerogative of Europeans. It examines early ecological studies and curious anomalies of plant distribution, as well as the modern-day emphasis on plant diversity and the need for conservation. Furthermore, it embodies implicit lessons that speak to our present-day concerns with climate change and the environment.

[page left intentionally blank]

Contents

Note on Plant Names

In this book, I have used the common or vernacular name followed by the Latin name of a plant. Latin names are the "stock in trade" of botanists and are universally recognized by them. There is a good reason for using Latin names. There may be many vernacular names for a single plant and this can only lead to confusion. Also a plant known by a common name in one place may be known by a totally different name elsewhere; for instance, the "Mayflower" of eastern North America is an entirely different plant from the "Mayflower" of Britain. The French common name for dandelion, Pissenlit, is not translated and used as a common name in English (apart from in Newfoundland) because it was too vulgar for prudish British and American minds.

A Latin name is binomial; it has two parts, the generic name followed by the specific name. The generic name recognizes the genus, or group of plants, which have certain features in common, inherited from a common ancestor. The specific name or epithet usually recognizes some special feature of the plant characteristic of that particular species. The two names together provide a readily identifiable name for only one species of plant. To be strictly correct, the binomial names should be followed by the authority (i.e. the abbreviated name of the person who named the plant). I have omitted the authority to make the account more readable, but I have followed the nomenclature in H. R. Hinds's *The Flora of New Brunswick* (2^{nd} edition), except in a few cases where newer but widely accepted names are used.

Latin names follow the rules of the International Code of Botanical Nomenclature. These rules are developed and agreed upon at International Botanical Congresses held every six years. Changes in names, perhaps because of a re-interpretation of a plant's relationships (or for some other reason), are accepted or rejected by the International Committee of Botanical Nomenclature.

List of Plant Illustrations

Note on Plant Illustrations

In a few illustrations, plants are shown with complete root systems. These drawings were made by reference to herbarium specimens, most of which were collected well over one hundred years ago and long before conservation became an issue. In no case was a plant taken up by the roots in order to make a drawing.

List of Maps

Abbreviations

DCB	*Dictionary of Canadian Biography*
GSC	Geological Survey of Canada
HSTC	*Scientia Canadensis: Journal of the History of Canadian Science, Technology and Medicine*
NB Naturalis	*New Brunswick Naturalist*
NHSNB	Natural History Society of New Brunswick
NBM	New Brunswick Museum
PANS	Nova Scotia Archives and Records Management
RSC	Royal Society of Canada

Acknowledgements

It is with sadness that I record my indebtedness to Harold R. Hinds, "Curator" of the Connell Memorial Herbarium, University of New Brunswick, with whom I had many long conversations on plant distribution in the province. Up to the time of his death in 2000, he encouraged me to investigate the historical aspects of plant exploration. It proved not only to be a subject of human interest and plant diversity, but also to have wider implications in the realm of changing ideas and the development of the science of botany. My thanks are due also to the University of New Brunswick, Department of Biology, for allowing me access to the herbarium. In 2001, Beverley Benedict, formerly Collections Manager, Connell Memorial Herbarium, gave me access to specimens and records of the herbarium without which it would have been difficult to finish this work.

Libraries have played an important part in my understanding of the background for this book. I owe a special debt of gratitude to the Director of UNB Libraries, John Teskey, the founding Director of the Electronic Text Centre, Alan Burk, and the retired archivists, Mary Flagg and Patricia Belier, for their support and encouragement towards the publication of this book. The librarians and archivists of the Harriet Irving Library and the Science Library, University of New Brunswick, have been ever helpful and courteous.

Readers of the manuscript, Dr. Steven Turner, Professor Emeritus of History, University of New Brunswick, and a specialist in the history of science, Dr. Stephen R. Clayden, Curator of Botany at the New Brunswick Museum, and the historian Dr. Margaret Conrad, Professor Emeritus, University of New Brunswick, have my special thanks. Their pertinent and useful comments on the manuscript were appreciated.

Others to whom I turned for specific information were Dr. A. G. Bailey and Dr. A. R. A. Taylor. Stephen R. Clayden generously shared some of his research on G. U. Hay and the Rev. James Fowler. Dr. Ruth Newell, of the Acadia University Herbarium, Nova Scotia, provided information on plants stored there. Dr. Gail Campbell gave valuable comments. Eric Swanick of the Legislative Library, Fredericton and Don Lemon, formerly archivist at the New Brunswick Museum, gave me access to specific records under their control. Other archives consulted include the Nova Scotia Archives and Records Management, Public Archives of New Brunswick and the Archives of the Royal Botanic Gardens at Kew, England. Any omissions or errors, however, are my own.

I have been fortunate in always having the support of my family. I give heartfelt thanks for their singular patience when long walks were punctuated by botanical exploration. Carolyn Young provided specialist information on New Brunswick trees in the British building trade and gave general support. Dr. Graham Young, a paleontologist, read and commented on the drafts of the first and last chapters and gave me advice on mapping. I could not have written this book without the understanding and support of my husband, Murray, who provided encouragement and was long-suffering as I prepared the manuscript. Long discussions with him on the triangle of trade amongst New Brunswick, the West Indies, and Britain and on the general historical background in New Brunswick gave me a better understanding of the complexities of the background to this study. He has my special thanks. As has my brother, A. John Harrison of New York, who encouraged me to complete the writing. As a language specialist, he read the typescript, made suggestions on English usage, and corrected punctuation errors.

I am grateful to Erik Moore, Director of the Centre for Digital Scholarship, University of New Brunswick Libraries, who despite the difficulties of setting up a new department found an elegant print format and guided this book from typescript to an electronic text. It has been a pleasure to work with the copy editor, Dr. Patricia Simmons. Her interest in the project and her careful attention to detail have resulted in a much better book.

Note on the Author

C. Mary Young's interest in plants arose during childhood walks in the wilds of Exmoor and along the shores of the Bristol Channel in England. An aptitude for observation was fostered by college ecology classes in the Mendip Hills and visits to many botanic gardens. A trained biologist, she worked on field surveys of soil insects and pests of agricultural crops for the British Ministry of Agriculture in World War II. Later she was a researcher in the Entomology Department at the London School of Hygiene and Tropical Medicine; she has a PhD degree from London University. Married to a Canadian, she now lives in New Brunswick where she has developed her interests in plants, gardens, and botanical illustration. She played an active role in the establishment of the Nature Trust of New Brunswick (an organization dedicated to the conservation of critical natural areas), serving as secretary, president, and past-president. While working as a volunteer in the University of New Brunswick herbarium, she noticed plants preserved from the 1830s. This piqued her interest and she set about discovering the history of plant exploration in the region.

Foreword

Botanical exploration was formerly considered to be a very glamorous pursuit with tremendous prestige and immense practical application. Governments recognized the great potential of plants as sources of medicines, food, and economic benefits and used to fund botanical exploration. Residents of New Brunswick and elsewhere in Canada commonly had a fair working knowledge of our native plants, since plant collection and identification were part of the study curriculum in most elementary schools. Many scientists and scholars, no matter what their main field of study or focus, also used to have good botanical expertise. Unfortunately, botanical knowledge among members of the public has declined. Expertise on field taxonomy of plants is also diminishing, as funding agencies and researchers focus on molecular technology and scientists become more and more highly specialized. Likewise, many plant collections in herbaria are in jeopardy, as academic institutions face budgetary challenges and no longer seem to understand or recognize the historical, cultural, and conservation importance of such collections.

Dr. C. Mary Young's meticulous research documenting nearly 400 years of botanical exploration in New Brunswick reminds us that there are many very important lessons to be learned from carefully examining the past and preserving our heritage. Her fascinating book traces the evolution of botanical science in the context of societal change and the joys, hardships, challenges, inspiration, and determination that epitomize the history of botanical collection. As Mary points out, the botanical explorers of New Brunswick had certain qualities in common, notably tireless enthusiasm, intellectual curiosity, and a very strong work ethic.

Botanical explorers needed these qualities to help deal with many daunting challenges and the paucity of tools available to them. Imagine years of research data and important collections being lost at sea, the lack of access to accurate maps of the province and the high risk of becoming lost while exploring for plants, the inaccessibility of much of the province and the level of physical fitness needed to get to remote areas, and biting insects so prolific as to nearly drive a person mad. Imagine, also, the lack of comprehensive botanical reference books or field guides, the lack of expertise and knowledge on this continent, and that many plant species were new to science and had not yet been named or described. In our current era of nearly instantaneous gratification in communication and information exchange, it's difficult to imagine that communication was limited to in-person visits and written correspondence, and often took weeks, months, or sometimes years.

Mary is a masterful storyteller and her lovely prose is so intimately infused with science that the reader is often unaware about how much they are learning. She weaves an intriguing story of ethnobotany, how plants and society have influenced one another over time. The human elements of her story demonstrate how the botanical explorers' lack of professional training could be overcome by enthusiasm, how changing ideas and concepts sparked new exploration efforts, and how North Americans and New Brunswickers empowered themselves to take over botanical traditions that were once the exclusive domain of Europeans. Mary also describes how the New Brunswick flora has changed over time and how native plant populations have been affected by humans, traces the path of how plants have evolved and migrated into the province, and reveals historical records of when and how species from abroad were introduced here and became invaders.

Just like the scholars and scientists that she highlights in her book, Mary exemplifies the time-honoured tradition of a scientist and scholar with a broad range of expertise that extends well beyond the discipline that she devoted her career to. Mary's academic training and career focused on entomology, but she has become a very knowledgeable botanist, both in the field and in the laboratory. Her scientific expertise and her love of botany are clearly evident in her botanical illustrations that accompany this book; these are not only accurate but beautiful.

In recounting the history of plant exploration and collection in New Brunswick, Mary humbly omits her own contributions. I can't visit the Connell Memorial Herbarium without thinking of Mary and her devotion to the plant collections there. I picture her lovingly mounting the plant specimens onto herbarium sheets and preparing and affixing labels, carefully scrutinizing specimens to ensure they have been correctly identified, and precisely mapping, cataloguing, and recording the data for each plant collection that she has handled. I picture her excitement at discovering a herbarium specimen of Butterfly Weed (*Asclepias tuberosa*), collected from the Petitcodiac River in the 1800s, far to the north of its known geographic range. When I'm at Southwest Head on Grand Manan, I can envision Mary admiring the diminutive Tiny All-seed (*Radiola linoides*) that grows there. And whenever I'm at one of the Nature Trust of New Brunswick's nature preserves, I think of how Mary's leadership helped inspire the protection of important natural areas and their plant residents in this province. Mary is a perfect role model for carrying out the wishes of our friend, the late Hal Hinds, who encouraged readers of his *Flora of New Brunswick* to "Learn them, love them, protect them."

It is my sincere hope that Mary's stimulating book will rekindle a sense of wonder and pride regarding New Brunswick's rich botanical legacy, and will inspire current and future generations to continue the fine tradition of botanical exploration in this province, as well as to foster greater commitment to stewardship and conservation. Let us also hope that Mary's astute observation that great diversity of forms exist within plant species in New Brunswick becomes more widely recognized by scientists, researchers, and funding agencies, so her dream for the complexity of their genetic make-up and their relationships with the environment to be adequately studied will be realized.

Dr. James Goltz
Fredericton, New Brunswick
2014

[page left intentionally blank]

To see a World in a Grain of Sand
And a Heaven in a Wild Flower
Hold Infinity in the palm of your hand
And Eternity in an hour
—William Blake, "Auguries of Innocence"

[page left intentionally blank]

Prologue

I wandered along the Grand Manan Island shore looking for an Arctic plant. In the arctic, most plants are low-growing, so I was searching for something ground-hugging and perhaps mound-shaped. This vision vanished when I stopped to look at a ribbon of lustrous-leaved plants standing five or six feet (180 cm) tall at the top of a shingle bank. There, with its yellow, daisy-like flowers silhouetted against the clear blue sky, was the Seabeach Groundsel (*Senecio pseudoarnica* Less.). This plant is usually identified with the western Arctic, where it grows around the Bering Strait, southward along the British Columbian coast and westward through the Aleutian Island chain to Siberia, Korea, and Japan. Here in eastern Canada, it is found only in a few isolated colonies around the Gulf of St. Lawrence, along the Labrador coast, and on the west coast of Newfoundland. The Grand Manan colony is one of the most southerly on the North Atlantic.[1]

On the leeward side of the shingle bank, just a few feet from the Seabeach Groundsel, at the edge of marshy ground, I found a very different plant: here was the small, six inch (15 cm) tall pink-flowered Gerardia (*Agalinis neoscotica*). It is a local variety of a southern plant with a distribution extending from New Brunswick and Nova Scotia to Florida. On Grand Manan, it grows mostly in roadside ditches and in gravelly moist soil in the southern part of the island.

These plants, surviving in their tiny havens at the extreme limits of their ranges, illustrate two features that make the flora of New Brunswick notable: the meeting and intermingling of northern and southern species and the presence of isolated populations of rare or uncommon plants. Although our flora lacks the richness and variety to be found farther south, it has distinctive aspects that make it worthy of study. There is, for instance, a puzzling anomaly along the Northumberland Strait

Figure 1. Seabeach Groundsel, *Senecio pseudoarnica* Less.

coast where a number of species have affinities with plants found hundreds of miles away to the south, but not found in the intervening regions. Plus, there are two unique endemic species: the Bathurst Aster occurs only in the mud flats at the mouth of the Tetagouche River in Bathurst and the Furbish Lousewort is found only in the northern reaches of the St. John River valley. These species are found nowhere else on earth.

Isolated plant colonies are like ancient artifacts: they provide us with a window on the past. Merritt Lyndon Fernald, an eminent American botanist at the Gray Herbarium at Harvard University, was the first scientist to clearly identify the complexity of the Maritime region. He called these isolated plant colonies "relicts of a former age."[2] He visited New Brunswick, Nova Scotia, Newfoundland, and the Gaspé Peninsula early in the twentieth century. His analysis led him to recognize that some of our plants had relationships to species found in surprisingly far-flung parts of the globe. Fernald followed in the footsteps of an earlier Harvard University botanist, Asa Gray, a pioneer in the discipline of biogeography. This subject seeks to answer the fundamental questions of why particular plants are found in particular places and how they arrived there. It is a science that has made giant strides in recent decades.

In Fernald's time, most people believed that the continents and oceans occupied permanent positions and had always occupied those places on the earth's surface. Since the mid-twentieth century, however, our ideas have changed. By studying fossils and the composition of rocks, geologists and palaeontologists have determined that, over a time span of millions of years, powerful forces in the earth's mantle have moved continents across the globe and have caused old oceans to disappear and new ones to be born. As long ago as the sixteenth century, Francis Bacon noticed that Africa and South America have reciprocal shapes which, if pushed together, would fit like the pieces of a jigsaw puzzle.[3] This idea developed into a theory only in the 1920s when a German meteorologist, Alfred Wegener, proposed his theory of continental drift. At first the theory was ridiculed, but gradually evidence from rocks, fossils, and the variation in the magnetism of volcanic rocks laid down in different geological eras proved that continents had indeed wandered.[4] The theory was finally accepted in the 1960s after it was discovered that new oceanic crust was welling up through mid-oceanic ridges, such as the mid-Atlantic ridge, causing the ocean floor to spread. Further, the old sea floor was being sucked under or "subducted" in deep sea trenches at some of the ocean's margins where the oceanic tectonic plates meet the continental tectonic plates.[5] This renewal and destruction of the sea floor with material dragged into the much hotter earth's mantle was a sort of recycling process. The convection currents set up in the earth's mantle acted as a conveyor belt.

Occasionally, over the earth's long history, continents collided and then rafted together, forming super-continents. A super-continent of this type, Pangea, was formed approximately 350 million years ago. Approximately 100 million years later, this land mass fractured into two: a northern continent, Laurasia, and a large southern continent, Gondwanaland, with a developing ocean, the Tethys Sea, between them. The Laurasian continent eventually gave rise to much of North America. Inundation by an arm of the Tethys Sea into a rift valley on the Laurasian continent allowed another ocean, the Atlantic, to be born. The widening Atlantic Ocean cut off southern Europe and North Africa from North America.

Sometimes pieces of the edges of continents broke away, moved independently of their parent continent, and became accreted to another continent. This kind of activity accounts for much of the geological complexity of the Maritime region of Canada where broken-off pieces of Pangea, sea mounts, and volcanic island chains became accreted to the northeastern part of Laurasia.

All these continental movements were incredibly slow on our time scale. They happened over millions of years and the movements were usually in the order of centimeters or a few inches per year. Through a long period of time, they caused Laurasia and therefore North America to move from the southern hemisphere across the equator and into the northern hemisphere.

The importance of these continental movements becomes

Figure 2. Nova Scotia False Foxglove, *Agalinus neoscotica* (Greene) Fern.

clear when we consider the plants which occupied these lands. The vascular plants—those having a conducting system for water and food—first arose approximately 400 million years ago and the true flowering plants approximately 140 million years ago. That was well before Laurasia broke away from the super-continent, Pangea. These continents carried the precursors and ancestors of our modern plants with them on their travels. Each continent was a sort of ark for the plants which happened to occupy it at that particular time. On those continents separated for a long period of time by wide oceans, the plant and animal life (or biota) evolved independently; continents isolated in this way for millions of years came to have distinctive assemblages of life. Where continents have some common history, the plants and animals may show some similarities. North America and Europe, for instance, have a number of plants which are closely allied. Ferns have many species common to both continents. Pairs of similar species of trees and shrubs can also be distinguished; the American Elm and the European Elm, our Jack Pine and the European Scotch Pine, the North American Hop Hornbeam and the European Hop Hornbeam, the American Beech and the European Beech, and the high-bush cranberries and elderberry bushes on both continents have marked similarities.

While plate tectonics account for some of the broad patterns of vegetation, plant evolution and climate have both played a decisive role in determining our modern flora. A giant cooling beginning two million years ago led to ice formation around the poles. There were a series of glaciations or ice ages, the ice at times advancing into lower latitudes, at other times retreating toward the poles. During the ice ages, vegetation migrated southwards, only to return when the glaciers melted in the warmer interglacial periods.

In North America, the last ice age (known as the Wisconsin Glaciation) reached its maximum development approximately 24,000 years ago. The ice extended to the edge of the continental shelf and south as far as Long Island, New York. So much water was locked up in the ice that sea levels fell. At the same time, the weight of the ice depressed the land by a few hundred metres, causing the relatively plastic layers below to be squeezed outward and the edge of the continent to buckle upward so that the edge of the continental shelf stood above the sea level.[6] At the end of the ice age, the melting ice and rebounding land led to many changes in the coastal configuration. In the Maritimes, this exposed a corridor, a temporary land bridge, extending from Cape Cod to Nova Scotia. Forest appeared on this exposed continental shelf before the glaciers had finally retreated from northern New Brunswick. Here, then, was a route for plants to migrate and return from their southern refuges and to bring other plants with them into Nova Scotia. It was several thousand years later that the melting ice led to coastal changes in what is now New Brunswick, so that some of the Passamaquoddy islands and Prince Edward Island were linked to the mainland by exposed continental shelf.

During the glaciers' advance and retreat, they flayed the skin off soil, scraped and gouged the rocks, and left a surface of poorly compacted rock and impoverished glacial till. Large erratic boulders were scattered over the landscape. The boulders and scrape marks often found on rock surfaces are the present-day evidence of past glacial action. When the climate warmed, the ice sheets melted over a period of several thousand years. The return of plants from their refuges in the south was a gradual process. We can imagine a situation similar to that at the edge of glaciers in present times: tundra-like vegetation appeared first, followed by boreal forest, and finally the mixed forest typical of the Acadian region today.

The last ice age ended approximately 15,000 years ago. Fluctuations in climate since the last ice age add to the complexity of this story. Specialists examining pollen grains deposited in lake sediments and bogs have discovered that approximately 10,800 to 10,000 years ago there was an abrupt cooling known as the Younger Dryas. At this time, the vegetation changed from boreal forest back to shrub tundra. A warmer period 7,000 to 5,000 years ago allowed White Pine, Hemlock, and Oak to become common, followed by Maple and Beech. All of these changes in climate have played a significant part in the establishment of our present New Brunswick flora.

Fernald based his theories of relict plants on small enclaves of rare plants hundreds of miles distant from others of their kind. Such a theory demands an extensive knowledge of the flora, which could only be obtained by many years of plant exploration. When the first Europeans arrived in this part of North America 400 years ago, they knew nothing of the plants which grew here. They were invariably struck by the barren nature of the rocky and sandy shores and the backdrop of gloomy and forbidding forest. The forests were seen as an evil excrescence on the earth, fit only for wild beasts. "Being covered on every side by one continuous forest," exclaimed the Jesuit priest, Father Biard, "it naturally follows that the soil hardly ever becomes warmed through."[7] The New England Puritan clergyman Cotton Mather was even more scathing in his criticism: "the Plymouth colony was founded in a 'hideous and desolate wilderness ... full of wild beasts ... and the whole country full of woods and thickets'. The colonists were aghast at the sight of a countryside covered by 'wild and uncouth woods'; and they set about destroying trees so as to make 'habitable' ... [the] 'dismal thickets'."[8] They had envisioned an orderly society set in a rural landscape of well-tended fields and productive gardens. Here, they were faced with a wilderness totally divorced from their past experience.

For the first travellers and settlers in New Brunswick, some knowledge of the plants was imperative. Many of the plants they found were unknown to them. Which ones were useful as food or as medicines? At that time, medical cures for diseases were based largely on plant extracts. The native people shared their knowledge with the newcomers. They told the Europeans of plants which they knew had curative properties or were poisonous. They knew, for instance, that the White Hellebore (*Veratrum viride*) was a poisonous plant, but an extract from the roots was used against head lice. Similarly, the Skunk Cabbage (*Symplocarpus foetidus*) was poisonous, but an oil extracted from the crushed leaves was inhaled by native people to relieve headaches. This was the kind of information which was useful to the settlers. The Mi'kmaq and Maliseet people explained the use of Fiddlehead Ferns, the making of maple syrup and spruce beer, and the use of Cattails as food. Theirs was a practical knowledge passed on orally from generation to generation. Europeans then began to observe plants, recording and collating their own information.

The early explorers usually collected some plants to take back to Europe with them for further study. Later, European botanists and naturalists were occasionally sent to other parts of the world to make special collections. Plant exploration in a region such as New Brunswick has been a long and arduous process. Early accounts illustrate the formidable difficulties that plant hunters encountered. Two and a half centuries after Samuel de Champlain visited these shores, the forests were practically impassable. In 1841, the military engineer Sir Richard Henry Bonnycastle was conducting a survey of the Gulf of St. Lawrence. He and a companion landed on the New Brunswick shore near the mouth of the Restigouche River, but when they attempted to penetrate the forest they "found it so dense and so obstructed by fallen timber that they were at last obliged to return to the shore."[9] Later, the surveyor Sir James Alexander, working in New Brunswick in the mid-nineteenth century, described the province as "a vast ocean of trees through which the compass alone can guide us."[10] Trails and roads were constructed slowly while the rivers remained the only means of penetrating central New Brunswick until well into the nineteenth century. The 1829 map, prepared by the surveyor general Thomas Baillie, shows an area across central New Brunswick south of the Tobique River as being "a country very little known."[11] In 1900, the New Brunswick botanist, cartographer, and wilderness explorer William Francis Ganong (1864—1941) reported that this same area was "unsurveyed, wrongly mapped and scientifically little known," and could be reached only after several days' canoe journey.[12]

Among these serious obstacles to plant exploration, the hordes of insects that attacked all who entered the forest through much of the spring and summer seasons were particularly obnoxious. "Nowhere," wrote Leith Adams, "are mosquitoes more abundant and bloodthirsty than in the forest tracts ... . Pennyroyal and Camphor are effective, but require to be constantly applied. The lumber man covers his body with pork fat until he is encased in lard—a sort of enamelling process which seems to drive the old hunter distracted."[13]

The first European plant explorers, working farther to the south, assumed that the vegetation of northern New England and the Maritimes was merely an extension of a broad and continuous range of plants known from other parts of Canada and the United States.[14] Few botanists and plant hunters bothered to visit northeastern Canada. In the wider world, the eighteenth century was marked by the launching of expeditions specifically designed to obtain information about plants and animals. The illustrious Swedish botanist Carl Linnaeus (1707—1778), for instance, collected plants in Lapland (1732) and later brought about a revolution in the way plants were named and classified. In the next generation, Sir Joseph Banks was perhaps the most notable of all plant explorers and collectors, at least in terms of the number of specimens that he obtained. Supported by a large private fortune as well as by governmental sponsorship, he sailed from Britain to Newfoundland (1766) and later to Australia (1768–1771), returning with remarkable collections of plants and information which were to form an important element of the collections of the British Museum and the Royal Botanic Gardens at Kew. Subsequently, as president of the Royal Society of London (1778), Banks was able to ensure that plant collecting continued to be one of the objectives of British government exploration overseas.

Despite many European expeditions to all parts of the world, no famous plant hunters visited the province of New Brunswick: no David Douglas nor Robert Fortune explored these shores and forests.[15] Yet remarkable progress has been made. In the 400 years since the arrival of the Europeans, many less celebrated individuals have contributed their skills and expertise to expanding our knowledge. We must turn to the botanical periodicals, naturalist journals and other publications, and to herbaria (libraries of pressed and dried plants) for the material evidence of their activities—the plants they found. Armed with the tools of their trade—the trowel, pocket knife, vasculum, plant press, and cartridge paper—these pioneers traversed bogs and waterways and braved the forest depths to determine the nature of our plant communities.[16] Their story is a saga of individual adventure and accomplishment. This account examines their progress in the context of the botanical ideas of the time in which they lived and searches for answers to the problems of those small plant populations isolated by hundreds of miles from others of their kind.

[page left intentionally blank]

Chapter 1

Acadia and the Flowering of French Botany

The first European travellers to visit the shores of north-eastern North America were intent on either finding a route to reach the Far East to access the wealth of the spice trade or looking for tangible wealth in the form of gold, silver, or copper. It is perhaps ironic that much of the wealth they found was in the natural resources of the region: fish, pelts, and trees.

In 1534, Jacques Cartier sailed into the Bay of Chaleurs in his vessel, the *Grande Hermione*. A party from the boat landed to examine the shore and record their first impressions.[17] They marvelled at the peas, red currants, strawberries, and "wild wheat," which grew abundantly on the strand, and they gathered plant samples to take back to France.[18] Among their samples was the White Cedar (*Thuya occidentalis*), thought by some later explorers to provide a cure for scurvy.

Seventy years later, Pierre Du Gua de Monts and Samuel de Champlain arrived on the coasts of North America and also made reports of the plants they discovered. Their party established a habitation on Dochet's Island near the mouth of the St. Croix River in 1604. This proved to be a disaster; in the winter months, the island was surrounded by ice, which isolated them from mainland food sources. Many of their company died of scurvy. Although de Champlain attempted to discover the plant "Anneda" or "Tree of Life" (possibly White Cedar) which Cartier had used to stem the tide of this disease among his crew, he was unsuccessful; the indigenous people "knew it not."[19]

After wintering on Dochet's Island, de Monts, de Champlain, and others transferred to a more sheltered site at Port Royal on

Figure 3. Riverine Grape, *Vitis riparia* Michx.

the opposite side of the Bay of Fundy. From this new location, they explored the coasts to Cape Cod (1606). When visiting the lower St. John River valley, they were accompanied by the knowledgeable Parisian apothecary, Louis Hébert, who was interested in plants.[20] He was impressed by the great Oaks, Beeches, Butternuts, and Cedars that grew along the river valley; they also discovered grapes and "wild onions," all of them useful species.[21]

Jesuit priests arrived in Acadia close on the heels of de Champlain and de Monts. Although they were chiefly concerned with saving souls and converting the Aboriginal people to Christianity, their reports to their superiors in France were broad in scope. They described the nature of the country and reported on the vegetation and wildlife. Pierre Biard, who was in Acadia between 1612 and 1616, wrote of the acorns and "Chiquebi roots" (ground nuts), which were gathered by the natives as a source of food. He found the roots growing around oak trees and compared their flavour to truffles, "but better ... and [they were] ... strung together like a rosary."[22] Along the St. John River, the Jesuits found wild grapes growing in sand and gravel, while large trees, "walnut," hazel, oak, beech, elm, poplar, and cedar, were thriving despite the obvious poverty of the soil.[23]

French patrons who had financed the voyages to the New World were interested in the profit that could be derived from these explorations. The explorers searched for medically useful herbs not only for their own use, but also because plant extracts with curative properties could be sold profitably in France. They examined trees that could provide valuable timber,[25] pitch, and turpentine,[24] and collected the seeds of herbaceous plants that could be used as a source of fibres for rope-making.[26]

At that time, botany was in an embryonic state in Europe. Interest there was centred on the herb gardens that were associated with medical schools or with groups of apothecaries. This attitude had grown out of a need dictated by the fact that plants were a major source for medicine. Seeds and roots taken to France by adventurers and traders were cultivated and examined by physicians. While most specimens were

Figure 4. Groundnut, *Apios americana* Medik.

undoubtedly sent from Quebec after the founding of that community in 1608, some were sent from Acadia as early as 1606.[27] Both de Champlain and Hébert were instrumental in ensuring that seeds reached Paris.[28] Hébert also sent specimens to a number of correspondents in other parts of Europe.[29] The plants were studied in *materia medica* classes, and it was this practical study that gave an impetus to the development of botany. In Paris, the Jardin Royal des Plantes Medicinales was the receiving centre for plants from Quebec and early Acadia. Essentially a medicinal herb garden, it was described in 1644 by the English diarist John Evelyn as having hills, meadows, and woods and was "richly stored with exotic plants."[30]

While the explorers provided general descriptions of the vegetation and tried to discover from the local inhabitants those plants which were medically useful, it was the French physicians, botanists, and gardeners who examined the plants in detail, recorded the information, and then disseminated it. Publications on eastern Canadian plants began to appear in Europe. As early as 1576, the Flemish botanist Charles de l'Escluse described a few plants common to eastern Canada, among them the Milkweed (*Asclepias syriaca*) and the Pitcher Plant (*Sarracenia purpurea*).[31] By 1601, some Canadian plants were listed in Jean Robin's catalogue of plants of the Jardin Royal des Plantes Medicinales,[32] and by 1635, approximately 50 Canadian plants were cultivated there.[33] The Swiss botanist Caspard Bauhin (1560–1624) listed 27 Canadian species in his *Panax* (1623) or concordance of plants.[34]

These early observations on the North American vegetation were followed by others made by perceptive travellers. Nicolas Denys, for example, a trader and owner of numerous Acadian fishing stations, travelled the coasts from the mouth of the Penobscot River in Maine to the mouth of the Nepisiguit River in northern New Brunswick. His book, *The Description and Natural History of the Coasts of North America* (1672), is replete with descriptions of the native flora and fauna, particularly of their value as food or for the manufacture of useful objects. Denys found the wild grapes to be of good flavour, but with thick, hard skins; he reasoned that since the latitude was similar to that of

Figure 5. Turtlehead, *Chelone glabra* L.

France, it should be possible to cultivate them and make wine.[35] He listed the varieties of fruit generally found growing wild in Acadia—cherries, brambles, currants, and gooseberries—while on land around the Miramichi and Nepisiguit Rivers were large quantities of strawberries, raspberries, and hazelnuts.[36] He made observations on the common trees and the grain of their woods while his carpenters sawed planks to send to France.[37] Denys was fascinated by the ingenuity of the Mi'kmaq and Maliseet, who used plants for food, medicines, dyes, arrows, pipes, and other useful objects.

The first real landmark in our knowledge of Canadian plants came with the publication in Paris of *Canadensium Plantarum Historia* (1635) by Jacques Phillippe Cornut (d. 1651).[38] Cornut was a medical doctor and his book, arranged alphabetically as an herbal, was written in Latin and illustrated with bold engravings. In addition to some plants from other countries, Cornut described 43 Canadian plants obtained from Vespasian Robin, curator of the Royal Garden in Paris.[39] Although he was largely interested in plants of medicinal value, Cornut made other observations. For instance, he recorded whether they were annuals or perennials, the time of day when the flowers opened, and whether they exuded perfume.[40] The system of plant names or nomenclature that he used, based on that of the Flemish botanist Matthias Lobel,[41] does not enable us to put modern names to many of the plants he described; the names and illustrations clearly indicate the identities of others. Among those which can be readily recognized are the following:

Asarum canadense	Wild Ginger
Adiantum pedatum	Maidenhair Fern
Aralia racemosa	American Spikenard
Apios americana	Groundnut
Dicentra cucullaria	Dutchman's Breeches
Cypripedium parviflorum var. pubescens	Yellow Lady's Slipper
Toxicodendron radicans	Poison Ivy

In his book *Science in the British Colonies of America*, R. P. Stearns describes Cornut's book as excelling "all others on North American flora before ... 1660," stating, "neither the Dutch in New Netherland, nor the English in Virginia, Maryland and New England produced anything comparable to it."[42]

As foreign plants arrived at the Jardin Royal des Plantes, various botanists associated with the garden began to name and classify them. The garden remained a famous teaching institution for over two hundred years. In the early period, the botanist Joseph Pitton de Tournefort (1656–1708) worked on plant classification for his lectures there and became a respected savant among botanists of the day. He was also a member of another select body, the Académie Royale des Sciences.

The establishment of the Académie in 1666 has been described by Trevor Levere and Richard Jarrell as "the most important event for Canadian science during the French regime."[43] Academicians, unlike members of the Royal Society of London, were appointed and paid by the state, and they had an obligation to collect information and specimens from any area where there were French interests.[44] The journal of the Académie (*Journal des Sçavants*) provided a forum for the cooperation of member scientists. In this way, they advanced the botanical knowledge of remote areas under French control.

Joseph Pitton de Tournefort corresponded with botanists in other countries and with plant collectors in foreign lands. Occasionally at his instigation, surgeon-botanists were commissioned by the Royal Garden to collect specimens abroad. The surgeon and trader Sieur de Dièreville visited Acadia in this capacity from 1699 until 1700. He regarded the mission as one of considerable importance. Villebon, the commander at Fort Saint-Jean, received advance notice with instructions to facilitate Dièreville's work. Villebon was delighted to give assistance and was already familiar with the indigenous people's knowledge of herbaceous plants.[45] Dièreville spent much of his time at Port Royal but also visited the lower St. John River valley. On his return to France, he wrote a slim volume describing his experiences in prose and verse.[46] He was impressed by the plant diversity of the forest floor and believed that plants were created for the benefit of man, in keeping with the Christian biblical instruction.[47]

Twenty-five specimens preserved in the herbarium of the Muséum d'Histoire Naturelle in Paris are associated with Dièreville's Acadian exploits.[48] Among them were two plants new to French botanists: the Yellow Bush Honeysuckle (*Lonicera diervilla*), named in his honour, and the Turtlehead (*Chelone glabra* L.); both were described by Joseph Pitton de Tournefort in 1706.[49] Dièreville also recorded the use of spruce beer and described the extraction and preparation of maple syrup.

Dièreville's visit to Acadia came in a short period of peace, between the treaty of 1697 and the outbreak of war again in 1702. During this period, the French government made a determined effort to explore the economic potential of the region. Jacques L'Hermitte, an engineer of the marine, was sent to the Fredericton area in 1698 to hunt for woods suitable for the ordnance department. He found "an abundance of fine and sound masts and excellent elms suitable for pumps and gun mounts, and quantities of good ash for pulleys and other articles."[50] Fourteen French carpenters and mast makers arrived the following year to cut wood for the king's arsenal and were employed around the St. John River, sending many masts back to France.[51] By the following spring, only those carpenters necessary to direct operations remained in Acadia.[52]

Our knowledge of the plants of the region during the period extending from the sixteenth to the eighteenth centuries depends on the records from various European centres of learning. During the eighteenth century, botany was at a peak of activity in France. Plant collecting was encouraged and given an official seal of approval in 1726 when Louis XV issued an ordinance inviting all ships' captains to bring seeds and plants from foreign countries to the garden of medicinal plants, Jardin des Plantes Médicinales, at Nantes and to the apothecaries' garden of the Jardin Royal at Paris.[53]

Some twenty years later, plant collecting was still receiving official encouragement. Roland-Michel Barrin de La Galissonière, the governor of New France and an associate of the Académie Royale des Sciences, sent a directive in 1749 to all French forts and to travellers, requesting them to collect seeds and roots to be remitted to France.[54] La Galissonière offered advancement to soldiers for their zeal in this undertaking[55] while he, himself, assiduously acquired information on the natural history of areas many miles from Quebec.[56] The king's physicians in Quebec added to their observations. Michel Sarrazin and later Jean-François Gaultier were active in this respect. Jean-François Gaultier also gave careful instructions on the most suitable medium for planting seeds on their arrival in Paris.

Occasionally, there was a search for a particular plant known from other regions. In 1756, for instance, the French hunted for ginseng in Acadia.[57] This valuable medicinal plant had been found in China in 1709 by the French missionary Père Jartoux, who suspected that parts of Canada were so similar to China that ginseng might be found here also.[58] By 1752, there was an extensive export of ginseng from the Canadas (Upper and Lower Canada) said to amount to 20,000 pounds sterling.[59]

The working methods of these early French botanists were revealed in a manuscript, *Histoires des Plantes de Canada*, found in the twentieth century at the Seminary of Sainte Hyacinthe, Quebec.[60] Plants collected in Quebec (and a few from Acadia) were sent to Paris each year together with written descriptions of their habitats, geographic distribution, and use. In Paris, the botanist Sebastien Vaillant then compiled an alphabetical plant list with both Latin and common names, synonyms, date of collection, and added comments.[61] Some descriptions were long and detailed and included information on medical uses and the type of soil in which the plants grew. New information was inserted each year in the appropriate places. The document was then sent back to Quebec as a working aid.[62] Additional annotations were sometimes made in Quebec. At least two specimens from Acadia, both of them species of St. John's Wort (*Hypericum* spp.) were identified in the report as being taken to Quebec by the Sieur de Dièreville, while the White Pine (sometimes called Lord Weymouth's Pine) is annotated as "Pin de Millor Weimouth."[63]

Unfortunately, the early enthusiasm for plant collecting displayed by the French in Acadia was followed by a period in which the area became a botanical backwater. The first half of the eighteenth century was marked by rivalry between the French and English, culminating in the expulsion of the Acadians from New Brunswick and the fall of Louisbourg in 1758. There was then a short hiatus before the thread of plant discovery was picked up by another colonial power.

[page left intentionally blank]

Chapter 2

The Botanical Network

Early French explorers and settlers were not the only people searching for plants in eastern North America. To the south in the British North American colonies, similar activities were taking place. These are relevant to our story for two reasons. First, many plants of Maritime Canada are part of a common plant community stretching from Newfoundland to the mid-American states. This common community was noted by the American colonial plant explorer and collector John Bartram (1699–1777); he discovered that plants found in New England were similar to those sent to him from Acadia and Newfoundland.[64] In the twentieth century, the New Brunswick botanist William Francis Ganong (1864–1941) also called attention to this identical community of plants stretching from north-eastern Canada to Pennsylvania and west to the Mississippi.[65] Second, plants taken back to Europe were examined and those with similar features were grouped together (even when they originated in different places); this process of classifying plants enabled botanists to communicate more effectively.

One of the earliest English visitors, John Josselyn (1608–1675), was a perceptive observer of the Maine coastal vegetation.[66] On his visits to Black Point, Maine (now Scarborough near Portland), in 1638 and 1663–1671, he found the plants of New England to be "generally of a ... more masculine virtue but not to so terrible a degree, as to be mischievous or ineffectual to our English bodies."[67]

His observations are of historical interest because he also identified a two-way movement. While North American plants were carried to Europe, European plants of domestic value were brought to North America. At the same time, accidentally introduced European weeds thrived in wastelands and open areas, changing the nature of the local plant communities.

In the wake of the first explorations and interest in medicinal plants, there was extensive traffic across the Atlantic in other kinds of plant material. The European appetite for new species was fuelled by a number of factors.[68] A drive for trade and profit, a desire to expand the diversity of garden plants and trees, the British landscape movement, the acquisitiveness of the great collectors, and the desire for expanding knowledge of the natural history of other parts of the world all contributed to heighten the demand for seeds, plants, and dried specimens.

Occasionally, official and individual interests went hand in hand. This was the case for many members of the Royal Society of London, for whom scientific and economic interests were closely entwined; members and even the society itself invested in trading companies that imported plants to Britain.[69] Scholarly patrons sought adventurous young men willing to undertake the Atlantic crossing to search for plants in the American colonies. Among the most renowned patrons were a bishop of London, Henry Compton (1632–1713), and two London merchants, James Petiver (1663–1718) and Peter Collinson (1694–1768). Colonial plant collectors who responded to their requests included John Banister (1650–1690), John Mitchell (ca. 1690–1768), and John Clayton (1694–1773), all of Virginia, and perhaps the best known of all, the Pennsylvanian farmer John Bartram (1699–1777).[70]

John Banister's plant collecting activities in Virginia were supported by Bishop Compton, together with fellows of the Royal Society, Robert Morrison of the Oxford Botanic Garden, and other individuals well known in the European scientific world. Banister sent back live roots, seeds, dried plants, and descriptions and drawings of the plants he found, and he prepared manuscripts and catalogues of the plant and animal life of Virginia.[71] Many of these were used by English and continental scholars of the eighteenth century in the preparation of their own treatises. The great Swedish plant systematist, Carl Linnaeus, referred to Banister's plants in his *Species Plantarum* in 1753.[72] Bishop Compton was particularly interested in American plants, and his garden at Fulham (London) was a paradise of American species.[73]

Two other famous Virginian plant collectors, John Mitchell and John Clayton, had contacts with British scholars, members of the Royal Society, and scientists in other parts of Europe, especially the Netherlands.[74] John Clayton sent specimens—including some collected in Canada in 1746—to the Dutch botanist Jan Frederick Gronovius.[75] These were seen and identified by Linnaeus, who was residing in Holland.

In the eighteenth century, a member of the Royal Society, Peter Collinson, was pre-eminent in the plant trade from the American colonies.[76] Collinson's influence on the gardening and botanical establishments in England in the mid-eighteenth century was immense: he ensured that North American plants were passed to Philip Miller of the Chelsea Physic Garden and to many influential, wealthy noblemen who were interested in expanding the varieties of plants grown on their estates.[77] Peter Collinson's chief colonial supplier was the Pennsylvanian farmer and fellow Quaker John Bartram. They started trading on a small scale, but Collinson was soon asking for seeds for friends. Eventually, a syndicate was formed whereby all the recipients paid a fee for Bartram's services. Collinson's activities were remarkable in the introduction of many North American trees to Britain.

A paper, written for His Majesty's Commissioners for the Navy, reporting a British timber shortage, was delivered to a committee of the Royal Society in 1662. This caused a general alarm and led to discussions in the Royal Society and to the publication of the book *Silva* (1664) by John Evelyn. After he urged tree planting and conservation, reforestation became a priority.[78]

While the commissioners' report and John Evelyn's book gave an impetus to tree planting, the landscape movement of the seventeenth and eighteenth centuries provided a further motivation. Trees from foreign sources not only produced timber with different properties from the indigenous species, but also gave a refreshing variety to the landscape and improved the aesthetic appearance of estates. The financial gain was an added inducement. In the seventeenth century, a modest amount spent in laying out a plantation could bring more than a three hundred-fold return in eighteen years.[79] Before and even after the founding of the Bank of England (1694), trees were a convenient form of investment. Yet despite reforestation, there continued to be a timber shortage in both Britain and France.

Through the industry of John Bartram and Peter Collinson, thousands of tree seeds reached England to stock the parklands of the great estates with North American species.[80] The extent of this traffic is well documented in the case of Lord Petre: there is a record of the numbers of seeds sent to him and an inventory of the 10,000 trees for sale on his estate after his death in the mid-eighteenth century.[81]

The importation of North American plants had a profound effect on the English landscape and gardens. Avenues of trees leading to large houses became commonplace on English estates, while in conjunction with changing attitudes towards nature, the emphasis on formal planted gardens was replaced by landscape gardening. Groves of trees were planted so that different shapes and shades of green and russet, of coniferous and deciduous trees, acted as foils for each other. In France, a similar interest in reforestation developed; they, too, were short of timber. André Michaux was sent to North America in the late eighteenth century specifically to collect trees and was responsible for introducing 600,000 trees and other plants to France.[82]

The changing fashions on the estates and in the gardens of English country houses only served to heighten the demand for trees and herbaceous plants from foreign sources, including North America. North American herbaceous plants added a further interest to English gardens and challenged gardening skills. "American gardens," frequently planted in peat beds to give suitable conditions for acid-loving plants, became the vogue. Gradually, in the early and later nineteenth century, eastern American species were supplemented with beautiful plants from the American northwest and western United States. Eventually, the “American garden” gave way to the influx of interesting plants which explorations in China and other parts of the world made familiar. Nevertheless, American plants were often retained as a special planting. “The American plants, in general,” recalls the English gardener John Loudon, writing in 1835 of the garden at Cassiobury Park, Hertfordshire, “are grouped together in dug masses, surrounded by turf: and they have grown to such a size as totally to cover the margin of the dug space around them and to form a broken picturesque outline on the turf.”[83]

In the newly discovered parts of the Americas, the Spanish, French, Dutch, Portuguese, and English vied for the riches and territory to be gained. Yet the degree of cooperation between people of like interests in the plant exploration and botanical field in Europe was remarkable. Cultured Old World scholars of various nationalities communicated freely with each other in Latin and passed seeds and botanical specimens to one another. On occasion this friendly attitude even extended to the return of specimens captured from enemy vessels in time of war.[84]

This cooperative spirit was helped by the various religious upheavals in Europe (in which many individuals had to flee the country of their birth) and the movement of students from one country to another in search of further education. The English universities in particular were geared to a strictly religious and classical education, leading to the detriment of science and medical training, and to the necessity of travelling elsewhere to complete an education.[85] The common use of Latin provided an easy means of communication.

The common bond of European botanists and plant lovers led to the exchange of specimens: Joseph Pitton de Tournefort in Paris sent plants to William Sherard in England, while plants received in London from John Clayton of Virginia were transmitted to Gronovius in Holland, where they were also examined by Linnaeus. The generosity of botanists in the exchange of dried and pressed plants was considered a common courtesy. (Indeed, when Linnaeus accepted specimens without returning the favour, Peter Collinson wrote to him in a fit of pique pointing out that he was well known for his lack of cooperation in this way.)[86] This plant exchange led to a general knowledge of the North American and other floras in eighteenth-century Europe.

In both France and Britain, the value of specimens in the study of natural history created a spirit of acquisitiveness and discovery. Not only were seeds and live roots of plants transported to Europe to add to the stock of medicinal and garden plants, but dried plants, too, were of interest to collectors. The large collections of natural history objects acquired by wealthy patrons became a symbol of status and prestige. This was another facet of the display of wealth associated with large houses, estates with exotic gardens and parklands well-stocked with trees often of foreign origin.

Collecting dried specimens sometimes became an end in itself. In his book, *The Naturalist* in Britain, David Elliston Allen describes such collections as "essential furnishings" for the leisured classes. While few collectors could rival that ardent collector of natural history objects, Lady Margaret Cavendish Bentinck, wife of the second Duke of Portland (whose collections took 38 days to auction off in 1786), there were many with a scientific bent who acquired more specimens than they could handle adequately.[87] Cabinets of curios, which often included dried plants and their fruits and seeds, were also considered to have an educational value.

Whether the motivation for making plant collections was economic advantage, prestige, or scientific curiosity, it did not lead to the development of altogether distinct entities. Scientists were frequently given access to the status collections and specialists were employed in sorting and cataloguing the treasures. Herbaria, essentially reference libraries of dried plants, enabled scholars to make careful and detailed comparisons and to become familiar with the geographical distribution and variation of plants.[88] They became an integral part of botanical gardens. The medical uses of plants were no longer the sole aspect studied. Alphabetically arranged herbals were gradually replaced by botanical floras and treatises dealing with medicinal properties—the pharmacopoeia. In the floras, plants were classified and named according to certain botanical principles. With the gradual shedding of superstition and the advance of enlightened thinking based on reason, there was a search for the order and broad relationships between plants.

While plant classification was used by scholars in this search for general laws which govern the natural world, the naming and categorization of plants also had a purely practical aspect. Horticulturalists were continually frustrated by the plethora of names and lack of standardization encountered in plant lists and garden catalogues. In 1730, the London Society of Gardeners issued a *Catalogus Plantarum* in an attempt to deal with the confusion which existed over the same plant being sold under different names.[89] Some sort of classification became a necessity as a ready reference system for the storage and retrieval of information.

Previously unknown plants received from North America and elsewhere acted as a stimulus to European scholars who tried to fit the new species into classification systems based on their current ideas concerning diversity in the plant world. No simple formula was found by which they could be relegated to indisputable groups and consequently many different types of classification were devised.

The Italian Andrea Cesalpino (1519–1603) divided plants into herbs and trees, as the ancient Greeks had done, and then examined them on the basis of their fruits and seeds. The Flemish botanist Matthias de L'Obel (1538–1616) used the leaves as a basis for classification and distinguished between those plants with single-seed leaves and those with two. The Oxford professor of botany Robert Morrison (1629–1705) classified plants by comparing their fruits. Another English botanist, John Ray (1627–1705), believed that many features should be used. Like L'Obel, he recognized those plants with single-seed leaves (Monocotyledons) and those with two (Dicotyledons) and defined the distinguishing features of a species as those which are propagated through the seed and not due to environmental conditions.

Joseph Pitton de Tournefort (1656–1708), who was a revered botanist at the Royal Garden in Paris when Dièreville visited Acadia, based his classification largely on the flower petals or corolla and he identified genera which were later recognized by Linnaeus. John Ray was critical of Tournefort's method, which, he said, "often led to manifest absurdity."[90] Tournefort refused to accept the idea of sexuality in plants, but his successor, Sebastien Vaillant (1669–1722), described the function of pollen grains and pistils in fertilization. He may have influenced Linnaeus's thinking.[91]

Apart from the system proposed by Ray, most of these classifications were essentially "artificial" in that they were based on one or very few features; but perhaps the most artificial classification devised was that of the renowned Swedish systematist Linnaeus.

Although Linnaeus acknowledged that a perfect natural system would follow the plan of the great creator, he noted the difficulty of establishing such a system as long as knowledge of many plant species was incomplete.[92] His classification of flowering plants, published in *Systema Naturae* (1735), was based on the numbers and arrangements of the male and female parts. He organized plants into twenty-three classes according to the number of stamens in each flower. These were then subdivided into orders based on the number of female organs or pistils. The terms used by Linnaeus to describe his classes of plants were the butt of derogatory comments among his botanical colleagues. For many, the connotations of polyandry and polygamy were seen as examples of the various states of connubial bliss. He called the flowerless plants "cryptogammia" or "hidden sex." His classification had the advantage of being simple to use. By 1740, it was well known in the American colonies.[93] By 1763, it was in common usage at both Cambridge and Edinburgh Universities.[94] This simplicity of use was critical at a time when plants from many sources were flooding into Europe.

Linnaeus's most lasting contribution to the field of botany was his binomial system of naming plants.[95] Until that time, names had been long and unwieldy and had involved descriptions of parts of the plant. Linnaeus separated the names from the descriptions by using a generic name followed by a specific epithet. These he introduced into his books *Species Plantarum* (1753) and *Genera Plantarum* (1754). He named many North American plants, which were supplied to him from the garden of the Anglo-Dutch financier George Clifford at Hartekamp, Holland, as well as those sent to him from America by John Banister, John Mitchell, John Clayton, and the Swedish botanist Pehr Kalm.[96]

Although the Linnean binomial system of naming has withstood the test of time, his system of plant classification was not so universally accepted. In Britain, there was resistance to his system until 1760, for that of Ray had long been used and found satisfactory,[97] while in France other systems were being devised.

At the time of the French explorations in Acadia, Tournefort identified plants arriving at the Royal Garden in Paris. Later, Bernard de Jussieu (1699–1777), after arranging the Royal Garden at Versailles according to the Linnean system, was troubled by certain obvious discrepancies and started to rearrange the plants so that those that looked alike in many features were placed close together.[98] Other types of "natural" classification were introduced by the De Candolles in Switzerland (Augustin and his son Alphonse) and George Bentham and Joseph Dalton Hooker of Kew.[99]

Underlying all the systems of classification devised before 1859 was one basic concept: that of the fixity of species. There were exceptional individuals who realized that mutations or changes in the genetic structure could take place.[100] In his old age, Linnaeus doubted the fixity of species and believed changes were possible.[101] For European botanists, herbalists, and students of natural history, the constancy and fixity of species was a basic belief reinforced by Christian dogma and doctrine. Each species of plant and animal was individually created according to Biblical tradition. Natural theologians impressed by the harmony of nature were convinced that the natural world was a theatre or spectacle of the past creation. Here was a mirror which reflected the perfection of God, by means of the remarkable adaptations of plants and animals to their particular purpose and worldly niche. The natural theologians' view was teleological and full of purpose; the design of every creature was evidence of the greatness of the Creator.

These ideas on the nature of species and botanical classification were familiar to botanical scholars at the beginning of the nineteenth century when New Brunswick was being colonized by people of British stock. They were, therefore, generally accepted by European-trained botanical explorers who sent information back to their European colleagues.

Chapter 3

The Rape of the Forests

> Sixty years ago, almost the entire surface of New Brunswick was an unbroken wood, and the first settlers carried a musket in one hand to protect themselves … and an axe in the other to clear away the trees.
>
> —Abraham Gesner, *New Brunswick* [102]

The British finally gained clear title to the area now called New Brunswick—including a part of what is now the province of Nova Scotia—by the Treaty of Paris in 1763.[103] Over the next two decades, the provincial surveyor-general, Charles Morris, made efforts to estimate the economic potential of the land and of the indigenous plants and trees. This was a matter of immediate concern to a government responsible for regulating speculators and entrepreneurs; the government was anxious to promote the settlement of new immigrants and aimed to extract profit from the new province.

On his visits to the St. John River valley, Morris noted the richness of the intervales and of the marsh grasses useful for winter cattle feed.[104] He found the settlers were successfully raising fine corn of a variety obtained from Canada, with ears growing "close to the Ground"[105] and hemp nine feet high.[106] While the forests along the Long Reach (on the lower St. John River) had been burnt by the aboriginal peoples, he found useful hardwoods on the intervale land from Belle-Isle to Grimross (Gagetown). Here were "Timber trees, such as Elm, ash, Beach [*sic*] and what the inhabitants call Black Wallnut [*sic*], not such Timber as the Black Wallnut of Virginia and Maryland, but is called, from a Black Wallnut which it bears, about the Bigness, and indented like a Peach Stone, but rougher, and is of a blacker Colour; the Colour of the Timber is somewhat darker than Maple, and of a Grain much like it."[107]

Morris and other observers found that forest growth was a good indicator of the richness and suitability of the land for settlement. In a general description of the whole region, he observed:

> The fertile rich lands are thus distinguisht that they abound with ash, maple, beech. Elm, black birch the meaner sort with spruce and white birch. The timber growth is a standing rule of forming a judgement of the richness of the soil in all the northern American plantations and by which they make the least mistakes and the wild lands there according to its different growth of trees sells either for more or less price.[108]

While the rivers provided a route into the province's interior and the fertile valley lands were suitable for settlement, it was the forest trees that had the greatest potential as a source of wealth.

The competition between states for supremacy at sea was an important factor in the search for forest resources in North America. Britain and France vied for the control of these resources because the home forests of both countries were being depleted. Both the demand for wood in smelting iron and the drive to increase the size of the naval fleets led to a shortage of timber. This is hardly surprising when some 2,000 oak trees were required to build a seventy-four-gun ship in 1812.[109] British naval personnel were encouraged to search for valuable timber in all their territories overseas. In the nineteenth century, officers of surveying parties were instructed to obtain specimens of tree flowers and fruits, to sketch the habit of growth, to make measurements of selected trees with a "Hoppus Measurer," to find the specific gravity of a cubic foot of wood cut from the trunk, to note the type of soil in which the tree grew as well as the nature of the country for conveying logs to water.[110] The execution of this information-gathering process was encouraged by the establishment of two prize medals.[111]

John Winthrop, governor of Connecticut, was present in Britain when His Majesty's Commissioners for the navy presented a paper to the Royal Society on timber shortage (1662). He had ties to the Massachusetts Bay Company and he immediately pointed out the potential of New England as a provider of timber and ships. In a paper to the society, he enumerated the supply of Spruce and Fir for masts, Pine for tar and pitch, and Oak for shipbuilding.[112] In the seventeenth century, the supply of Baltic timber had the advantage of closeness to Britain, but the North American White Pine was found to be serviceable for a longer period than the Scots Pine of the northern European forests.[113]

During the American Revolution, when New England forests were closed to them, the British turned to the St. John River valley of New Brunswick for masts and spars for the Royal Navy. With the loss of the American colonies and the arrival of the Loyalists in New Brunswick, the pines of the area became a vital strategic reserve. Their importance was symbolized in the Great Seal approved for the province when it was set apart from Nova Scotia in 1784.[114] The White Pines of the New Brunswick forests were impressive. A traveller passing towards the Miramichi River valley at the end of the eighteenth century commented, "we entered a valley of immense pines which were the loftiest I had ever seen, and so numerous that I supposed the whole British Navy might be supplied with masts and spars from it. Many of the trees we supposed to be seventy to eighty feet to the first branches."[115]

Naval scouts fanned out through the forests and marked the noblest of the White Pines (*Pinus strobus*) with the broad arrow, indicating that they were Crown property. In his *Forest Life in Acadie*, Campbell Hardy vividly describes how they located the pines. The scouts ascended the tallest trees and from these pinnacles of sight took compass bearings of distant pine groves. They then descended and continued on their "errand[s] of destruction."[116] Majestic pines were harvested

Figure 6. White Pine, *Pinus strobus* L.

with consummate care. Paths were cleared and prepared to soften the trees' fall, and the route to water was carefully chosen to prevent any damage to the timber. Only trees of at least 150 feet in height and 6 feet at the butt were considered suitable for ships' masts.[117] The extraction of timber that could not easily be taken to water was not a simple task. Sometimes twenty yoke of oxen were required to haul a single tree.[118] By 1805, "most of the accessible trees suitable for masts in the province had been felled," notes Graeme Wynn in *Timber Colony*.[119] The cutting of pines for this purpose then gave way to their exploitation for "ton timber," 200,000 trees being felled in the peak year of 1825 alone.[120] Ton timber was a measure of volume used in the Maritimes for squared timber. When loading sailing vessels, one ton occupied forty cubic feet of space. For timber for the navy, the requirement was fifty cubic feet.

Conserving the White Pine for the express use of the navy was the responsibility of the Surveyor-General of the King's Woods in North America. This task was a profoundly difficult one; most settlers regarded the exploitation of the forests as a God-given right.[121] Sir John Wentworth, who held the office from 1766 to 1820, settled in Nova Scotia in 1783.[122] In his early years, Wentworth and his deputies had some success in protecting the navy's wood supply,[123] but when, in 1807, Napoleon closed the Baltic to British shipping, the demand for North American timber became so great that for the next ten years no attempt was made to regulate the exploitation of New Brunswick's forests.[124]

When regulation was restored after the Napoleonic Wars, the old system of promoting some forest conservation in the interest of national security gave way to an imperial policy that encouraged exploitation. At a time when the Industrial Revolution and a rapidly growing population increased Britain's appetite for wood, a prohibitive tariff was imposed on the import of Baltic and other foreign timber. From all parts of colonial New Brunswick and the other eastern North American colonies accessible to navigable water, wood flowed across the Atlantic.[125] In 1815, New Brunswick sent 92,553 loads of fir and pine to Britain, more than twice as much as was sent from Nova Scotia and Upper and Lower Canada together.[126] It is hardly surprising that by 1830 the big trees had gone from the pine forests of southern New Brunswick, and contractors were moving northward to the upper St. John River valley and to the valleys of two rivers which flow into the Northumberland Strait and Bay of Chaleurs, the Nepisiguit and Restigouche. There they continued to square the big trunks by hand and to make ton timber. The extent of the export of timber in 1841 was described by naval officer Richard S. Bonnycastle: "By the middle of July the Bay of Chaleurs had already freighted from its different ports ninety sail of square rigged vessels for the British market with timber."[127] In areas from which the largest trees were gone, entrepreneurs then built sawmills to cut logs into deals for export. Deals were Pine or Fir planks of three to three-and-a-half inches thick, seven inches broad, and ten to twenty-four feet long. The big spruce thus fell to the axes of the lumbermen and went beyond the seas, as the great pines had before them.[128]

A well-known resident of New Brunswick described this plunder of the forests in 1825:

> The forests are stripped and nothing left in prospect, but the gloomy apprehension when the timber is gone, of sinking into insignificance and poverty… . Men who take no interest in the welfare of the province, continue to sap and prey on its resources.[129]

And again:

> The persons principally engaged in shipping the timber have been strangers who have taken no interest in the welfare of the country; but have merely occupied a spot to make what they could in the shortest possible time.[130]

The lack of adequate controls on timber-cutting led to enormous wastage: sometimes large pines were felled, one or two pieces of square timber were cut from each trunk, and the remainder left to rot,[131] or whole trees were cut and left to rot on the ground.[132] Frequently, land was obtained with the pretence of settlement, but, actually, with the sole intent of removing valuable timber.[133] Occasionally, timber was even destroyed to prevent gain by another exporter.[134]

The North American timber trade became a crucial link between New Brunswick and Britain. The economic exploitation of the White Pine and Spruce was followed by the use of other species of forest trees as the necessity arose. Hemlock trees (*Tsuga canadensis*) were stripped of their bark to be used in tanning leather; the trees were then left as a stark reminder of the ruthlessness and wastefulness of humankind.[135]

Although the pillage of trees for the navy and other purposes may be regarded as more in the domain of economics than of interest to the student of natural history, there are two ways in which it is of particular concern to the naturalist. The navy scouts, surveyors, and lumberers extracted the finest trees, the monarchs of the New Brunswick forests. This was a selective process carried out over a long period of time and the precise results of this selection can no longer be measured. But the removal of large numbers of magnificent trees of cone-bearing age, leaving only inferior trees to scatter their seeds, may have led to a loss from which New Brunswick forests have never recovered. Secondly, tree extraction was the beginning of the opening up of the forests, allowing both the penetration of foreign species and the fragmentation of the forest, changing both water run-off and the balance of nature.

[page left intentionally blank]

Chapter 4

Surveyors, Plant Hunters, and Botanists

Naval scouts directed their efforts to finding trees suitable for naval supplies, masts, spars, pitch, etc. It might be said that they could not see the forests for the trees: they paid scant attention to shrubby and herbaceous plants. Nevertheless, at much the same time that naval scouts were active in the eastern American forests, a number of knowledgeable European plant hunters began to arrive to investigate the nature of the vegetation. These were master plant hunters with a sufficient knowledge of botany to recognize what was different and would be of interest to their European patrons. The plants they found provided an overview of the dominant vegetation and, on occasion, included particularly valuable or rare species. With their narratives and collected plants, they revealed the secrets of the North American wilderness and whetted the European appetite to know more. These plant hunters hailed from several European countries.

The Swedish Academy of Sciences sent Linnaeus's student Pehr Kalm to the American colonies and Canada between 1748 and 1751. He was instructed to search for hardy plants which could be successfully introduced into Sweden. He collected an array of information from Pennsylvania, New York, and New Jersey. Later he travelled up the Hudson and Richelieu Rivers to Lake Champlain and into Canada. In his journal, *Travels in North America*, Kalm vividly describes his explorations and provides a commentary on plants known by native peoples to have medicinal virtues. Many of his collected plants were later named by Linnaeus.[136]

The director of the Royal Garden in Paris sent André Michaux to the American colonies where he made a vast collection of trees and established a nursery to provide trees to replenish the French forests.[137] Together with his son, François André Michaux, he introduced at least 60,000 North American trees to France and also collected herbaceous plants.[138] François André Michaux was remarkable for his observations on forest succession. He recognized plant succession and compared the growth of trees in forest clearings with other standing growth, and he urged careful husbandry for the future well-being of North American forests.[139] This was a new concept in America, where trees had always been regarded as an encumbrance on the land and a hindrance to settlement. Michaux travelled into Canada (1792) and collected plants on his way up the Saguenay River valley towards Hudson's Bay. Owing to poor weather, he turned back without reaching the bay.

At a time when long journeys were hazardous, assembling a plant collection was only one part of the story. Transmitting the treasures to Europe required special conditions and good fortune. Shipwrecks were frequent and there were tremendous difficulties in keeping plants in good condition on board ship, where they were exposed to salt water and rats, or left to the mercy of the ship's captain.[140] Michaux's collection suffered the worst of all possible fates when, on his return voyage to Europe, he was shipwrecked off the Dutch coast. Fortunately, he survived and found most of his plants, seeds, and notebooks washed ashore.

The Dresden-educated Frederick Pursh lived in the United States between 1799 and 1811, and later settled in Montreal, where he worked on the flora of Canada. He is reputed to have surveyed the flora of the Maritimes. Unfortunately, his specimens were lost in a fire and he died shortly afterwards in dire circumstances.[141] The Royal Botanic Gardens at Kew sent the successful collector Francis Masson (1797) to search for plants around Lake Ontario and Lake Superior and near Montreal and to visit British stations on the Gulf of St. Lawrence.[142] Later, the Scottish botanist David Douglas, of Douglas Fir fame, was sponsored by the Royal Horticultural Society to visit eastern

America (1823–1824). He botanized around the Windsor region and collected plants along the Canadian side of the Niagara River.[143]

While all these eminent plant explorers and collectors concentrated their efforts on the American colonies and central Canada, Joseph Banks sailed on the fisheries protection vessel *Niger* to Newfoundland and Labrador in 1766.[144] He collected plants around St. John's, the Labrador coast, and the northern peninsula of Newfoundland. Despite a fierce storm on the return journey, Banks arrived back in England with a well-documented collection, which was studied by a number of distinguished botanists.[145] Other observations on the Newfoundland flora were made by Newfoundland-born William Eppes Cormack during his epic journey on foot across the island in 1822. He sent plants to the Linnean Society in London.[146]

In the Maritime region, the Scottish naval surgeon Archibald Menzies collected a few "Arcadian" plants when he was stationed in Halifax, Nova Scotia in the 1780s. These he presented to Sir Joseph Banks on his return to England. Menzies became famous at a later date as a collector of seeds and plants from the pacific northwest, and as a surgeon and naturalist on the *Discovery* during Captain George Vancouver's voyage around the world.[147]

Despite the deployment of these many European explorers to North America, none went specifically to the New Brunswick colony. Occasionally, a particularly perceptive traveller would comment on the plants of the province. Patrick Campbell, for instance, visited New Brunswick in 1791 and travelled on foot between the Nashwaak and the Miramichi River valleys. He noted that near the junction of the Taxis and Miramichi Rivers, "all along the banks of this river are seen great quantities of hops growing spontaneously, and as luxuriant as those cultivated in the most fertile part of England and small onions, with which we used to season our food."[148]

The Scottish gardener and botanist John Goldie made a fleeting visit to New Brunswick (1817) while en route to Quebec from Halifax. He made notes on the geology and botany of the Bay of Chaleurs region and found there the Venus-Slipper

Orchid (*Calypso borealis* [*Calypso bulbosa*]).[149] The roots and specimens that Goldie assembled in the Maritimes and Quebec were placed on board a ship bound for Scotland, but were lost at sea. A similar misfortune dogged him on other occasions, resulting in the loss of two full years of work.[150]

The information gathered on these various expeditions to North America, together with the European advances in botanical classification and nomenclature, led to the publication of several general North American floras. André Michaux's *Flora Borealis Americana*, based on his years of work in the American states, was printed in Paris in 1803. Frederick Pursh published his *Flora Septentrionalis* in England in 1815.

William Jackson Hooker of Glasgow University and later the Royal Botanic Gardens at Kew collected information from a variety of informants. For him, the Sir John Franklin overland expedition to the far north (1825–1827) was a particularly rich source of information. He also gleaned information from a variety of travellers in Canada, Nova Scotia and New Brunswick, which was incorporated into his *Flora Boreali-Americana 1833–40*.[151] The two volumes of this book, illustrated with fine line drawings, referred more to plants of the northern regions of Canada than the southern parts. Hooker acknowledged this defect when he wrote in the preface, "it is to be wished that the southern boundary adjoining the State of Maine and the Great Lakes, Huron and Superior were more accurately searched." Hooker had obtained some New Brunswick plants from Edward Nicholas Kendall between 1836 and 1838.[152] Kendall came to New Brunswick originally on behalf of the British Colonial Office to make astronomical observations concerned with the boundary dispute between New Brunswick and Maine, and again later as agent for the New Brunswick and Nova Scotia Land Company, which had purchased half a million acres of land in the Stanley area to be developed for settlement.

As a naval lieutenant, Kendall was no stranger to scientific exploration. He had already served as assistant surveyor on the Arctic expedition of George Francis Lyon to Melville Sound and had been chosen to be a member of Franklin's expedition to the Arctic.[153] Naval officers who accompanied Arctic exploring expeditions in the nineteenth century were trained in a variety of fields and were skilled in surveying, topographical drawing, and making astronomical observations.[154] They were also frequently interested in other aspects of science and natural history. Kendall had accompanied the surgeon and naturalist Dr. John Richardson from the mouth of the Copper Mine River and overland to Fort Franklin on the Great Bear Lake.[155] Kendall must have been familiar with the idea and methods of collecting plants and may have helped Richardson with this activity.[156]

Among the plants that Kendall found in New Brunswick were the Indian Cucumber-root (*Medeola virginiana* L.), the Coral-root Orchid (*Corallorhiza multiflora* [*Corallorhiza maculata*]), and the Slipper-orchid (*Cypripedium humile* [*Cypripedium acaule*]). He also found a plant which is thought to have been extirpated from the province, the large white Trillium (*Trillium grandiflorum*).[157]

From the 1830s on, the British showed a more active interest in the plants of the region. A request from the secretary of state for the colonies was placed in the *Royal Gazette*, Fredericton (1838), on behalf of the trustees of the British Museum asking for mineralogical, zoological, and botanical specimens. A column of directions for collecting and preserving plants for a herbarium accompanied the request.[158]

Sir William J. Hooker, hoping to encourage a flow of information from the colonies to Britain, wrote the section on botany of the 1849 *Manual of Scientific Enquiry*. His instructions were intended for the use of surveyors, medical officers, and general visitors to the colonies. He emphasized the value of information collected on the spot and gave advice both for preparing herbarium specimens and transmitting live plants for cultivation. He stressed the use of Wardian cases[159] for sea transit, and requested specimens of useful plants for the museum of economic botany.[160] Plants which would yield "medical substances" were of particular interest and "merit[ed] the attention of travellers in every country," he wrote. "Even with regard to the many frequented spots it has been truly observed that few persons visit them 'with their eyes open'."[161]

Figure 7. Indian Cucumber-root, *Medeola virginiana* L.

Sometimes military surveyors, working in relatively unknown territory, added to the fund of knowledge by recording the trees and herbaceous plants present. In 1844, the military surveyor James Alexander was in New Brunswick surveying a route for a proposed military road which was to run from Halifax to Quebec.[162] The survey cut diagonally across the province from the bend of the Petitcodiac River to Grand Falls. Alexander recorded his first impressions of the province for his British audience: "The general idea of it was, that it was an immense expanse of dark woods, over which hung everlasting mists, that a few fishermen inhabited the stormy coasts."[163] Perhaps he should be forgiven for his dreary opinion because few people had penetrated the interior of the province.

On this expedition, the surveyors took all kinds of equipment with them, including creeping irons that were used to climb tall trees to determine the best general direction of the survey. They also used them to evade the constant attacks of mosquitoes and blackflies: "It was a great relief to sit on the cool top of a pine tree out of reach of the flies below," surveying "a boundless deep immensity of shade," Alexander wrote.[164] His assistants recorded the various kinds of forest they passed through, while he "made a herbarium of dried plants and collected every portable thing, and noted and sketched everything of interest on our route."[165]

Alexander provides us with a charming insight into the common nineteenth-century belief that all plants and creatures were put on earth for a specific purpose. After noticing that the pitcher of the Pitcher-plant contained water, he reasons, "The use of the water seems to be this (and it is indeed a singular arrangement of the great Creator) mosquitoes are reared therein for they are seen to issue from the cups in numerous flights in the spring."[166] He goes on to explain that flies drowned in the cups provide nutrients for developing mosquito larvae.[167]

The appendix of his book relating his Acadian experiences lists the plants he found (both their common and Latin names). This was the kind of information surveyors and engineers were gathering to be remitted to the home government and to Royal Botanic Gardens at Kew in London.

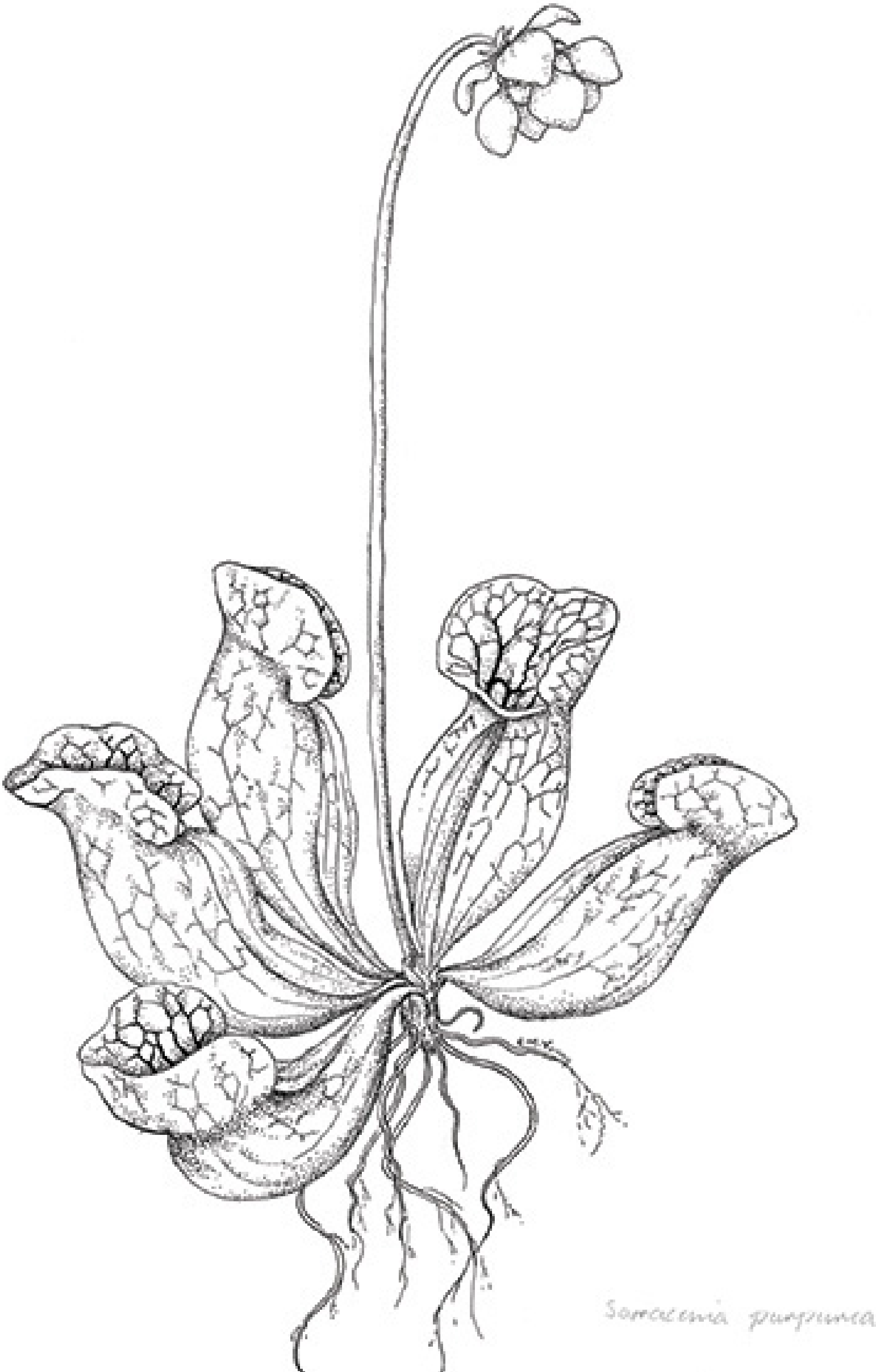


Figure 8. Pitcher-plant, *Sarracenia purpurea* L.

Although by 1864 Sir William J. Hooker acknowledged that Kew held extensive collections of Canadian plants, he continued to request plants from the southern districts of Canada.[168] He felt that there were probably many plants which, though known from the United States, might never have been listed as occurring in Canada. At that time, Hooker was collecting information for a proposed book on the Canadian flora.[169] The British government insisted that self-governing colonies should pay for their own floras, yet it continued to nurture the flow of botanic information from overseas to Britain. This had helped to establish the Royal Botanic Gardens at Kew as the pre-eminent treasure house of plant specimens and information from all parts of the world. In the mid-nineteenth century, ships of the British navy, the East India Company, and the Hudson's Bay Company still, at times, carried agents free of duty to and from places abroad for the Royal Society, the Royal Horticultural Society,[170] or the Royal Botanic Gardens.[171] Through the goodwill of the Colonial and Foreign Offices, packages could be sent to the director of the Royal Botanic Gardens without payment of postage and Sir William J. Hooker actively encouraged the use of this service.[172]

As the western parts of North America opened up, the British directed their energies in plant collecting there. The Palliser Expedition of 1858 to Saskatchewan and the Rockies, for instance, was accompanied by Eugène Bourgeau, an eminent French plant hunter, who was employed by the British Government to make plant collections for the Royal Botanic Gardens at Kew.[173]

The Americans, too, had become intensely interested in the flora of the whole of North America. The exploration of the west by organized expeditions, such as the one by Meriwether Lewis and William Clark (1803–1806) and by individual botanists such as Thomas Nuttall, had acted as a stimulus. There was a wealth of botanical material flowing from all parts to the centres of knowledge in the eastern United States.

Books based on the data collected by members of these various expeditions began to appear. The field botanist Thomas Nuttall wrote the *Genera of North American Plants* (1818), while between 1838 and 1843 the Americans John Torrey and Asa Gray, whom Nuttall referred to in a disparaging fashion as "closet botanists," wrote a *Flora of North America*.[174] Gray's classic work *A Manual of Botany of the Northern United States* appeared in 1848.

Torrey and Gray's *Flora of North America* was a turning point for North American botanists. Until that time, plant collectors had sent most of their specimens to Europe for identification and had accepted the European pronouncements with a time-honoured acquiescence. Asa Gray had spent time in Britain, France, and Holland familiarizing himself with North American botanical specimens in the great European herbaria.[175] He met many European botanists and became acquainted with Charles Darwin just after he returned from the voyage of *The Beagle*. Gray returned to North America armed with books and equipment and then, cooperating with John Torrey, set about identifying plants that were arriving at New York and Boston from collectors who had braved the relatively unknown regions of the western and midwestern states. In Europe, Gray had earned the respect and friendship of Sir William J. Hooker, who was "not only giving encouragement to the Flora but was shipping whole sections of his herbarium to New York."[176] Gray and Torrey thus became the final arbiters on many questions of taxonomy of North American plants.

Chapter 5

River Journeys

> The province is cut asunder lengthwise, by a great river called the St. John, about two hundred miles in length, and at half way from the mouth, a full mile wide… . In this Province the rivers and creeks were the only roads from settlement to settlement. In summer we traveled in canoes.
>
> —William Cobbett, *Advice to Young Men*[177]

We can well imagine a sunny morning with the mists just rising off the St. John River. A canoe pushes off from the Fredericton shore. Its two occupants set off paddling quietly up the river. The older of the two is a Maliseet guide and the younger is a newly appointed professor of chemistry and natural science at King's College (later the University of New Brunswick), Dr. James Robb. James Robb would have observed the physical features of the valley: the raised river terraces of the left bank indicating the past history of the river, the spent volcanic cone of Currie's Mountain on the right, the width of the river, and the shape of the valley. He would have noticed the groups of pine trees on the right bluff and maybe an osprey swooping to the river and rising labouredly from the water with its prize. The two would have passed islands whose shapes were dictated by the river currents, stopped momentarily at Sugar Island, and later landed on the bank of the St John River at Crock's Point.

There James Robb crossed the river gravels hunting for unusual plants. He would have passed the trees festooned with the Riverine Grape (*Vitis riparia* Michx.), avoided the Poison

Ivy (*Toxicodendron rydbergii*), and noticed the Clematis (*Clematis virginiana*) and the Wild Cucumber (*Echinocystis lobata*) clambering over other vegetation. He found the Saint John River Tansy (*Tanacetum bipinnatum* subsp *huronense* var. *johannense*), but did he find another special plant of the St. John River valley, the St. John River Oxytropis (*Oxytropis campestris* (L.) DC. var. *johannensis* Fern.)? We do not know. These river islands were usually partially flooded in the spring freshet and might well have unusual plants. When Robb returned to Fredericton, he pressed and dried the plants he had collected and then mounted them on sheets of paper, labelled them, and placed them in his herbarium cabinet—the beginning of the oldest institutional herbarium in Canada.

In the nineteenth century, teachers appointed to King's College found canoeing the rivers to be a satisfactory way of penetrating and exploring the interior of the province. The rivers were also the principal highways. Arriving from Scotland in 1837, James Robb took the river boat from Saint John to Fredericton. He had been recommended for the new post by the botanist Sir William J. Hooker. His duties included teaching geology, botany, zoology, and chemistry. He was dismayed at the wide requirements of the post and wrote to Sir William J. Hooker: "It is melancholy to see one compelled to divide their [*sic*] attention to so many branches but in my situation it is hardly possible to avoid it."[178] He was expected to provide a sound background for his students in geology and chemistry as well as botany. It was unusual for universities to divide these subjects; most Canadian universities had no chair specifically devoted to botany.[179] Even thirty years later, there were only half a dozen professors of botany in the whole of the United States.[180] In spite of the broad scientific requirements, the establishment of colleges and universities in the British North American colonies and the United States gave an impetus to regional geological and botanical studies.

The fledgling University of New Brunswick was housed in a fine Georgian building set amidst a grove of trees situated high on the hill overlooking the St. John River. Behind the college, pristine forest stretched away and provided a rich area for botanical investigations. There, within easy walking distance, could be found orchids, trilliums, mayflowers, and many vernal flowering plants. It was there that Robb found Goldie's Round-leaved Orchid (*Platanthera macrophylla*); this plant is no longer seen in these woods. He also found another orchid, the Chequered Rattlesnake Plantain (*Goodyera tesselata*) and the American Hop Hornbeam tree (*Ostrya virginiana*). The river valley provided a different kind of flora—that of the St. John River floodplain with its Butternut trees, Ostrich ferns, and Wild Cucumber. In 1838, he visited Keswick Ridge and discovered the small Birds-eye Primrose (*Primula mistassinica*). Robb collected, pressed, and mounted many plants from these haunts and frequently canoed to the river islands or up the Nashwaaksis stream or other tributaries to search for specimens. He quickly identified seventy different plants growing around Fredericton and sent a list to Hooker in 1839.[181] Included in this list were the provincially rare Hepatica (*Anemone americana*), and the Climbing Bittersweet (*Celastrus scandens*). The Bittersweet has not been seen in the province in recent times.

One of the advertised aims of the college was to familiarize students with the native plants and their uses.[182] When Robb arrived and winter was approaching, there were no plants available for teaching purposes and no ready-made herbarium. He complained that "he was somewhat cramped for want of plants."[183] Within a year, he set off on a long expedition to observe both the plants and the geology. Accompanied by a student and native guides, Robb canoed up the St. John River and after making a detour up the Tobique valley, reached Madawaska in the northern part of the province. Their route then lay up the Grande River across the portage to the Restigouche River system, and thence to the Bay of Chaleurs. Robb described the journey:

> This was a dreadful journey. The headwaters of the Grande River and Restigouche are shallow, narrow, winding like a serpent or 5000 serpents, infested by mosquitoes, black flies, and sand flies so numerous that the moon could scarcely rise through them, so hungry that they light by

> thousands on every exposed point of your body leaving it all streaked with blood. Then the alders grew on each side and met in the middle so that we had to push our body through below them or through the heart of them, and 1000 burnt stumps of trees had fallen across besides and then we had to jump into the water and push or carry our canoe across or cut them with our axes where it was too deep water or fairly take the canoe on shore and carry it on the head till the river (or rather ditch) became again navigable.[184]

After negotiating the Restigouche River, they crossed the Bay of Chaleurs to Bathurst and then proceeded to Chatham, where they could still see the effects of the great forest fire of 1825.[185] A further journey to Sackville, Pictou, and Halifax and back across the Bay of Fundy, brought them to Saint John, having covered more than 1,000 miles. Later, Robb travelled extensively throughout the province, covering 2,000 miles with the Scottish agricultural chemist James F. W. Johnston of Durham University, England; the latter had been appointed by the government to investigate the agricultural potential of the province.[186] The geology and local flora provided a good indication of land suitable for agriculture. Robb felt that Johnston painted too rosy a picture of the agricultural potential and stated that his estimate was "unduly exalted."[187] Robb also undertook a journey to Quebec City by canoe and raft via the Saint John and Chaudière Rivers. He had been asked to research Acadian history for the provincial government. The observations of the provincial flora and geology made on these journeys were invaluable to Robb for teaching purposes.

The plants Robb collected were pressed and mounted on white herbarium paper sheets with meticulous care. He labelled them with the Latin name, date, place of discovery, and noted any special features. He often indicated the books he had used for identification; Thomas Nuttall's *Genera* and the floras by John Torrey and Asa Gray and by William J. Hooker were the texts favoured.[188] The specimens were then preserved in a herbarium cabinet in the small university "museum."

Plant study was a concern in the fledgling universities of North America because many medical cures were still derived from plant extracts and because little was known of the uses of North American plants for medicine and agriculture. James Robb's training fitted him well for this task. His medical training at Edinburgh University emphasized the importance of plant identification and the curative properties of plants. His subsequent studies gave him a broad background. Steeped in the Scottish tradition of excellence and enquiry, he travelled in Europe studying and visiting at prestigious university centres. Unlike most young men, who in the early nineteenth century undertook the grand European tour, Robb did not spend his time among the classical ruins and watering places of the continent. Instead, he studied in Paris and visited scientific centres in Montpelier, Milan, Pavia, and Geneva. Armed with letters of introduction from eminent Parisian scientists, Robb and a Belgian comrade travelled for two months with the express aim of making "much progress in Botany, Entomology, malacology and Geology."[189] A later expedition took them on foot from Paris over the Jura Mountains to Lausanne.

Robb was fortunate to study in Paris. He arrived there close on the heels of a creative period in French natural history, which extended over eighty years from 1750. Many new biological methods and concepts had been developed there: Georges-Louis Leclerc, Comte de Buffon (1707–1788) wrote his famous treatise on natural history; Georges Cuvier (1765–1832) used the comparative method in his work with fossils and stratigraphic analysis; Étienne Geoffroy St. Hilaire (1772–1844) put forward his principle of a common unity of animal plans and the theory of the homology of parts; Jean-Baptiste Antoine de Monet Lamarck (1744–1829), although more universally known for his theory of evolution by transformation, produced a four volume flora of France. The botanist Antoine Laurent de Jussieu was renowned for his contributions to plant classification. Other French biologists were working on the major principles of classification both of plants and animals.[190]

While in Paris, Robb attended lectures on botany, geology, and zoology at the Museum d'Histoire Naturelle and at the

Jardin des Plantes. There he was exposed to the ideas of Isidore St. Hilaire (1805–1861), son of Étienne St. Hilaire; to Adolphe-Theodore Brongiart, famous for his studies on fossil plants; and to lectures on botany given by Adrien de Jussieu (1797–1853), son of the distinguished botanist Antoine Laurent de Jussieu (1748–1836).[191] He also accompanied Adrien de Jussieu on botanical expeditions around Paris in the Seine valley[192] where he collected approximately 500 plants.[193]

Within two years of his arrival in New Brunswick, Robb lamented his isolation from other scientists. To him the biological sciences involved not only exploration and the collection of specimens, but also thought about the origins, distribution, and classification of plants. "Scientific thought," he mused, required "collision" with others in the field.[194] He felt deprived of the stimulating discussion of colleagues on scientific theories and ideas to which he had been party in both Scotland and in his travels on the European continent. To combat his isolation, Robb made a concerted effort to keep in touch with the wider scientific world; he corresponded with fellow scientists and attended meetings of some of the most prestigious scientific societies. He corresponded with William J. Hooker of Glasgow University, Professor Silliman of Yale University, leading microscopist J. W. Bailey of Westpoint, New York, and was a personal friend of William Thomson (Lord Kelvin).[195] In 1839, he visited museums and colleges in Upper Canada, New York, Philadelphia, and Boston.[196] In 1840, he was in Glasgow, Scotland, giving a short paper on the river terraces of the St John River to the British Association for the Advancement of Science.[197] Later, he attended meetings of the Great Railway Convention in Portland, Maine; the North American Scientific Association at New Haven (1850); and the American Association for the Advancement of Science at Providence (1855) and Montreal (1857).[198]

Philosophical questions of how new species had arisen after the extinctions through the ages, and the problems of how plants came to be situated in certain places, were frequently discussed by biologists. In Britain, the rigorous religious education which was a regular part of university courses strongly influenced the scientific thought of the period. The idea of natural theology thrived. In France, the vitalistic theory was popular; this recognized the presence of a vital life-giving force fulfilling divine ends.[199]

James Robb's ideas on the natural world were inevitably coloured by his background and training and by the intellectual climate to which he had been exposed in Europe. He had been nurtured amidst the Scottish intellectual ferment in the fields of geology, natural history, and theology. Problems arose in the effort to reconcile the biblical account of the creation in Genesis with the geological time scale observed in the rocks, with the progression of different plant and animal fossils found in strata of different ages, and with the punctuated fossil record. Much of the debate centred on Edinburgh. On the one hand were the members of the Wernerian Society[200] led by Robert Jameson; on the other were the Uniformitarians, championed by Charles Lyell. The Wernerians supported the theory of Catastrophism, which explained the great extinctions by catastrophes, such as floods and earthquakes. In contrast, the Uniformitarians believed that the geological record could be explained by gradual changes, with heat and volcanoes acting as mountain-builders and water, ice, and wind as the weathering agents.[201]

Where did the botanists fit into this debate? Western theologians and naturalists were constantly amazed at the diversity of plant and animal life revealed by the opening up of the so-called New World and other regions of the globe. At a time before the ideas of Darwin had been broached, most naturalists, and particularly British naturalists, viewed this diversity as superb evidence of the wonder of creation.[202] Not only was the creation described and the Divine Law revealed in the Bible, but here also was the book of nature for all to see the evidence of creation. The idea of natural theology extended also to the details of structure. Organisms were superbly adapted to their environment and this could only have been achieved by the intervention of a deity.[203]

Some scientists, particularly those who supported the catastrophist interpretation of geology, believed that each extinction was followed by a new creation. Others, including most Uniformitarians, believed that there was an all encompassing plan that, once put into motion, proceeded in an orderly fashion towards perfection and divine ends—the doctrine of final causes. This doctrine was an integral part of James Robb's beliefs and for him "the abnegation of chance and accident and anomaly" was basic to his philosophy of life and to his attitudes as a scientist.[204]

In a letter to Sir William J. Hooker in 1839, Robb stated that he attempted always to give his students "general views regarding means and ends and final causes and natural Theology."[205] Religion was for him an unassailable sanctuary. In 1839, he wrote to his brother that "the great want in works of British naturalists is that of a 'vivifying principle' such as that of necessity or final purpose." He felt that the Catastrophists' ideas and even many of those of Linnaeus were no longer valid.[206]

The significant point for botanical explorers and classifiers of plants was that belief in natural theology and final causes entailed belief in the creation of every creature by God, the pattern of creation having been set in motion in some past time. To them, plants and animals were immutable and demonstrated an ever increasing complexity from lowly forms to that of the highest form in the chain of being—man, the whole scheme leading to some higher purpose to the glory of God. This was the framework through which James Robb viewed the plants he encountered in his daily life.

Robb's isolation in a backwater and increasing demands on his time kept him from being caught up in new intellectual currents. It is not known whether he read *On the Origin of Species* (1859) or kept abreast of the controversy surrounding the Darwinian revolution. His energies were expended in many directions, from teaching and collecting plants and rocks to encouraging improvements in provincial agriculture, to preparing geological maps for the agricultural chemist James F. W. Johnston and the geologist Sir William Logan. He also acted as a city alderman and as an expert legal witness. The provincial government used his services and his knowledge of French for researching the history of Acadia. In his many expeditions through the province, his botanical interests were secondary to geology and agriculture because the province did not provide funds for plant enthusiasts or botanical collectors. His plant collection and his stimulating lectures to science students were his main contributions in the botanical field. The evidence of his botanical expertise lies hidden in herbarium cabinets. The plant specimens he collected provide a background of the provincial flora and are available for studies today. Dogged by ill health and worn down by family cares, James Robb suffered an untimely death at the age of forty-six.

In 1861, Loring Woart Bailey succeeded James Robb at the University of New Brunswick. He, too, arrived by riverboat from Saint John, having travelled by steamer to that city from Boston. He was described by the writer Juliana Horatia Ewing[207] as a "delicate looking man" and "a good botanist."[208] Bailey was trained at Brown and Harvard Universities as a chemist, but he also had a special interest in geology. His botanical interests had been encouraged by his father, Jacob Whitman Bailey, professor of chemistry, mineralogy, and geology at Westpoint Military Academy.[209] His father had been the first person to investigate the flora of Mount Katahdin, Maine and had taken Loring and his siblings on botanical rambles near their home in Westpoint.[210] Through his training at Brown and Harvard, and through his brother William Whitman Bailey, Professor of Botany at Brown University, Loring Woart Bailey came into contact with many of the outstanding American scientists of the time.

Like James Robb, Bailey botanized on the college lands where there were "trees often clustering in almost impenetrable thickets over ground with spongy mosses."[211] He also travelled extensively in the province to learn about the geology and plants first hand. He was enthusiastic about journeys through "wild and unexplored land, accessible only with Indian guides and canoes."[212] Since the provincial government of the day was particularly interested in geology and the possibility of finding minerals that could be exploited for profit, Bailey's summer field explorations were heavily biased in favour of geology. Nevertheless, he brought back many plant specimens to Fredericton. Like Robb, he also lamented the "isolation from scientific centres" and the lack of stimulating scientific discussion.[213]

In 1863, in response to a request to carry out a mineralogical survey for Lieutenant-Governor Arthur Hamilton Gordon, Bailey undertook an expedition up the St John River, then up the Tobique River, across the portage, and down the Nepisiguit River. This route across the province was less well known than the one undertaken by Robb, which was an ancient aboriginal trail. It was also more hazardous because, as Ganong noted, the Nepisiguit River is beset with falls and has a steeper gradient. While on the journey, Bailey was bothered by incessant insect attacks. He found a mixture of tar and an extract of Penny-Royal gave the best protection. Despite the nuisance of mosquitoes and blackflies, he could still be enthusiastic about the geology and flora.[214]

Bailey found the Tobique valley to be varied in terms of plants, many of which differed from plants elsewhere in the province.[215] His observations on Bald Mountain[216] echoed those of Alexander von Humboldt in that he identified three distinct zones of vegetation: a dense growth of pines, firs, and cedars near the base of the mountain; an area of predominantly white and yellow birch; and at the summit a carpet of dwarf shrubs with the Leather-leaf (*Cassandra calyculata* [*Chaemodaphne calyculata*]) and Labrador Tea (*Ledum latifolium* [*Rhododendron groenlandicum* (Oeder) Kron and Judd]) particularly abundant.[217] The following year, Bailey was in southern New Brunswick making a geological survey of rocks around Saint John. Later he brought back to Fredericton rock and plant specimens from journeys along the southwest Miramichi and other rivers, and from neighbouring Maine and Quebec.

When Bailey first arrived, there was a railway line from St. Andrews to Woodstock and, later, one between Saint John and Shediac. It was also possible to go from Saint John to Fredericton by stage-coach, and from Chatham to Fredericton. Bailey describes his journeys on survey work:

Figure 9. Labrador Tea, *Rhododendron groenlandicum* (Oeder) Kron and Judd

> They involved traveling in every way then known: horse-back, rail, steam and sail-boat. Wagon and canoe, … and mainly on foot; the ascent of larger streams by pole and paddle, of the smaller by wading, often in ice-cold waters; the penetration of pathless woods, with the occasional losing of our way.[218]

On one occasion, Bailey's native guides had acquired some forbidden liquor and he was treated to a fine display of bravado:

> As a consequence they stood up, twirled their paddles in the air, and, with a whoop as would have disconcerted the colonists in early days, rushed wildly into Black River Rapids on the upper Saint John, then much more formidable obstacles than at present, as the channels have been straightened by stream drivers.[219]

Loring Woart Bailey was a compelling teacher. His student George Parkin (later Sir George Parkin) noted that the course in natural history was "the opening of a new world" to him and provided the "intellectual stimulation" he needed.[220] Like James Robb, Bailey was expected to cover the whole spectrum of physics, chemistry, zoology, botany, and geology; but in later years this was reduced to biology and geology. Bailey strongly believed that museums were a necessary addition for the benefit of students; he believed that they were valuable for the storage of all the biological and geological specimens he was finding and would provide a permanent record of these discoveries. He lobbied the government for funds to establish such a museum. When his requests fell on deaf ears, he compared the situation to that of Harvard where there were five museums with over half a million dollars devoted to their development. Even without the funds for a museum, Bailey was not deterred from adding to the university collections.[221] His geological work was extensive and was reported in the publications of the Geological Survey of Canada. He was a charter member of the Royal Society of Canada and president of the geological section in 1888 and 1918. After his retirement, he studied diatoms, a subject that had interested his father. Bailey extended the work and became such an authority that he received specimens from the Pacific coast, lakes in Albertan and Saskatchewan, and the eastern coasts of North and South America.[222]

At Harvard, Bailey had been exposed to the burgeoning new ideas and scientific controversies of the age. Harvard numbered among its illustrious professors two giants of science: Asa Gray and Louis Agassiz. The botanist Asa Gray, following in John Torrey's footsteps, had moved away from the Linnean system of plant classification, which had been the hallmark of American botanists from its introduction in the mid-eighteenth century. He introduced a more "natural" system based on many characteristics, particularly fruit anatomy. The data he collected on plant distribution led him to support the Darwinian ideas of evolution. The paleontologist Louis Agassiz, who had been influenced by the French geologist Cuvier and ideas of Catastrophism, opposed Darwinism. The geological record showed that there had been a number of extinctions through the epochs.[223] Agassiz believed in the absolute fixity of species and in new creations after extinctions. The antagonistic positions of Agassiz and Gray were debated before a discerning audience in Boston in the spring of 1860.[224] It was against this backdrop that Bailey entered the comparative wilderness of New Brunswick.

Bailey must have been well aware of the controversy arising from the discussion of Darwin's book *On the Origin of Species*, yet he only once discussed his views of the natural world. In an address on the duties and requirements of a college course given shortly after his arrival at the University of New Brunswick, he stated:

> But beyond the merely practical results which the study of Natural History is calculated to afford. Or even that intellectual pleasure and healthy development of physical and mental powers, which the thorough and systematic naturalist never fails to gain, there rests behind these a far nobler and more lofty pleasure in the tracing out of Nature's Laws. It is to view them as the laws of God, to see therein, His Hidden

> ways, to recognize in the manifold adaptations of means to ends, in the infinite diversity in the midst of infinity, the existence of that plan which pervades the whole creation, and which is no less manifest in the smallest microscopic life than in the motions of those "countless orbs" which people space.[225]

He never directly discussed the issue of Darwinism and it has been suggested that he had "too much tact to involve himself in the biological controversy and consequently remained in perfect harmony with both sides."[226]

James Robb and Loring Bailey, among the first resident scientists in the province, made a remarkable start on plant exploration. The specimens they found give a picture of many of the widespread plants of New Brunswick, along with the occasional rare plant. Their work was carried out under tremendous difficulties and was largely an adjunct to their other duties and particularly to their geological fieldwork. As a colony, New Brunswick carried out its own geological survey, which began when Abraham Gesner was appointed in 1838. The provincial government was always anxious to discover the economic potential of minerals of the region, particularly how any profitable mining could be developed. Bailey had played a significant role in providing information on minerals when he worked for this geological survey for two summers. After New Brunswick became a part of federated Canada in 1867, the federal government was responsible for geological surveys. The Canadian Survey Acts of 1872 and 1877 put geological and botanical information gathering on a firmer footing. While the collection of geological information was of prime interest to the survey, from this time on field geologists were encouraged to collect natural history specimens for the National Museum in Ottawa. The intent of the Acts was made quite clear through the change in title to the Geological and Natural History Survey.[227]

Although Loring Bailey appears to have limited his summer field reports for the Survey strictly to geology, many of the officers made notes on the plants and animals they observed. The field officer D'Urban, working in south-eastern Quebec and along the New Brunswick border, listed at the end of his report in 1865, plants found along the Patapedia and Restigouche Rivers.[228] Other naturalists also collected plants for the Survey. George Upham Hay, for instance, made a collection of Miscou Island plants for the Survey in 1886.[229]

There was one member of the national Geological Survey who invariably enriched his reports with information on plants found in the province. Robert Chalmers (1833–1908), born and buried at Belledune, Gloucester County, has been described as a "sturdy, stocky, tenacious man."[230] He trained as a schoolmaster and was a reporter on scientific subjects for local newspapers. At the same time, he was an enthusiastic amateur geologist. His contributions in this field were acknowledged when he received an honorary doctorate from the University of New Brunswick in 1900. He began working for the Geological Survey on a temporary basis in the summers, but later became a permanent member of the Survey team. Chalmers was good humouredly dubbed the "superficial geologist" by his friends, not because they were casting aspersions on his work, but rather because his field of expertise was "surfacial geology."[231]

Chalmers's reports on western New Brunswick (1882–1884) listed species of trees and herbaceous plants found. He reported that Furbish's Lousewort (*Pedicularis furbishiae*) was discovered for the first time in the upper reaches of the St. John River valley. This feathery-foliaged plant, rare in world terms because it is known only from the St. John River valley, was collected originally by G. U. Hay of Saint John. Unfortunately, he did not realize that it was an undescribed new species. Later it was rediscovered on the Maine side of the border by the intrepid and remarkable woman, plant collector, and illustrator, Kate Furbish. The other rare plant from the St. John River valley reported by Chalmers was the Seneca Snakeroot (*Polygala senega*).[232]

In his later reports, Chalmers concentrated his attention on the forests. In 1886, he noted the large tracts of "forest primeval" in the region of the Upper Restigouche.[233] By 1894, he again listed the species of forest trees, and decried the terrible desecration of the forests. He was eloquent about the "pristine grandeur" of

Figure 10. Fringed Polygala, *Polygala paucifolia* Wild.

the forest about the time of the arrival of the Loyalists and the subsequent selective destruction of one species after another, beginning with the White Pine, and he warned of the almost certain tragic demise of New Brunswick forests.[234]

Because of the economic potential of mineral and coal discoveries, the geology of the region took precedence over the listing of plants and was the primary concern of these early investigators. Nevertheless, James Robb, Loring Bailey, and Robert Chalmers provided us with the first clear indication of the identity of provincial plants. Their pressed and mounted specimens give the first physical evidence of the flora of the time.[235] These records are still of use today. They can be added to databases and examined in the light of modern ideas. The activities of these investigators, covering the period stretching from the colonial imperial interests of Britain to the development of the Canadian Geological Survey as a national body responsible for the national natural history collections, serve to highlight the importance of contributions made at the local level when national bodies were in their formative years.

[page left intentionally blank]

Chapter 6

Ice, Migration, and Isolation

The century beginning in 1800 ushered in a new era of plant exploration. Leading the way was the great German naturalist Alexander von Humboldt. He had been inspired by Reinhold Forster's voyage to the South Seas with Captain James Cook. Accompanied by a French companion, Aimé Bonpland, von Humboldt travelled up the Orinoco River of Venezuela and to other parts of South America (1799–1804). They noted the relationships between geography and plant distribution. In particular, they recognized the zonation of plants from the tropical forest of the valley floors to the Arctic flora of the Peruvian Andean mountain tops.[236] Their accounts opened up a new field: it became important to relate plant species and their distribution to geography, physical features, and climate.

These early observations were followed by several specific studies. The Swiss botanist Alphonse P. De Candolle (1820) made a detailed study of oak trees in relation to their distribution. By mid-century, a similarity of East Asian and eastern North American flora had been noted by the American botanist Asa Gray. A vast amount of information on the dispersal of species of all kinds was collected by Charles Darwin in his work while on the voyage of the *Beagle*. Edward Forbes, Professor of Botany at King's College, London, studied the distribution of plant fossils relative to modern plants. Later, Joseph D. Hooker, whose Antarctic voyage and plant hunting expedition in the mountains of Nepal gave him a particular focus on Arctic and montane plants, indicated that present-day plant distribution was influenced not only by geography, climate, and physical features, but also by past events. The observations of these eminent explorers and naturalists were echoed in other parts of the world by local observers and botanists; New Brunswick was no exception.

Loring Woart Bailey made Humboldtian observations of plant zonation when he described the plants of Bald Mountain in 1863, but the full force of the debate hit New Brunswick five years later when Joseph D. Hooker's seminal paper, "Outlines of the Distribution of Arctic Plants" (1862), was reprinted in the *Canadian Naturalist and Geologist*. It was pertinent to the Canadian scene.

Hooker's broad survey suggested that the Arctic could be divided into five floral provinces with an abrupt break in the region of Baffin Bay. The flora to the west of this line had a large admixture of American and Asian plants together with plants of northern Scandinavian origin, while plants to the east of this line were almost exclusively of Scandinavian origin. Hooker proposed a theory to account for this distribution. Arctic plants probably of ancient stock originating in Lapland, he suggested, had spread throughout the Arctic region before the glacial period. During the glacial period, these ancient plants had been driven southward ahead of the ice sheets. With the return of warmer times, they had migrated northward again and, in North America and Asia, were accompanied by Asian or American plants of more recent origin from the regions they had invaded. In their northward migration, some had been left in mountain refuges where they are now found. For most Arctic plants, the competition and varied conditions to which they had been subjected in their travels had given rise to "a plexus of more or less distinct varieties or species characteristic of the arctic today." The migration patterns would also account for the paucity of species on the Greenland peninsula with its totally northern latitude.[237]

Recognizing the significance of Hooker's findings, local Canadian observers examined plants from the standpoint of floral origin. Within a year, after Hooker's paper was printed in the *Canadian Naturalist and Geologist*, New Brunswick naturalists examined the plants of their region relative to their probable origin. A paper titled "The Occurrence of Arctic and Western Plants in Continental Acadia" was written by George F. Matthew (1869). He was an exceptional individual with interests in natural history and geology. As a Saint John customs officer (he became chief clerk and surveyor), he noticed the various rocks used as ship's ballast.[238] He pursued a subsidiary career in geology and paleontology and, although originally an amateur, he became an expert in these areas, contributed many papers to the learned journals, and received international recognition by the scientific community. In the early years of the Saint John Natural History Society, George Matthew's interests extended to botany.

George F. Matthew (1837–1923) was clearly familiar with Joseph D. Hooker's work. He looked at the physiography, soils, and climate of New Brunswick and related the distribution of various floral elements—Arctic, boreal or western plants—to these factors.[239] Although some continental-type plants inhabited the warmer interior parts of the province, it was the large number of subarctic plants found along the Gulf of St. Lawrence and the Bay of Fundy coasts that impressed him. The melting of the glaciers inundating the low parts of New Brunswick, he suggested, would have left the southern hills standing above an "icy current which swept by on either side." He theorized that the Polar Current and the Labrador Current acted as distributors of seeds from northern regions. Driftwood, ice floes, and debris sweeping along the coast from Siberia and the Mackenzie River region would account for the isolated occurrence of plant species characteristic of those regions. This theory of plant distribution by water was in accord with ideas expressed by Darwin, who believed that the distribution of closely related plants in widely separated coastal areas was effected by the transport of seeds by water. (Darwin had carried out extensive experiments on the effect of salt water on seed viability.)[240] In contrast, Joseph D. Hooker favoured a theory positing colonization over land-bridges in the distant past. Hooker's theory had been formed during his travels and work in Antarctic regions and on the islands of the southern ocean, as well as on the tip of South America and South Africa.

Matthew had used information on New Brunswick plants collected by himself and Loring W. Bailey, Rev. James Fowler, and Rev. J. P. Sheraton.[241] He acknowledged, however, that his paper was based on fragmentary evidence, since the flora of New Brunswick was so imperfectly known. This pioneering study may have influenced another prominent nineteenth-century provincial plant explorer: Rev. James Fowler.

James Fowler (1829–1923) examined the Arctic and subarctic floral elements in more detail and discovered a greater proportion of these species in New Brunswick than might be expected from the latitude of the province. He attributed the occurrence of Arctic species along the Bay of Fundy coast to the presence of numerous "congenial retreats" or suitable niches for their survival following the retreat of the ice sheets at the end of the last glacial period.[242] The cold current along the coast, the Bay of Fundy fogs, and the long winters, he maintained, were major factors in providing a suitable climate for them.[243]

Fowler was an inveterate plant collector who attempted to identify all the plants of the province. He had been trained as a Presbyterian minister, but like many nineteenth-century officers of the church, was renowned for his knowledge of and interest in natural history and made a major contribution to the knowledge of New Brunswick plants. He was the son of a Scottish millwright and farmer who had emigrated from Aberdeenshire, Scotland, to Bartibog in Northumberland County, and later to Bass River near Richibucto. It was there that Fowler was born. His father died when Fowler was fourteen and he helped his mother to keep the mill operating. At the same time, he attended Chatham Grammar School and later studied theology at the Free Church College in Halifax.[244]

Fowler was a true nineteenth-century scholar, able in several fields of endeavour, cultured, and a linguist. He read some Greek, Latin, and Hebrew and spoke French and some German.[245] His botanical interest, already evident when he became a minister, turned into a passion. He collected, pressed and identified plants, and requested specimens from others.[246] No doubt as his knowledge grew, he became much more proficient at understanding the geographical distribution of plants in the province.

Fowler quickly became familiar with the local plants of Kent County and subsequently extended his interest to other parts of the province. He soon discovered anomalies in the local plant distribution. "A large number of species is peculiar to the St. John River basin," he wrote.[247] He also noticed that the vegetation of the beach at the mouth of the Eel River (Restigouche County) was distinctive and was possibly associated with introductions by early settlers. The area of the Restigouche appeared to him to be "virtually a *terra incognita* to botanists," and was "par excellence a land of thistles (*Cirsium arvense*) where a white flowered variety is not uncommon."[248]

During his time in New Brunswick, Fowler moved from his ministerial work in Bass River to Saint John and later became the science master at the New Brunswick Provincial Normal School in Fredericton.[249] This move allowed him to broaden his knowledge of plant distribution in the province. Fredericton proved to be a useful centre for studying plants of the western part of the province and the upper St. John River valley. Here he found many plants similar to those of areas outside the province lying to the southwest. Plants, such as the Seneca Snakeroot (*Polygala senega*) and the Lake Huron Tansy (*Tanacetum huronense*) were not common throughout other parts of the province.[250] He found the Lake Huron Tansy growing abundantly on the gravelly shores of the river at Woodstock and Grand Falls.[251]

Fowler was well aware of the deficiencies in the knowledge of provincial plant distribution. In 1879, he wrote, "when the whole region between the boundary of the State of Maine and the St. Lawrence, which is at present almost unknown to Botanic Science, shall have been subjected to examination many new facts will doubtless be discovered largely modifying the opinions at present entertained respecting the northern range of certain species."[252]

His desire to collect samples of all New Brunswick plants gave him a reason for exchanging specimens and communicating widely with other botanists.[253] He was frequently in contact with George William Clinton, president of the Buffalo Society of

Natural Sciences, and, occasionally, with Asa Gray of Harvard University.[254] Gray recommended Fowler for a position at Queen's University, Kingston, Ontario. Fowler took his large personal collection of pressed and dried plants to Queen's when he became professor of natural history there in 1880.[255] His crowning achievement on the New Brunswick flora was his extensive list of plants (1878 and 1880);[256] this he enlarged at intervals and produced a more complete list in 1885.[257]

At the same time, the Canadian Geological and Natural History Survey was busy cataloguing all the plants of Canada.[258] The Survey botanist John M. Macoun visited most parts of the dominion collecting specimens and seeing for himself the habitats of the various species.[259] He visited New Brunswick and in the company of G. U. Hay botanized in the upper St. John River region around the Aroostook River.[260] For the New Brunswick part of his list, however, Macoun took Fowler's list. Macoun himself wrote, "New Brunswick notices are principally from the catalogue of New Brunswick plants, published in the years 1878–9 by the Rev. James Fowler."[261] However, Macoun made various additions to the list from the observations of an active group of naturalists who published their results in the *Bulletin of the Natural History Society of New Brunswick*.

Fowler was generous with his specimens and made sure that local naturalists were familiar with his work. In 1895, he sent the New Brunswick Museum a collection of about 1,000 New Brunswick plants[262] from which the 1885 list had been compiled.[263] After the turn of the century, Fowler produced a catalogue of plants of the St. Andrews area. He visited the biological laboratory there, intending to study marine algae. Disappointed with his work on them, he turned his attention to the land plants. The land flora amply rewarded his efforts because there was a veritable abundance of foreign plants. The foreign plants he noted had become established and displaced the local flora.[264] Sixty-two percent of plants in the Aster family found around St. Andrews were of foreign origin.[265] A particular knotweed also found in this area was named *Polygonum fowlerii* in Fowler's honour by the Gray Herbarium (Harvard) botanist B. L. Robinson.

Like many people of the Victorian era, George F. Matthew and Rev. James Fowler were propelled by a tireless enthusiasm, intellectual curiosity, and the work ethic in their quest for knowledge. Their observations gave a new perspective to work on the local flora. They were truly in the tradition established by Alexander von Humboldt, but how did other New Brunswick naturalists and botanists respond?

[page left intentionally blank]

Chapter 7

The Rise of the Natural History Societies

By 1870, there was a quickening in the pace of discovery and invention in all fields of human endeavour. An Atlantic Ocean undersea cable made it possible for news to be exchanged between Europe and America in a matter of minutes. People in Saint John could exchange views with acquaintances in far places by means of the telegraph line between London and New York. New and faster steamships were operating on the seas, while on land a new railway and telegraph line, to which Saint John had access, linked the east and west coasts of North America. The quickening in the pace of technological change was matched by a quickening in other fields. Dramatic changes in politics occurred in both Europe and North America. In 1867, New Brunswick became a province of Canada, giving up its autonomous status as a colony of Britain; its institutions were now to be closely integrated into the new pattern that was emerging in North America.

Excitement over the new pace of change extended into the world of ideas. Charles Darwin had published his *Origin of Species* twelve years earlier and it set in motion vigorous discussions among geologists, biologists, and theologians in both Britain and the United States. While evolution appears to have been rarely discussed on the local scene, perhaps because of religious sensibilities, other areas of scientific endeavour received considerable attention. Enthusiastic naturalists banded together to found natural history societies. These societies stimulated plant, animal, and fossil discovery, and acted as forums for the exchange of ideas. Members founded journals for the publication of their findings and played a significant role in the establishment of museums.

A remarkable group of people came together to form the Natural History Society of New Brunswick at Saint John. It was founded in 1862 by members of a local geological society, the Steinhammer Club, at the suggestion of Sir William Dawson, geologist and principal of McGill University.[266] Many members came from the educated section of society; they were doctors, lawyers, civil servants, and educators. At the same time, few of them were trained in the sciences, but they were dedicated amateurs in this field with a boundless enthusiasm for self-education. Their accomplishments stand as an example to us today. Some became experts in their chosen fields of interest and their contributions to the field of natural history were outstanding. Their work was of a scientific calibre recognized in a wider sphere: George F. Matthew, C. Fred Hartt, Loring Woart Bailey, and Robert Chalmers were or became well-known geologists, while James Fowler, George Upham Hay, and William Francis Ganong were botanists of distinction.

The Natural History Society suffered from various vicissitudes in its early years, culminating in the Saint John Fire of 1877. After the fire, the Society rose like a phoenix from the ashes and became particularly active after 1880.[267] The various interest groups—geological, botanical, zoological, ornithological, and entomological—recorded their activities in the publication of the society, the *Bulletin of the Natural History Society of New Brunswick*. This provided a permanent record of the interests and thoughts of society members. The establishment of a museum was considered a necessary adjunct. A number of members made a significant contribution by devoting themselves to the acquisition of specimens.

From the beginning, there was an enthusiasm for botany. Robert Matthew, brother of George F. Matthew, presented plants in 1865. At a later date, George Upham Hay and Robert Chalmers donated a collection of approximately 400 mounted and labelled specimens, including many grasses, sedges and ferns. A. I. Trueman added dried plants from Westmorland County and James Vroom a collection from Charlotte County.

John Moser, whom Hay described as "one of the keenest observers of plants," and as "modest and retiring as many of the plants he so industriously seeks out,"[268] contributed plants from York County.[269] The specimens assembled in this way, together with James Fowler's collection added in 1895, formed the nucleus of the society's herbarium. By 1909, the number of specimens had risen to 6,000.[270]

James Vroom of St. Stephen, a corresponding member of the Society[271] and at one time science master at the New Brunswick Normal School,[272] later editor of the *St. Croix Courier* and town clerk of St. Stephen,[273] prepared a list of 600 plants and their distribution in Charlotte County. In order to cover all areas of the county, he visited the island of Grand Manan in 1880.[274] In 1881, he wrote to Dr. Bailey that he had ten plants which were not in the published lists of the New Brunswick flora.[275] Included in his list was the beautiful blue Clematis (*Clematis verticillaris*), which he found at St. Stephen, and the Skunk Cabbage (*Symplocarpus foetidus*) from the shores of Lake Utopia.

One of professor Fowler's students, J. E. Wetmore, investigated the flora of the area around Andover in the upper St. John River valley.[276] Two teachers, John Brittain of Petitcodiac and Philip Cox of Newcastle, canoed down the Restigouche River in 1888 and found nineteen rare plants not previously recorded as occurring in the province.[277] Many society members were determined to collect and record representative specimens of all New Brunswick plants. At the same time, in keeping with the nineteenth-century interest in plant distribution, members recognized different floral elements in various parts of the province.

Northwestern New Brunswick was neglected until 1883 when Natural History Society member George Upham Hay (1843–1913) decided to visit the area. With three companions, he canoed along the St. Francis River to Beau Lake. This was a difficult journey. A heavy sailboat and oars, transported to Edmundston by train, had to be hauled forty miles by horse-drawn wagon before they could start their river journey at Glazier Lake.[278] Here they found the Alder-leaved Buckthorn

(*Rhamnus alnifolia*), which was regarded as a comparatively rare shrub at that time.

Hay was a particularly active individual, and the accounts of his many journeys through the province make fascinating reading. He was born at Norton, New Brunswick, and educated in New Brunswick schools. To overcome what he felt to be his ignorance of botany, he took an extramural course in literature and natural science at Cornell University.[279] By means of a correspondence course, he acquired a Bachelor of Philosophy from Illinois Wesleyan University and later was awarded an honorary MA (1894) and an honorary PhD (1901) from Acadia University.[280] After a short apprenticeship at the *St. Croix Courier*, his career alternated between journalism and education. He was a reporter, then the editor of the *Daily News*. This was followed by twenty-five years of teaching in Saint John. He later combined these two overriding interests by becoming editor of the *New Brunswick Journal of Education* and, finally, in 1897, a full-time educational journalist.[281] He wrote a history text for New Brunswick schools, but his spare time must have been largely consumed by his hobby of botany. He investigated all kinds of vascular plants, as well as fungi, mosses, and seaweeds.

Hay's journeys through the province are well documented in the *Bulletin of the Natural History Society of New Brunswick*. He found the flora of the main St. John River valley to be more varied than that of the St. Francis valley. Along the St. John River, he discovered two lovers of alkaline soil, the Alpine Milk Vetch (*Astragalus alpinus*) and the yellow St. John River Oxytropis (*Oxytropis campestris* var. *johannensis*). Two other plants, the Lake Huron Tansy (*Tanacetum bipinnatum* ssp. *huronense*) and the Seneca Snakeroot (*Polygala senega*), generally considered to be inhabitants of more western areas, were also present. At the mouth of the Eel River were several rare plants, including the Wild Leek (*Allium tricoccum*) and the large Round-Leaved Orchid (*Platanthera orbiculata*).[282]

George U. Hay was frequently accompanied by friends with similar interests.[283] In 1900, he spent three weeks in the little known region of the South Tobique Lakes with W. F. Ganong and M. I. Furbish of Attleborough Falls, Maine.[284] In 1896, accompanied by William F. Ganong, Hay followed the route taken by James Robb fifty-eight years before, from St. Leonard over the watershed dividing the St. John and Restigouche River systems and then down the Restigouche River to its mouth. In 1902, he wrote about his journey with Robert Chalmers from Bathurst up the Nepisiguit River, through the Nepisiguit Lakes to the Tobique Lakes, and down the Tobique River to the St. John River.

Hay gives us a vivid picture of the rivers, lakes, and their banks, and he intersperses his descriptions with comments on the plants he was finding. While on his journey down the Restigouche River, he noted how the evergreen trees would give a sombre character to the deep valley "but for the sparkling water." Here the Balsam Fir (*Abies balsamea*) rose to a height of seventy or eighty feet and Balsam Poplar (*Populus balsamifera*) was common on the low ground of the middle and upper reaches of the river valley. He wrote of the Bladder Campion (*Silene vulgaris*), an old world plant that had followed in the footsteps of man and had penetrated these inner fastnesses of the province. He carefully recorded some rare indigenous plants that are frequently associated with alkaline areas. Along the Restigouche River, just below Jardine's Brook, he found the Long-fruited Anemone (*Anemone cylindrica*) and the Northern Painted-cup (*Castilleja septentrionalis* Lindl.). At Down's Gulch, among other plants, were the Grass of Parnassus (*Parnassia glauca*), the Sticky False Asphodel (*Tofielda glutinosa*), and the Purple-fringed Orchid (*Platanthera psycodes*). Below Hero's Rapids were the rare Butterwort (*Pinguicula vulgaris* L.), the Cleft-leaved Anemone (*Anemone multifida*), the Groundnut (*Apios tuberosa* [*Apios americana*]), the delicate Primula (*Primula mistassinica*), and the Pale Touch-me-not (Impatiens pallida).[285]

Hay conjured up visual images of plants in their habitats for armchair explorers. The Devil's Half-Acre on the Restigouche he describes as,

Figure 11. Northern Painted-cup, *Castilleja septentrionalis* Lindl.

> one of the wildest and most rugged spots, and is a precipitous bluff, whose rocky base is surmounted by calcareous slates, rising from the river to a height of some three hundred feet. His satanic majesty's preserve, however was very good botanical ground. The buffalo-berry [*Shepherdia canadensis*], *Polypodium vulgare*, [Rock Polypody], *Woodsia ilvensis*, [Rusty woodsia], *Solidago squarrosa*, [Downy ragged goldenrod], *Potentilla arguta*, [Tall cinquefoil]. Roses and pyrolas and several heath plants were seen.[286]

The Nepisiguit River valley proved to be less interesting and varied, but the trees of the upper reaches of the valley were impressive. Jack Pines (*Pinus banksiana*) rose forty to fifty feet in height, while on the ridges around the headwaters were large groves of Red Pine (*Pinus resinosa*) eighty to ninety feet tall.[287] Thomas Baillie's 1829 map of New Brunswick labelled an area just south of the middle to upper reaches of the Nepisiguit as "great forests of pine." Logging there was probably extensive in the 1830s, but it seems that some sixty-five years later, the trees had regenerated.[288] The common invader of the Restigouche, the Bladder Campion, was nowhere to be seen, but the small herbaceous Eyebright (*Euphrasia nemorosa*) was universally present.

The Nepisiguit Lakes area was a plant treasure trove, while the Tobique valley was not as rich in rare species as either the Restigouche or the Nepisiguit. Near the source of the Tobique River, Hay found "a virgin forest as yet untouched by forest fires and into which the lumberman had not yet penetrated."[289] He was particularly impressed by trees crowning the summits of the ridges around the Tobique Lakes. The White Birches were of a remarkable size and beauty while the Red Spruce trees were magnificent. The shores of streams undulated with the luxurious waving fronds of Osmundas and Ostrich Ferns.[290]

Hay found canoeing New Brunswick rivers to be an exhilarating experience: "The delight of riding full speed on the back of a rapid torrent, racing past islands covered with osmundas ... the tumultuous waters rioting among the fronds ...

the delights of days like that, with a little spice of danger thrown in linger in the memory for a life time," he wrote of the journey down the Serpentine River.[291]

Hay's descriptions are reminiscent of many of the romantic writers of the late-eighteenth and early-nineteenth centuries. Some passages echoed the poems of William Wordsworth and Percy Bysshe Shelley.[292] Unlike some of his contemporaries, Hay did not see nature "primeval" as "red in tooth and claw."[293] For Hay, nature was a symphony of sensations to be appreciated, the surrounding beauty uplifting the spirit, symbolizing some higher purpose. Not only did he write of the "swift pebbly stretches of the Restigouche," the "rockstrewn rapids of the Nepisiguit," and the "many devious windings of the Tobique and Serpentine," the "chasms" and "wild grandeur" of the Tobique, but also of religious feelings inspired by the great Spruce trees of the South Tobique Lakes region. "They rose," he wrote, "from seventy to ninety feet in height, straight as an arrow, long slender cone shaped trees like church spires that were suggestive of some sylvan city of churches—and who could not be a worshipper in a city like that."[294]

Hay was often lyrical about the trees in remote areas and he was sometimes dismayed by the practices of the lumbermen. Around the South Tobique Lakes, the Serpentine and Trousers Lakes, for instance, he found the outlets dammed up, causing the lakes to rise five to six feet to provide a head of water which could be released at intervals to drive cut logs downstream. This resulted in drowning all the herbaceous vegetation and roots of trees, which then showed "a desolate appearance from the dead trunks leaning out over the waters."[295]

Hay described the flora of each turn and twist of a river with care. No longer were the botanists confined to listing the various species. For Hay, it was the total scene of plants in their habitats which arrested his attention. Nevertheless, the identification and recording of any plants new to the province remained an important objective and Hay was certainly not averse to the idea of a *hortus siccus*.[296] He collected specimens for the Natural History Society of New Brunswick, while specimens from his personal collection of New Brunswick

Figure 12. St. John River Oxytropis, *Oxytropis campestris* (L.) DC. var. *johannensis* Fern.

plants formed an initial gift to a newly established herbarium at Acadia University in Wolfville, Nova Scotia.[297] He also sought the help of many experts in identifying what he had found. He wrote, for instance, to several Harvard University botanists, and to others at Cornell University, the University of Wisconsin, and the New York State Museum.[298]

During the 1880s and early 1890s, the botanically inclined members of the Natural History Society of New Brunswick devoted their energy to identifying and listing provincial plants. In 1887, the botany committee suggested that they should redirect their energies and work in liaison with the agriculturalists and horticulturalists in the field of economic botany.[299] The medicinal properties of plants had not been investigated and it was suggested that such a study would not be amiss.[300]

In 1894, William F. Ganong, who had been Hay's companion on many of his river journeys, suggested a new approach.[301] Ganong had become interested in a field which he termed "phytobiology." This is a broad general term covering plants, their ecology, and their physiology. In 1894, Ganong wrote from Munich suggesting that the three provinces of Acadia provided "rich material for phytobiological study." The diversity of the area from sea cliffs to sand dunes, from fresh water bog to salt marsh, and from bare hills to deep forest, he suggested, presented a challenge to the botanist. Moreover, "more than a third of all species found north of the Tennessee and east of the Mississippi" are represented.[302] In earlier periods, a few far-sighted individuals had occasionally shown an interest in ecology. Titus Smith of Nova Scotia, for example, had been one of the earliest to note the relationship of plants to the nature of the land.[303]

How did members of the Natural History Society of New Brunswick respond to Ganong's suggestion? The papers produced in the *Bulletin* indicated that they carried on making new plant discoveries just as they had previously. John Moser of Havelock, that "reverent student of nature," graduate of Acadia University and school teacher, compiled a list of 245 mosses found in the province.[304] H. F. Perkins, a teacher who resided at Blissville, Sunbury County, and at Grand Harbour, Grand Manan, gave a paper on the flora of Blissville and produced a preliminary list of plants growing on Grand Manan.[305] F. G. Barton and Samuel W. Kain made a survey of the sea-shore plants in the vicinity of Saint John, while James Vroom wrote on trees and forests.[306] Hay later made an extensive study of marine algae, compiling and publishing a list in 1887.[307] A study of the provincial fungi was reported in the Bulletin in 1908. Loring W. Bailey's exhaustive study of diatoms found in provincial lakes and coastal waters was published in a series of papers between 1910 and 1913.

The Natural History Society 1898 summer camp, held at Quaco in southern New Brunswick, was a frenzy of activity. Members identified plants of the salt marshes and surrounding shores. Among the plants the botanists reported finding at Greer Settlement five miles from Quaco were a southern species the Figwort (*Scrophularia nodosa*) and a thriving colony of the Showy Lady's-Slipper (*Cypripedium reginae*).[308]

Occasionally, a report of a plant new to the province sent a ripple of excitement through the ranks of society members. Naturalists were fascinated, too, by new discoveries, such as the complexities of the life cycles of the lower plants, mosses, and ferns, known collectively as the cryptogams, which were revealed in a masterly synthesis by a German botanist William Hoffmeister (1851). The popularity of ferns was aided by the ease with which they could be grown in Wardian cases leading to a "fern craze."[309] This descended on New Brunswick when a Hart's-Tongue Fern (*Scolopendrium vulgare*) was reported to have been found by Peter Jack in 1881.[310] Jack, a cashier of the People's Bank in Halifax, Nova Scotia, was a fern enthusiast and claimed to have been given the fern by a Woodstock gardener, who had discovered it growing wild in a bank of leaf-mold. A debate then raged as to whether this fern was a garden escape of European origin or whether it was a true North American variety. The North American variety was known previously only from a few places in southern Ontario, New Hampshire, Vermont, and northern New York State. The controversy reverberated through the botanical literature and still surfaces from time to time, though it is now clear that the plants discovered by Jack belong to the European variety of the Hart's-Tongue Fern.

The importance attached to new plant discovery and to the expansion of the plant lists was clear. In the early 1900s, Ganong was encouraging members of the New Brunswick Natural History Society to draw up a new list of plants found in the province. The naturalists, however, delayed this project; they were awaiting the publication of a new edition of Asa Gray's *Manual of Botany*.[311]

In the 1880s, natural history societies proliferated in the province. A society formed in Fredericton in February 1895 under the chairmanship of Loring W. Bailey attracted a large number of educators.[312] Members included Burton C. Foster, principal of the high school; A. S. Macfarlane, later chief superintendent of education in the province; and Harrison Hammond Hagerman, John Brittain, and George A. Inch, all teachers at the Normal School. Although there is little evidence that this society was active in the botanical field, one member, George A. Inch, certainly collected plants and prepared herbarium specimens from York, Charlotte, Victoria, and Queen's Counties.[313] He seems to have had an eye for the more unusual plants because among his specimens are the Seneca Snakeroot (*Polygala senega*), the Bird's-eye Primrose (*Primula mistassinica*), the Hepatica (*Anemone americana*), the Wood Tick-Trefoil (*Desmodium glutinosum*), and the Ten-Rayed Sunflower (*Helianthus decapetalus*).[314] The influence of members of this society was evident in a broader sphere when they introduced teachers and school children to plant identification and collecting. Another society, the King's County Natural History Society, was formed in October 1897 and soon had fifty-one members.[315] They recorded the dates of flowering of plants and started a collection.

The most active society, apart from the Natural History Society centered in Saint John, was the Miramichi Natural History Association. This Association, organized in 1897, had a museum with a collection of 500 mounted and labelled plants within two years.[316] The old customs house was acquired for the

Figure 13. Butterwort, *Pinguicula vulgaris* L.

museum, and the herbarium grew apace, with the Dominion Botanist John M. Macoun and George U. Hay giving help in identifying plants.[317] The most active member of this Association in the botanical field was Philip Cox.[318] While in Newcastle, he championed the cause of science in schools and was an avid collector of plants. In 1905, he produced a preliminary catalogue of plants in the Association's herbarium and in that same year the association reported that plants in the herbarium had been numbered and classified.[319]

By 1905, few plants were arriving, although the list of objects donated to the Association rivalled the exotica displayed in many of the eighteenth-century European collections, a veritable gallimaufry of specimens: iron pot handles from Tracadie; a walrus jaw from Church Point; a tom-tom from West Africa; a stuffed aye-aye from Madagascar; lava, paving, and building stone from Pompeii; a striped water snake from South America; and a cone from a Cedar tree on Mount Lebanon.[320] A suitable building to house both the Association and the collection was acquired in 1911, and by 1913 the membership had risen to nearly 100.[321] The Association's museum still exists at Chatham and is unique because it has survived in its original state. Despite the early success of the Association, its vitality did not last and publication of the *Proceedings* ceased in 1913.

In 1913, Philip Cox returned to his alma mater, the University of New Brunswick, where he succeeded his former teacher, Loring W. Bailey, as professor of geology and natural history. Although Cox had been active in collecting plants of the Miramichi region, botany was not his field of passionate interest. He made his greatest contributions in the biology of fish. Some plant specimens from his earlier expeditions to the Bay du Vin area of Northumberland County and Millville, York County, are preserved in the university herbarium.

Members of the natural history societies were remarkably in touch with the frontiers of science in the broader world. Some, for example Bailey and Ganong, had the good fortune to be trained at internationally renowned centres. Others were corresponding members of societies in other places. Fowler was in touch with the Buffalo Society of Natural Sciences, while

Vroom was a corresponding member of the Torrey Botanical Club of New York.[322] Although living in remote New Brunswick, they were by no means ignorant of the mainstream of ideas prevalent in the larger centres of activity. Occasionally, they attended meetings of prestigious societies further afield, meetings of the American Association for the Advancement of Science or the Royal Society of Canada.[323] Some of them travelled abroad. Fowler visited Oxford, Cambridge, and Paris. Bailey visited Britain and Ganong trained in Germany. Moreover, the British Association for the Advancement of Science held its meetings in Montreal in 1884 and in Toronto in 1896. Bailey attended the meeting in Toronto.[324] Both Matthew and Bailey were charter members of the Royal Society of Canada, and Fowler and Hay were elected members of this prestigious society in 1891 and 1894 respectively.[325] In the summer of 1904, the Royal Society of Canada held its annual meeting in Saint John, celebrating the tercentenary of de Champlain's discovery of the Saint John Harbour.[326] The Natural History Society of New Brunswick joined other local societies in entertaining the visitors. There was thus an easy congeniality between members of the local society and the select group of scientists well known in Canada's larger communities.

Members of natural history societies who had not had the benefit of special education in the sciences also contributed much to the fund of general knowledge. It is to be remembered, however, that in the nineteenth century, there was little specialization, and scientific knowledge had not proliferated into the various disciplines we know today. The establishment of the museums and journals undoubtedly added significantly to their achievements because, as D. E. Allen has noted, "the ability to place on printed record the fruit of their members' work was the main inducement societies had to be scientifically productive."[327]

The achievements of the botanically inclined members of the natural history societies must be examined in the context of the period. They were remarkable in their botanical exploration of so much of the province before and during the early years of automobiles when there were few roads. They brought an enthusiasm to their subject that enabled them to collect and record a large quantity of data. They established museums and journals and this was critical to the preservation of specimens and knowledge.

Chapter 8

From Inventory to Ecology

> Fenced on its seaward border with long clay dikes from the turbid
> Surge and flow of the tides vexing the Westmoreland marshes—
> Miles and miles they extend level and grassy and dim
> Clear from the long sweep of flats to the sky in the distance
> Save for the outlying heights, green rampired Cumberland Point
> Miles and miles of green barred by the hurtling gusts.
>
> —Charles G. D. Roberts, "Tantramar Revisited"[328]

In his plant hunting journeys through New Brunswick, George Upham Hay was aware of the importance of habitat in plant distribution and the layering of plants in a forest. When on a well-travelled portage path between Trousers Lake and Milpagos Lake in central New Brunswick, he noticed four very different vegetation layers. The mosses of the forest floor gave way first to the small herbaceous plants, "which delight the wayfarer," then to the shrubs, and, finally, "towering above all were the trees."[329] One of his companions on his journeys, William Francis Ganong, was also interested in plant habitat. Ganong had recently returned from Germany where he had studied phytobiology and plant physiology. Some of his New Brunswick botanical studies were focused on the Tantramar marshes of southeastern New Brunswick.

The first time I visited the Tantramar, it was early fall and the "green rampired" higher land of Cumberland Point and the outlying heights of the marsh were not as obvious as described by Charles G. D. Roberts. Sea mists shrouded the low hills surrounding the marshes, and as the sun broke through, a soft

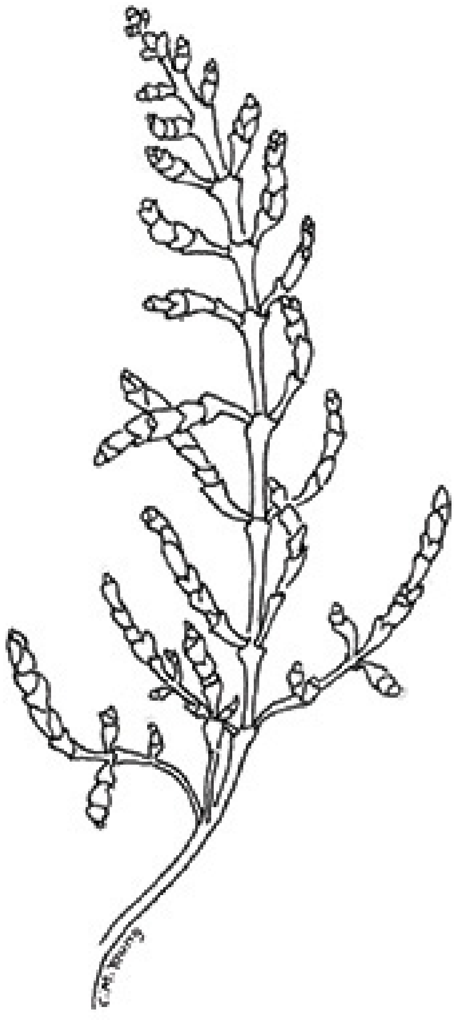


Figure 14. Glasswort, Samphire, *Salicornia depressa* Standl.

breeze caressed the grasses, sending waves of copper, red, and gold across the marsh. The meandering streams, ditches, and salt pools alternately flooded and drained the marsh with each rise and fall of the tides. A Great Blue Heron stood sentinel at the edge of a creek, ever watchful for unwary fish. Around the pools were salt-loving plants: green Samphire (*Salicornia europaea*) and Sea-milkwort (*Lysimachia maritima* (L.) Galasso, Banfi & Soldan). On the higher part of the marsh, Sea-lavender (*Limonium carolinianum* (Walt.) Britt.) gave way to Salt-water Cord Grass (*Spartina alterniflora*), Salt-meadow Cord Grass (*Spartina patens*), and Redtop Grass (*Agrostis gigantea*). The red mud trapped by the roots of these plants gives a rich habitat for invertebrates, including molluscs and insect larvae; in turn, they provide a wealth of food for migrating wildfowl and other creatures.

This scene would have been familiar to seventeenth-century Acadian settlers when they emigrated here from similar territory in the west of France. The farming methods they used in their home country were equally successful here in the marsh region. By using dykes, ditches, and sluice-gates to control the water flow, they exploited the Bay of Fundy marshes to produce grasses and salt-marsh hay for livestock feed. Today, most of the farms have been abandoned. Few hay barns are left standing, and the marshes no longer produce valuable hay. In his essay "The Tantramar Revisited," W. Austin Squires explains the vast amount of labour the Acadians put into controlling the water flow to produce the valuable hay crop: "Miles and miles of dykes were built of brushwood and mud, miles and miles of ditches were dug by hand, even the smallest fields were surrounded by ditches to reduce the moisture in the ground so that upland grasses would grow."[330]

William F. Ganong was the first person to make a serious study of the plants of these Bay of Fundy marshes.[331] He was interested in the relationship of plants to their environment and introduced a different type of plant exploration. In the late nineteenth century, serious studies of this type gave rise to a new science known as "oekologie." German scientists had invented the term and it was in Germany where Ganong was

Figure 15. Sea-milkwort, *Lysimachia maritima* (L.) Galasso, Banfi & Soldano

introduced to it when a student there in 1894.

William F. Ganong was a renaissance man and a botanist of distinction outside his own country. His interests encompassed invertebrate zoology as well as botany. He wrote extensively on molluscs and starfish of the Bay of Fundy, the morphology and biology of the living plant, plant physiology, and plant ecology. Renowned in his later years for his work on the physiography and cartography of New Brunswick and on provincial place names and early Acadian history, he was trained and earned his living as a botanist. His botanical stature was recognized by members of the Botanical Society of America who elected him as their president in 1908.

Ganong was born in Saint John in 1864. His impressionable years were spent in St. Stephen, where his bent for natural history was fuelled by the varied wildlife and plants of the Passamaquoddy region and the St. Croix watershed. He was a driving force in reviving the New Brunswick Natural History Society in the early 1880s,[332] and he contributed many articles to their *Bulletin*. After receiving bachelor's and master's degrees from the University of New Brunswick, he studied and later became an instructor at Harvard University.[333] There he worked under Professor George L. Goodale, who in 1861 had taken part in an extensive survey of the flora of the upper St. John River valley for the State of Maine.[334] In 1894, Ganong went to Munich, Germany, for further study. His doctoral thesis on the morphology and embryology of cacti encompassed physiological studies and plant adaptations to desert conditions.[335] He was, as were many American botanists of the period, influenced by the great school of German botanical physiology arising out of the work of Edouard Strasburger and Julius Sachs in the 1860s.

After returning to North America, Ganong became a lecturer at Smith College, Northampton, MA, where he stayed from 1895 to 1932. His summers were mostly spent investigating historical, biological, and physiographic features of his native New Brunswick. His explorations along the province's waterways and through rural settlements were motivated by his desire to document the rapidly disappearing historical background of settlements, place names, and

Figure 16. Sea-lavender, *Limonium carolinianum* (Walt.) Britt.

settlement sites and to map interesting features. He travelled, sometimes by canoe and sometimes on foot, along most of the rivers and lakes and explored the relatively unknown parts of central New Brunswick. The results of these expeditions and extensive researches were published in a series of papers in the *Transactions* of the Royal Society of Canada and in the *Bulletin of the New Brunswick Natural History Society*.

A North American pioneer in the field of ecology, Ganong may be credited with being ahead of his time in the breadth and depth of his investigations.[336] It was only in the last third of the twentieth century that ecological studies reached their zenith of popular appeal. In 1894, Ganong suggested that members of the New Brunswick Natural History Society should study the phytobiology of the province. They were not very responsive, but he took his own advice. His extensive study of the salt and dyked marshes at the head of the Bay of Fundy was carried out in the summers of 1899, 1900, and 1901. The paper he wrote on the ecology of the region was regarded by the American doyen of ecologists of the period, Henry C. Cowles, as a classic and as a model to other ecologists.[337]

Ganong claimed that the Bay of Fundy marshes were distinctive and quite unlike most other marshlands. They had been formed by the deposition of inorganic red mud and sandstones, eroded from the sides of the upper bay and deposited at the head of tide over an area, which had subsided in recent times. In places, eighty feet of mud overlaid a twenty-foot-deep sunken peat bed. The highest part of the marsh, he found, was at the head of tide. Rivers flowing into the Bay were dammed back at high tide. They then flooded the back marsh causing the formation of large floating fresh water bogs behind the salt marsh.[338]

The plants of the marsh were not unusual. It was the possibility of studying the dynamics of change and the environmental impact on the plant life of the marsh which appealed to Ganong. The Acadian system of altering the water courses and regulating the water flow gave another dimension to the study. He traced the succession of plants in the formation of the meadow of the reclaimed marsh, as well as the plants living in standing water in the back marsh. The fine nature of the soil, its depth, hygroscopic qualities, and relative lack of aeration, as well as the quantity of salt present in the soil, he suggested, were major factors in determining the type of vegetation present on the marshes. On the reclaimed marshland, there was an association of meadow grasses with Timothy Grass (*Phleum pratense*) and Couch Grass (*Agropyron repens*) the dominant forms. As long as drainage was maintained, the stand of Timothy remained the climax vegetation.[339]

Ganong recognized the limitations of his researches, but here was a new way of looking at plants. For him, the important point was the equilibrium established between the environment and the vegetation. The frontier of knowledge could only be expanded by studying the associations of the plants themselves, the physical features of the environment, the physiological characteristics of the plants, and the nature of competition.

The bogs of New Brunswick also commanded his attention. The coastal bogs around the Bay of Fundy in Charlotte and Saint John Counties, from Beaver Harbour to West Spruce Lake, and those on the east coast at Caraquet and Miscou near Richibucto, were raised bogs.[340] Ganong compared the more common flat bogs with these raised bogs. He discovered that flat bogs had a peat forming vegetation of mixed mosses, sedges, water plants and ericaceous plants.[341] In contrast, the raised bogs were a spongy, hummocky mass of sphagnum mosses with a few sedges and roots of dwarfed woody perennials interspersed with lichens. Water rising from lower levels allowed a large bed of mosses to develop. Ganong sent specimens of mosses and lichens to specialists in both the United States and Germany for identification.

Ganong's study allowed him to arrive at certain conclusions. He thought that raised bogs developed over basins of impervious clay and were of recent origin. They arose, he thought, in areas previously inundated by the sea, which were later raised above sea level. Acidic in nature, they require an abundance of rain to develop. The stunted nature of the herbaceous and shrubby plants was due to the paucity of potassium, calcium, phosphorous, and nitrogen, which is linked to a scarcity

Figure 17. Chaffy Sedge, *Carex paleacea* Schreiber ex Wahl.

of bacteria. The large hummocks of sphagnum growing over sphagnum saturated with water tended to keep the temperatures low in summer and affected the uptake of water and nutrients by herbaceous plants. Many of the herbaceous plants had leathery leaves with in-rolled margins characteristic of xerophilous or desert-type plants.

The distribution of individual plants and plant communities can often be linked to past events or climatic changes. Ganong looked at salt-loving plants (halophytes) at an inland site. He attempted to link their presence to subsidence in the past glacial period, followed by a subsequent inundation with a post-glacial sea and later elevation. At Sussex, New Brunswick, Ganong found thirteen halophytes around a salt spring, which he theorized had survived because of suitable conditions.[342] The most abundant plant was the succulent Glasswort (*Salicornia depressa* Standl.). He suggested that the salt-loving flora in other parts of the province was a suitable topic for local natural history societies to study. This idea appears to have been adopted by Robert King of the King's County Natural History Society, who, in 1899, gave a talk entitled "Sea Plants in the Interior of New Brunswick."[343]

Plant communities change with time. The plants which first colonize a cleared patch of forest are replaced by others in succession. Miscou Island, off the northeast coast, provided Ganong with ideal conditions for a study of plant succession. Here was an example of colonization in the raw from the first plants that established themselves on the sandy beaches to the complex ecological community of inland woods. Ganong studied the dynamics of shoreline changes and of plant colonization and succession.[344] He described the process. Sand washed away by wave action from the northern end of the island was deposited farther south, giving rise to a series of dunes, which were gradually colonized. Salt-loving plants were the first colonizers, followed by Beach Grass (*Ammophila breviligulata*), which acted as a binding and stabilizing element. Other species could then become established in sheltered areas. Many of these early colonizing plants were dwarfed, "likely due to the paucity of mineral nutrients in the sand."[345] Ganong studied the differences between the vegetation of the windward and leeward sides of the dunes and noted the establishment of meadow turf. Moving from the coast to the interior, mats of Juniper (*Juniperus horizontalis*) became common. These were interspersed with a variety of xerophytic plants, such as the Sea-Beach Heather (*Hudsonia tomentosa*), while in the swales, where the water table was near the surface, were the Bog Cranberry (*Vaccinium macrocarpon*), the Blue Flag (*Iris versicolor*) cattails and rushes. With greater protection inland, the herbaceous species gave place to larger Juniper mats and White Spruce and, finally, to plants typical of spruce forests of the region.

Ganong sent plants from Miscou to Dr. Merritt L. Fernald at Harvard University to ensure correct identification. He was interested particularly in plant population dynamics and how the physiology of the plants was affected by the environmental conditions. He concluded from this study of Miscou that vegetation "is always tending towards a climax type, determined primarily by climate."[346]

As a knowledgeable individual and a respected spokesman for conservation, Ganong was concerned to maintain both the cultural and natural provincial heritage. He frequently suggested an enlightened policy for forest management. He pointed out that the forest practices of the late 1890s would lead to "irretrievable damage." Forest fires and the "rapacity of the pulp mills," he maintained, resulted in deforestation of many areas and this led to fluctuations in the water level of the rivers.[347] Presumably, he expressed these warnings as a result of his own observations. Alexander von Humboldt had expressed similar ideas in the early 1800s.[348] Ganong suggested that tree felling "provokes in every climate two disasters for future generations, a want of fuel and a scarcity of water." He saw no reason why the crown lands of northern New Brunswick could not be managed with an eye to the future instead of allowing the short-sighted "opportunism" characteristic of the business interests of the time.[349]

He proposed certain steps to improve the situation, including the formation of a commission to work with a competent forester, administered by a board of trustees independent of politics. In his scheme, education would play a part, and he recommended the foundation of a forestry school at a suitable location, preferably the University of New Brunswick. "A disinterested devotion to the interests of New Brunswick," he noted, was the keystone to such a policy. Ganong challenged the legislators to meet the needs of the province and at the same time praised the House of Assembly for passing a bill authorizing the establishment of a forest reserve.[350] A government grant in 1907 made possible the establishment of a forestry school at the University of New Brunswick.[351]

William Francis Ganong contributed many scholarly articles to the *Bulletin of the Natural History Society of New Brunswick* and to the *Transactions* of the Royal Society of Canada. After the first few years of the new century, he devoted his New Brunswick investigations to the mapping and collecting of information on communities, while it was still available. He was keen that there would someday be a great New Brunswick survey bringing together a variety of information. His vision was a broad one, but one that could not be accomplished in one man's lifetime.

Chapter 9

Relicts and Refugia

The Natural History Society of New Brunswick in Saint John had been motivated by a few members who exhibited a rare zest for the exploration of their native province. By the 1920s, many had reached old age or had passed from the scene. In spite of these difficulties, a full-time curator, William MacIntosh, was appointed to the Natural History Society Museum in 1907 and the educational value of the museum took precedence. By 1910, the membership of the society was the largest in its history, but suddenly declined by half between 1914 and 1920. The collection continued to grow, but after 1914 the publication of the *Bulletin of the Natural History Society of New Brunswick* ceased.[352] The society reported that "war activities including the utilization of field and forest products received the whole attention of members during the next five years."[353] The collapse of the publication of their journal appears to have been critical because members no longer had a forum for the expression of their views. Undoubtedly, World War I and later the Depression played an important role in the fate of the society. The society disbanded during the depression years, but not before members had given their support and their collections to the newly established New Brunswick Museum, which was officially opened in 1934.[354]

The botanical gauntlet dropped by the natural history societies was picked up by professional botanists. Alfred Brooker Klugh of Queen's University, for instance, examined the plants of the St. Croix region, the St. Andrews coast, and the Nerepis marsh. However, it was the American professional botanists of the Gray Herbarium at Harvard University who made the most significant contributions. They expanded their own botanical explorations into New Brunswick from the late nineteenth to the mid-twentieth century.

The Harvard School of Botany had established a worldwide reputation for botanical taxonomy and plant geography under the leadership of Asa Gray. A central figure in the development of botany in mid-nineteenth-century America, Gray was responsible for training many of the later well-known American botanists. In this way, his ideas became widely disseminated. He had built up a vast network of plant collectors and had contact with many botanists in North America and Europe. Although originally trained in medicine, Gray was first and foremost a plant taxonomist (dealing with classification, identification, and naming). As Fisher Professor of Botany at Harvard (1842–1872), Gray built a herbarium collection which by 1864 numbered 200,000 specimens, collected from many different sources.[355] At a time when North American plants were relatively unknown, the collection was a great resource for botanical studies.

Gray's influence on the botanists who followed him is of particular significance because he was the first to champion Darwinian ideas in the United States. Darwin's theory of evolution, supported by the well-documented evidence he presented, brought about a dramatic shift of views. Throughout the eighteenth and early-nineteenth centuries, the concept of fixity of species had dominated the biological sciences: plants and animals were thought to exist in a rigid hierarchical structure along the "great chain of being," and each creature's essential nature was fixed and unchanged from the time of creation by God. By the mid-nineteenth century, scientists began to question the validity of concepts which had been universally accepted. Thoughtful naturalists and botanists especially were puzzled by many of the generally accepted ideas. Among the problems they saw was the unsatisfactory explanation for the presence of the same species of alpine plants on widely separated European mountain tops. The German botanist Gmelin theorized that they must have been independently

Figure 18. Parker’s Pipewort, *Eriocaulon parkeri* B. L. Robins.

created at many distinct points.[356] The Darwinists believed that plant distribution depended on the history of plants, and that plant populations were affected by the conditions to which they were exposed. The successful plants were those best adapted to their environment. Gray, a dedicated Christian, did not adhere to all of Darwin's ideas. He regarded variation as an innate, God-given quality. At the same time, Gray recognized the role of natural selection in ensuring the survival and reproduction of the fittest individuals.[357] Taxonomic studies, as Gray pointed out, were based on the premise that "the characteristics of a species could be clearly defined and any variations were considered as mere oscillations from the normal state."[358]

Variation, however, began to receive considerable attention. Both Darwin and Gray were familiar with the work of the Swiss botanist Alphonse De Candolle. De Candolle's monograph on oak trees (1820) emphasized the tremendous variation among trees of that genus.[359] He worked with very large numbers of herbarium specimens which were collected from different sources by "botanists of all sorts of views and predilections."[360] An examination of the geographical distribution of oaks led him to recognize that existing trees must be derived from ones present in former times and which had been subjected to geological and geographical changes and partial extinctions. It also led him to believe that species could no longer be regarded as immutable.

In reviewing De Candolle's paper, Gray agreed that the present vegetation is derived from past forms through a succession and series of changes.[361] The important point for Gray was "not how plants or animals originated but how came the existing animals or plants to be where they are and what they are."[362] In his own work, Gray examined the current limited distribution of giant sequoia trees of California relative to their past distribution. He found the most satisfactory explanation for their present-day distribution depended on the geological history of the areas previously inhabited by sequoias.[363]

Further studies in which Gray examined the arctic flora of North America determined that plants of the White Mountains of New Hampshire were similar to those of Labrador. This discovery was used by Darwin in his explanation of the part played by glaciation in plant distribution.[364] The evidence for glaciation, Darwin declared, was there for all to see:

> the ruins of a house burnt by fire do not tell their tale more plainly than do the mountains of Scotland and Wales, with their scored flanks, polished surfaces, and perched boulders, of the icy streams with which their valleys were lately filled… . Throughout a large part of the United States, erratic boulders and scored rocks reveal a former cold period.[365]

The migration of plants ahead of the advancing glaciers and their return as those glaciers retreated clearly accounted for the distribution of arctic plants on the White Mountains of New Hampshire and in Labrador.

Japanese plants brought back to the United States by Samuel Wells Williams and James Morrow, members of Commodore Perry's American expedition to Japan (1853), and Charles Wright, who accompanied Commodore Rodger's expedition (1855), presented a challenge.[366] Gray found that many of these specimens had close affinities with North American plants of the eastern Atlantic seaboard. He had discovered forty genera which were present only in these two areas of the world.[367] How, Gray wondered, did eastern Asia and eastern America come to have similar flora? He was convinced that the distribution could be explained by climatic and geological changes.

In what respect were Asa Gray's ideas of importance to the Harvard botanists who expanded their plant collecting into New Brunswick? Successors at Harvard continued his careful taxonomic work, examining the variation of plants. They also expanded his work in the field of plant geography and proposed theories to account for the presence of disjunctive species—species which are isolated and separated by great distances from their nearest relatives. One of the most ardent exponents of this type of botany in the first part of the twentieth century was Merritt Lyndon Fernald.

Fernald was born at Orono, Maine, where his father was a member of the faculty of the agricultural college.[368] He was keenly interested in plants of that state. This interest naturally extended into the surrounding areas. His investigations took him into northern Maine (1894) along the St. Francis and Aroostook Rivers close to the New Brunswick border, where he found a number of interesting plants. Fernald then suggested that New Brunswick naturalists should look for the same species on their side of the line.[369] In 1903, Fernald visited Saint John and examined the New Brunswick Natural History Society's collection which, he reported, contained several rare plants.[370]

Fernald was a tireless field botanist with a remarkable singleness of purpose and a formidable knowledge of taxonomic botany. He had what is sometimes referred to as a "taxonomic eye": by casting his eye over a patch of vegetation he could immediately pick out what was different. This aptitude was the result of his profound knowledge of species and what he might expect to see in a particular spot. He also had a great ability to memorize the minutiae necessary to determine varieties and ranges of plants. His papers, published over a span of fifty years in the New England Botanical Club journal *Rhodora*, refer to the subtleties of differentiation between species and varieties of plants. These studies led him, later, into the broader field of plant distribution over the whole of the northeast region of the United States and adjacent Canada.[371]

Fernald was frequently accompanied on his plant-hunting expeditions by friends of a botanical bent. In 1902, he was in Maine and New Brunswick with Emile F. Williams, "a stout jolly bachelor and prosperous importer of Oriental rugs, a thoroughly competent epicure, and a devotee of the theatre," who was a member of the New England Botanical Club.[372] Along the northern parts of the Maine coast, they found a number of subarctic plants. They then reasoned that since Labrador had many arctic plants it would be interesting to investigate an area between the two points.

They opted to visit the Bathurst area of New Brunswick. They were somewhat surprised and dismayed to discover that some plants of this region had a much more southerly character than they had expected; many species were familiar to them from

Figure 19. Small-flowered Anemone, *Anemone parviflora* Michx.

eastern Massachusetts.[373] Two plants in the Bathurst region were of particular significance. One found in the salt marshes at the mouth of the Nepisiguit River and washed by tidal waters was a variety (var. *obtusifolius*) of the Saltmarsh Aster (Aster subulatus [*Symphyotrichum subulatum* (Michx.) G. L. Nesom var. *subulatum*]). At that time, this plant was thought to range from Florida to southern Maine. The other, an inhabitant of the sand dunes, was a variety (var. *subcylindrica*) of the Pinweed (*Lechea maritima*), which characteristically ranged from eastern Virginia to southern Maine.[374] The significance of these discoveries was not immediately apparent, but at a later date, Fernald pursued this problem by persuading his student, Sidney Fay Blake, to study the flora of the Bathurst area.

Blake carried out his studies over seven weeks in 1913 and took samples along the coast from Miscou, Grand Anse, Bathurst, Petit Rocher, Newcastle, Tracadie, Richibucto, inland near Bathurst mines, and, finally, Moncton.[375] He was intrigued by the pace of life in the Bathurst area, so different was it from the turmoil of city life in Boston. In particular, he was fascinated by the Caraquet railway: "I again risked my life," he wrote, "the train plugs along on the one track road … and if luck and the winds are with her she covers 26 miles in two hours."[376] At the end of the summer, Blake returned to Harvard with his specimens.

During the following two years, Blake visited various scientific centres in London, Paris, and Berlin. At the Royal Botanic Gardens at Kew, he examined specimens he had taken from Bathurst and compared them with specimens in the collection there. Among the plants today in the herbarium at Kew are duplicate specimens from Blake's New Brunswick collection. In 1918, he wrote a corrected list of species for the area. He claimed there had been many errors in previously published lists due to mis-identifications.[377]

Blake confirmed the presence of the Saltmarsh Aster at Bathurst and discovered yet another endemic plant. This plant, also a Gulf of St. Lawrence Aster (*Symphyotrichum laurentianum*), found in brackish mud and sand at Tracadie, was referred to by Fernald as a "strangely isolated endemic …

of unglaciated spots about the Gulf of St. Lawrence."[378] Blake examined plants from various habitats around Bathurst—from the plants of the glacial sands and gravels to flora of calcareous areas around Petit Rocher, to the sands of Miscou Island. His observations extended the known ranges of many plants typically found further to the south.[379]

The New Brunswick plants that these American botanists found were the same species as plants familiar to them from other parts of eastern North America, yet they exhibited sufficiently marked differences for Fernald to distinguish them as varieties, which shows his meticulous attention to detail. The Saltmarsh Aster found at Bathurst, for instance, had broader round-tipped leaves, a more compact growth habit, and differed also in certain small features of the flowers from the form found further to the south. It was this kind of detailed examination that was useful in studying plant distribution and in determining what can happen in plant populations under conditions of isolation.

Accompanied by another American botanist, Karl McKay Wiegand from Wellesley College, Fernald visited the province again in 1909. Wiegand examined different kinds of Shadbush (*Amelanchier* species) and found hybrids between species. These had become established on disturbed land along railway tracks, while the parent species were in the nearby woods. They also collected specimens in the St. Croix River valley and in the immediate neighbourhood of St. Stephen and Milltown. They then took the train to Saint John, where they were entertained by Dr. and Mrs. Hay at their home "Ingleside" near Westfield, famous for its wild garden.[380] Hay had tried to introduce many of the wild New Brunswick plants and had made a point of recording the flowering dates of different species.[381]

Fernald and Wiegand botanized along the gorge and falls at the mouth of the St. John River, where they found the Livelong Saxifrage (*Saxifraga aizoon* [syn. *Saxifraga paniculata*]). This small rosette-type plant excretes a calcareous deposit from pores along its leaf margins. It is more typically found in subarctic regions. Hay entertained the visitors by taking them sailing on the lower reaches of the St. John and Nerepis Rivers.

Figure 20. Saltmarsh Aster, *Symphyotrichum subulatum* (Michx.) G. L. Nesom var. *subulatum*

Fernald was duly impressed by the marsh plants which formed broad dense islands in the deep water, but which at low tide stood a metre above the surface; clumps of bulrushes,[382] Wild Rice (*Zizania aquatica*), and the Broad-fruited Burreed (*Sparganium eurycarpum* Engelm.) were the significant species.[383] Later they took the train to Aroostook. At the Fairville Station (Saint John), they noticed "a veritable garden of ballast weeds, chiefly brought from the west."[384] Along the Aroostook River, they once again delighted in that botanical Eden of lime-loving plants, which was already familiar to Fernald.

These visits to New Brunswick were usually of short duration, but Fernald's investigations of the flora of Nova Scotia, Newfoundland, and the Gaspé Peninsula took the form of intensive summer expeditions. His regional studies enabled him to distinguish plant distribution patterns, to make comparisons with allied species in other parts of the world, and to formulate hypotheses on the origins of some of the province's flora. His results were sometimes surprising.

The relationships recognized by Asa Gray between some eastern North American plants and some eastern Asian genera, suggesting common ancestry, were confirmed. Among the genera that both Gray and Fernald listed as common to the two areas were the Ginseng (*Panax*), the Cohosh (*Caulophyllum*), the Skunk-cabbage (*Symplocarpus*), and the May-apple (*Podophyllum*). Fernald thought that many plants long considered to be closely allied with similar European plants were in fact more closely allied to similar forms in eastern Asia.[385] As an example, he cited the Alleghanian Enchanter's-nightshade, which he found identical with the Asian (*Circaea latifolia*). He maintained that those genera common to eastern Asia and North America had, at one time, stretched right across North America from west to east and that in the eastern regions there were now only remnants of these once widespread populations.

Of the many groups of plants Fernald recognized, three were of particular significance. All of these had a restricted distribution, but were related to plants further afield. First, there were arctic plants that normally occupied the circumpolar regions. Second, there were cordilleran plants typically found along the western Cordillera (Rocky Mountains), in Alaska, or along the Pacific coast. Third, there were coastal plain and estuarine plants that are most closely related to plants of the eastern American seaboard, well south of New Brunswick.

Fernald believed that the distribution of arctic-alpine plants could be explained by the last glaciation. They would have migrated southward, ahead of the glaciers, and returned northward again as the glaciers melted. In parts of northern Maine, Vermont, and New Hampshire, they have been left isolated and confined on the mountain tops. In New Brunswick today, they are found at a few points on the hills around the Bay of Fundy and in northern New Brunswick, particularly in the hills and valleys of the upper St. John River and the Restigouche River, where conditions are suitable for them.

Plants of cordilleran origin, Fernald's second group, occur chiefly in isolated localities around the St. Lawrence estuary. A typical cordilleran plant is the Blunt-fruited Sweet Cicely (*Osmorhiza depauperata*). There were also west coast species such as the Asian Iris [Beachhead Iris] (*Iris setosa*) and the Seabeach Groundsel (*Senecio pseudoarnica*). These are isolated far from their nearest relatives in the north-west.

Fernald, a true disciple of the Gray school of botanical investigation, looked for explanations of these anomalous plant distributions in the history of the area. Where, he wondered, had these plants come from? Why are some so isolated from their nearest relatives in the far west and for how long have they existed in this condition? He was convinced that the circum-boreal arctic-alpine plants and the cordilleran plants had different histories. In his imaginative and interesting paper on plants of unglaciated areas, Fernald examined the hypothesis that the ancestors of the cordilleran plants were originally centred on the Arctic Archipelago and Siberia and spread eastward and southward during the Pleistocene period (the last 500,000 years). He thought that they would have migrated along an interglacial corridor on the west side of Hudson's Bay and then into the St. Lawrence area. With the formation of the Wisconsin ice sheet, many were eliminated, but a few remained in unglaciated spots. During the last ice age, they

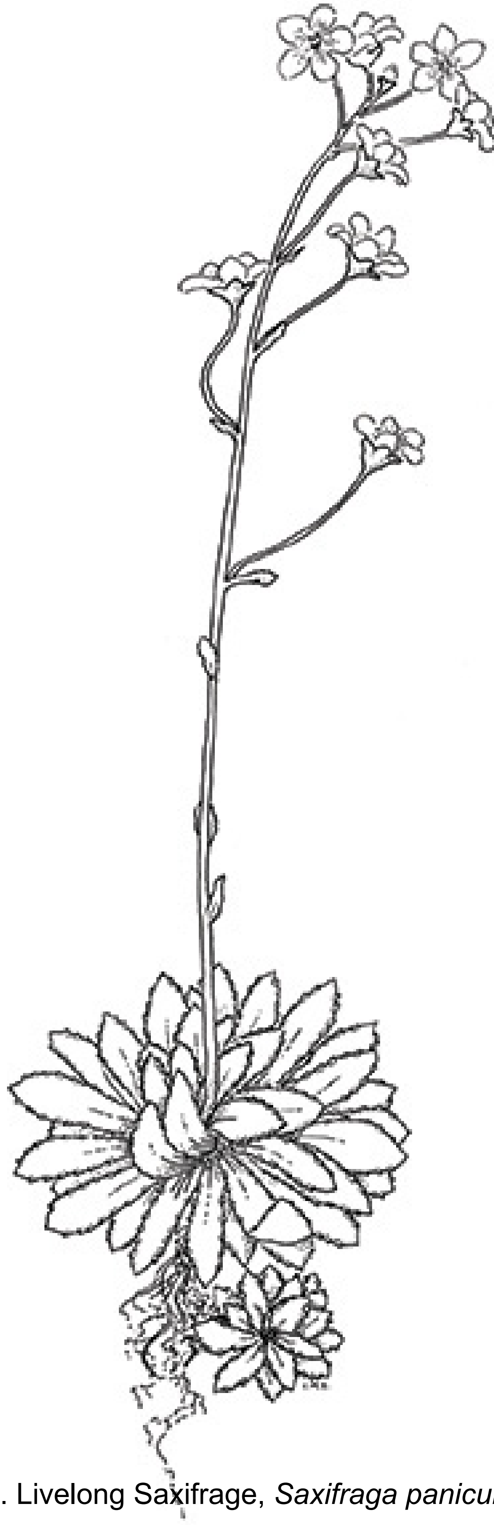


Figure 21. Livelong Saxifrage, *Saxifraga paniculata* P. Miller

became isolated in ice-free fastnesses or "nunataks," separated by approximately 3,000 miles from their nearest relatives, and here many of them evolved into varieties of their cordilleran forbears.[386] Fernald theorized that in contrast to the cordilleran plants, circumpolar arctic-alpine plants spent the ice age in southern refugia. They returned northward as "aggressive" colonizers and tended to crowd out the more ancient cordilleran group which today are hanging on as if by the skin of their teeth in their ancient refuges.

Fernald's third group of plants was of southern origin from the American coastal plain. These plants, he thought, had migrated northward from more southerly regions along the elevated coastal plain during the late Pleistocene period (the most recent geological time). During the ice age, a considerable amount of water was bound up, immobilized in the ice caps, and the sea level fell, leaving the continental shelf exposed. The coastal plains, he argued, had remained ice-free during the ice age and consequently provided refugia for plants. With the melting of the glaciers, subsequent rise in sea level, and drowning of the coastal shelf, some were left at isolated points, leading to a discontinuous range in northern regions. The passage of time and long isolation caused some of them to evolve into distinct varieties. The Saltmarsh Aster (*Aster subulatus* var. *obtusifolius*), found by both Fernald and Blake at Bathurst, and the Parker's Pipewort (*Eriocaulon parkeri* B. L. Robins.) are examples of this group.

Other plants that Fernald and his associates found in the Maritime region suggested still other enigmas of plant relationships.[387] Altogether his observations led to the conclusion that the flora of the region is a complex mixture of species with different origins.

The coastal plants, in particular the estuarine plants, attracted the attention of many botanists. The apparent anomaly of arctic plants occurring along the same stretches of coast as varieties of southern estuarine plants was evident to the Quebec botanist, Frère Marie-Victorin. Marie-Victorin, a founder of the Montreal Botanic Garden and the author of the Quebec flora *Flore Laurentienne* (1935), had discovered many such plants along the coasts of Quebec and the St. Lawrence estuary. The long, gently-shelving estuarine shores, warmed by the sun at low tide, provided suitable conditions for plants normally found in warmer regions to the south, he suggested. Further, he hypothesized that the rhythm of the tides and conditions in the estuaries quickened the pace of evolution and explained the many endemic varieties of plants in this habitat. In contrast, the general coldness of the cliffs and high parts of the shores gave ideal conditions for plants of a more arctic nature.[388]

The plants of the northeastern shore of New Brunswick had proved to be of so much interest to Fernald that he sent students to investigate the anomalies of their distribution. While Blake had explored the Bathurst shore, F. Tracey Hubbard, also of Harvard, made extensive collections around Shediac in 1914.[389] Norman Carter Fassett, "a born botanist" and Massachusetts native, was sent to collect estuarine plants in Maine, where he had spent summers in his youth. Was this an apprenticeship to familiarize him with the species of the American coast? It may well have been because later he investigated the estuaries of maritime Canada and the Gulf of St. Lawrence. Fassett found estuarine plants "tedious" to identify, but his ventures into the slimy estuarine mud were rewarding.[390]

Norman Fassett's survey of the estuarine rivers entering the Gulf of St. Lawrence revealed differences between the flora of Nova Scotia and New Brunswick. From Shediac across the isthmus of Chignecto and to the east in Nova Scotia, the estuaries were devoid of certain species. The brackish water plants Mudwort (*Limosella*), Water-pimpernel (*Samolus*), and a species of Arrowhead (*Lophotocarpus*), were almost always present in New Brunswick from the Miramichi to Buctouche Rivers, while the fresh water estuarine plant Beggar-tick (*Bidens hyperborea*) was present in all estuaries from the Restigouche River to Shediac. Fassett, like Fernald, searched for an explanation in the history of the region. He suggested that originally these plant species had been connected to populations of similar species in Maine via the isthmus of Chignecto. He reasoned that the isthmus region lacked these species due to a past inundation with salt water, leaving Nova Scotia an island

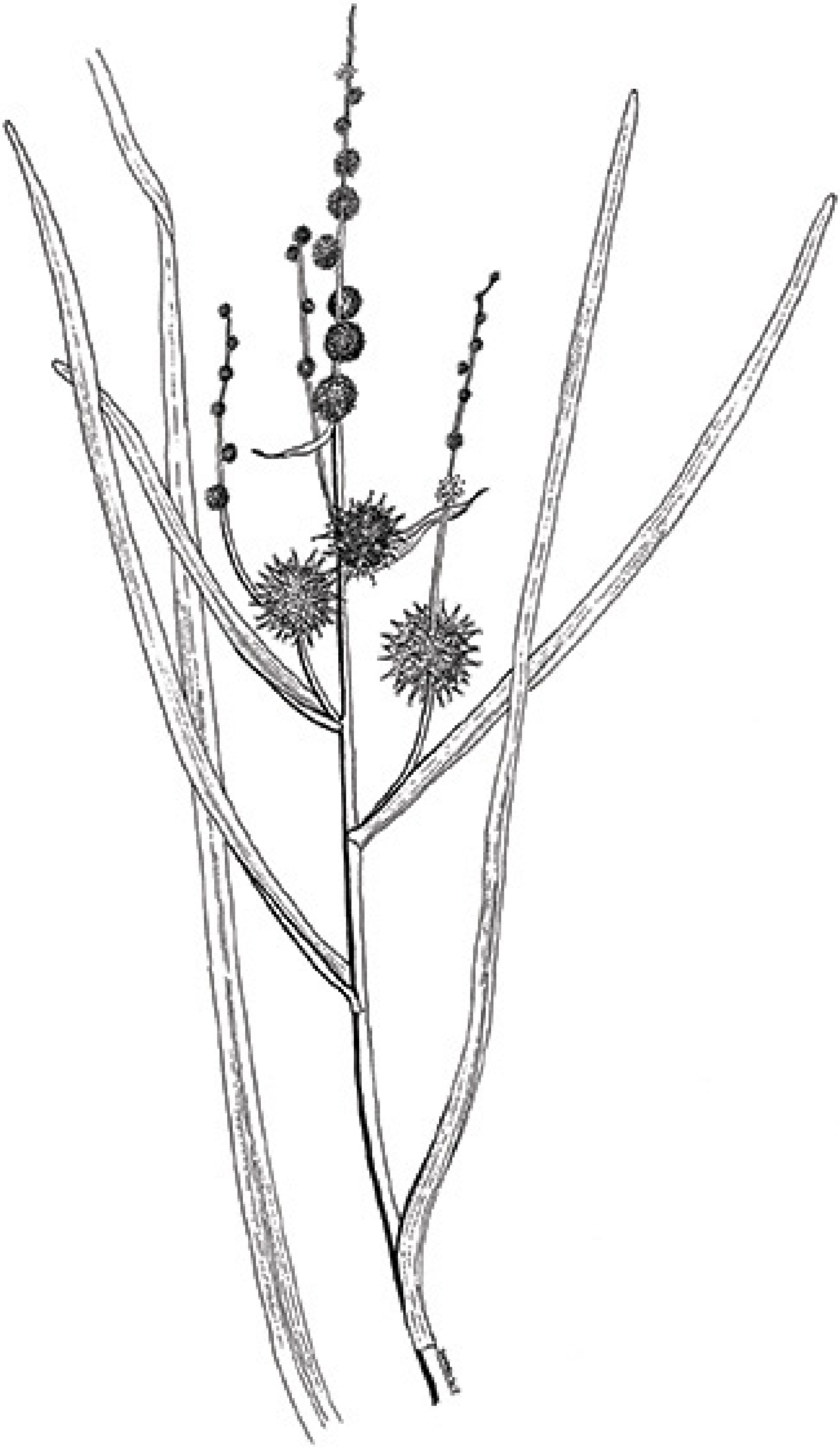


Figure 22. Broad-fruited Burreed, *Sparganium eurycarpum* Engelm.

with conditions that were unsuitable for their spread. To the north-west, however, conditions were favourable and allowed these plants to spread towards the Gaspé Peninsula and the St. Lawrence.[391]

Norman Fassett, nurtured in the Harvard School of Botany, brought a new dimension to the study of plants and their habitats. He was one of the first of the American botanists to recognize the value of "mass collections" of plants.[392] It had been usual for most plant observers to obtain one or very few specimens from a particular place. Fassett realized that it was essential to take a large sample from an area to recognize the patterns of variation and the forces of evolution at work. In this way, he was able to distinguish ecological gradients of change and also to find hybrids between plant species inhabiting the same territory. Occasionally, hybrids reproduced vegetatively, giving rise to "hybrid swarms"—that is, a group of plants, essentially all clones, derived by vegetative reproduction from their parents.[393] Fassett's contributions to botanical science in World War II, the search for cinchona in the forests of South America, are an interesting sequel to his more mundane searches for aquatic and estuarine plants in eastern North America.[394]

Plants are no respecters of political boundaries, and the interests of American botanists in the New Brunswick flora began as an extension of a plant inventory of Maine. Their careful studies led them to recognize plant varieties that occupied certain geographic areas. Their explanations for some of the distribution patterns were ingenious, but as we shall see were not always universally accepted. Nevertheless, the American botanists brought a degree of expertise to their investigations which had not previously been shown in the exploration of the provincial flora.

Asa Gray believed that species had not been independently created, but were "where they are and what they are" as a result of "a continuation through numerous geological, geographical and more recently historical changes of anterior vegetations."[395] The work of Harvard-educated American botanists endorsed this belief.

[page left intentionally blank]

Chapter 10

The Lure of Islands

> An island that promises little to the natural philosopher, for you are to consider that these small, very remote little islands do not possess the superficies for anything considerable in the way of flora and fauna peculiar to themselves. Do but think of the shocking paucity of land birds in Tahiti, so very much greater in mass. Banks remarked upon it with sorrow, almost reprehension.
>
> —Patrick O'Brien, *The Nutmeg of Consolation*[396]

Islands have attracted the attention of biologists from the time of Charles Darwin's seminal studies of the Galápagos Islands. Darwin had expected islands of that archipelago to have the same flora and fauna as that of the nearest South American land mass. While there was a distinct relationship with life of the mainland, he discovered that the biota of the Galápagos differed in many ways. Each island appeared to be distinctive. Prickly Pear Cactus plants (*Opuntia*), for instance, were shrubby on some islands, while on others they were trees. There were many different kinds of finches, which the expert British ornithologist John Gould identified as distinct species. The finch beaks were specialized, allowing each species to eat different foods and to occupy a different ecological niche. It was as though all these finches had radiated from the same stock, but in their island homes had become specialized. At a time when the fixity of species was a common belief, such a finding was particularly disturbing. These were the kind of observations that excited biologists and acted as an incentive to study islands.

From the time of John James Audubon's first visit in 1833, islands of the Bay of Fundy had been a favourite haunt of American naturalists. They were not oceanic islands in the same sense as the Galápagos. Grand Manan, the largest island, lies a mere twelve miles from the mainland and was therefore more likely to harbour a large variety of species common to mainland New Brunswick. Grand Manan was a convenient entity for Harvard University students to study. It was not far from Eastport, Maine, a regular port of call for the coastal steamers from Boston. Geologists and ornithologists found it particularly appealing. It was geologically interesting and was on one of the main flyways for the bird migration. As early as 1859, Addison Emery Verrill, one of Louis Agassiz's students, visited Grand Manan and took back plant samples, among them the coastal outlier and arctic disjunct, the Seabeach Groundsel (*Senecio pseudoarnica* Less.).[397] Two of Asa Gray's students, Joseph Trimble Rothrock (1861) and Joseph R. Churchill (1891), also visited the island. Rothrock returned with 130 species of Grand Manan plants.[398] Judge Joseph Churchill, who had studied law at Harvard and had also attended Asa Gray's lectures on botany, was an enthusiastic plant collector who tried to find samples of every species and variety of plant covered by *Gray's Manual of Botany*. The blue Skullcap (*Scutellaria* x *churchilliana*), which he discovered at Fort Fairfield, Maine, and which is also present in New Brunswick, was named in his honour.[399]

Grand Manan has been home to many observant and enthusiastic local naturalists, among them the ornithologist Allan Moses. He was not only an expert on Grand Manan birds, but also accompanied expeditions abroad as an assistant to the American Museum of Natural History and to the Cleveland Museum of Natural History. The most extensive and systematic study of the flora of Grand Manan, however, was made by the Americans Charles and Una Weatherby and by John Adams of the Agriculture Station at Ottawa. The Connecticut-born and Harvard-educated Charles Weatherby, originally a specialist in literature, was keenly interested in botany. After a period as an invalid, he turned to botany for a living and became a specialist in ferns, botanical taxonomy and bibliography.[400] Beginning as a voluntary assistant at the Gray Herbarium, he rose to a permanent position and was eventually a senior curator and a research associate.

Charles and Una Weatherby together with John Adams visited Grand Manan six times between 1926 and 1944. On each occasion, they studied the plants and collected specimens.[401] They were fascinated by the variety of plant habitats. Grand Manan, an island of contrasts between its western and eastern sides, is underlain by two distinct geological formations. The rocks of the eastern side are older, Precambrian and Upper Silurian, partly sedimentary, and partly volcanic in nature, while those to the west are younger rocks of volcanic origin. The divide between the two formations runs in a line from Whale Cove in the north to Seal Cove in the south. The juxtaposition of the two can be clearly seen at Red Point, Seal Cove. The two geological areas are characterized by a different physiography. The west is a plateau with 400-foot cliffs dropping majestically to the sea. The eastern side has a gentler nature with a great variety of plant habitats, from sandy and pebbly beaches to rocky shores and salt and brackish marshes.

Weatherby and Adams found the soils over both areas to be weakly acid, and yet there were also regions of "highly acid peat and sphagnum bogs."[402] A botanical study was of interest to them not only because of the variety of habitats, but also from the historical perspective; it would provide information on how man's activities affected the plant life.

The New Brunswick geologist Abraham Gesner visited the island in 1839 and reported that the highland district was covered with deciduous trees: Beech, Birch, and Maple. On the lower land—the older "Arcadian" region—was "an immense growth of pine and spruce but the large timber has been consumed by fire, the great destroyer of American forests."[403] By the time Charles and Una Weatherby visited the island, the position of the deciduous and evergreen trees had been reversed, with spruce on the higher ground and broad-leaved trees on the lower.[404] Even between their first visit in 1926 and a later visit in 1944, lumbering had changed the face of the island. Not only had some species of trees (e.g. the Northern Red Oak, White Pine, and Hemlock) practically disappeared, but the herbaceous vegetation had also suffered. Species dependent on a delicate ecological balance, for example the Swamp Willow Herb (*Epilobium palustre*), the Heart-leaved Twayblade (*Listera cordata*), and other orchids, were fewer in number.

Weatherby and Adams found that the most striking feature of the Grand Manan flora was the predominance of boreal species not commonly found so far to the south. Here were northern plants such as the Cloudberry (*Rubus chaemamorus*), the Black Crowberry (*Empetrum nigrum*), the Mountain Cranberry (*Vaccinium vitis-idaea*), the Seabeach Groundsel (*Senecio pseudoarnica* Less.), the Asian Iris (*Iris setosa* var. *canadensis*), and the Large-leaved Goldenrod (*Solidago macrophylla*). At the same time, a few southern species reached their easternmost limit on the island, among them Bluets (*Houstonia caerula*), the Bladderwort (*Utricularia gibba*), and the Sedge (*Carex swanii*). They found 513 species in all.[405] This is in accord with the general observations that islands have fewer species than the adjacent mainland, where at least 1,644 species are present.[406] While the northern species form a dominant part of the Grand Manan flora, approximately twenty-five percent of the total plant species are clearly related to more southern plants.[407]

From the early 1960s to the 1970s, the New Hampshire botanists Albion Reed Hodgdon and Radcliffe B. Pike studied the plants of several of the smaller islands of the Grand Manan archipelago—Machias Seal Island, the Wolf Islands, and the Kent Island group—and made a comparative study with Grand Manan. Did these islands have precisely the same flora, or were there differences, they wondered, and how did the island plants compare with those of the mainland?

The Wolf Islands had many plants not found on Grand Manan. Indeed, it was the abundance of Hemlock Parsley (*Conioselinum chinense*) on the Wolves and its absence from Grand Manan that prompted a comparative study. Among the species of boreal character were: the Bedstraw (*Galium labradoricum*),

Figure 23. Marsh Felwort, *Lomatogonium rotatum* (L.) Fries

the Bog Willow (*Salix pedicellaris* var. *hypoglauca*), the Northern Comandra (*Geocaulon lividum*), and the rare Marsh Felwort (*Lomatogonium rotatum* (L.) Fries).[408] Two species of Eyebrights (*Euphrasia randii* and *Euphrasia americana*) were also present but showed considerable variation.

Machias Seal Island and its tiny outlier, with their constant rain of guano, high humidity, and rock ledges covered with lichens and a few halophytic plants, present few promising places for plants to gain a foothold. Hodgdon and Pike found that the larger island had a dominant vegetation of Asters intermingled with Sea Coast Angelica, Broad-Leaved Docks, and Yarrow, all of which were remarkably vigorous. Plants of the southerly Kent Island group, also had similarities to mainland plants to the north and west. Once again the boreal nature of the flora was evident.[409]

There is a sequel to Charles Weatherby and John Adams's checklist of Grand Manan plants. A recent study (1995) of the flora made by Harold R. Hinds and George H. Flanders confirmed the presence of most of the plants found by Weatherby and Adams in mid-century. Fifteen species were not located, but a further thirty species were found. Some of these may have been introduced in recent years, but it is surprising that Weatherby did not find the small pink Gerardia, which is present in a number of places at the southern end of the island.[410]

Chapter 11

The Geological Survey and the National Museum

American botanists returned to the United States with the Canadian plants they had collected on their summer expeditions. The recipients of these plants, the American herbaria, were enriched by the work of Merritt Lyndon Fernald and his colleagues. Canadians interested in the development of their country often regretted the loss of specimens to American museums. In 1858, before Confederation, a writer in the *Canadian Journal of Industry, Science, & Art*, lamented that the field officers of the Geological Survey of the United Provinces of Upper and Lower Canada were not employed in collecting our flora and fauna: "What has been done by our Canadian Geological Survey for the advancement of Zoology and Botany of the Province?" the writer asked, and then answered, "Absolutely nothing though their parties have traversed from the heights of the Gaspé to far beyond the limits of Lake Huron."[411]

The British North America Act of 1867 brought about the beginning of Confederation, when the colonies of New Brunswick and Nova Scotia joined the United Province of Canada. Other provinces followed and the Geological Survey expanded to cover the whole of federated Canada. There was a drive to explore the unknown regions of the new federation and in particular to discover mineral resources which could be used to expand industry. In 1877, the mandate of the Geological Survey was enlarged to encompass plant exploration and to establish a national collection for reference purposes. Many field officers responded quickly to the expanded mandate. In New Brunswick, for instance, Robert Chalmers reported on provincial plants. The nucleus of a national collection was soon gathered by members of the Geological Survey.[412] In general, the field officers were in the habit of interesting "themselves in almost the whole gamut of outdoor sciences and their reports are storehouses of information on topography, climate, fauna and flora, and native people as well as the geology and mineral resources."[413] The collection gives us a picture of the whole country and is a rich historical record of Canadian exploration.

In 1902, Robert Campbell observed that "though the amount spent upon reporting the botanical productions of Canada has been too meager, excellent work had been done with the resources at the disposal of the Geological Survey for this department."[414] From 1907 onwards, field officers of the Geological Survey concentrated on geology, and specialists were employed for other work. John M. Macoun was appointed botanist in 1881. Macoun and his son James, who succeeded his father as botanist, were responsible for the Survey's botanical exploration across the whole of Canada from 1881 to 1920.

Pressed dried plants collected by members of the Survey were housed in the Survey museum, which moved from Montreal to Sussex Street, Ottawa, in 1881, and to the new Victoria Memorial Museum after 1907.[415] The museum's mandate, specified in the Mines Act of 1907, was "to collect, classify and arrange for exhibition in the Victoria Memorial Museum such specimens as are necessary to afford a complete and exact knowledge of the geology, mineralogy, palaeontology, ethnology and fauna and flora of Canada"—a daunting task, indeed![416] Although the new museum was an adjunct of—and financially dependent on—the Geological Survey, it began to take on a life of its own.

John Macoun, the botanist responsible for plant exploration, was born in Ireland. He had no formal botanical training, but he did not hesitate to appeal to professional botanists for help. Sometimes he sent specimens to the Royal Botanic Gardens at Kew for identification and, occasionally, he asked the American botanical specialists, Dr. Chester Dewey of Rochester, Dr. James

Figure 24. Wild Ginger, *Asarum canadense* L.

Robbins of Vermont, and Professor George Engelmann of Missouri, for advice.[417] Macoun also sought advice from the Scottish-trained George Lawson of Queen's University and later of Dalhousie University.[418]

Macoun's lack of professional training was overcome by his enthusiasm. This was illustrated when, accompanying Sanford Fleming of the Canadian Pacific Railroad on a journey westward, Macoun took passengers of a Lake Superior vessel on a botanical ramble of Michipicoton Island:[419]

> He led them a rare chase over rocks and through woods, being always on the look out for places that promised the rarest kinds, quite indifferent to the toil and danger. The sight of a perpendicular face of rock, either dry or dripping with moisture, drew him like a magnet, and with yells of triumph, he would summon the others to behold the treasure he had lit upon. Scrambling, puffing, rubbing their shins against rocks, they toiled painfully after him, only to find him on his knees before "some thing of beauty" that seemed to them little different from what they had passed with indifference thousands of times.[420]

John Macoun was in New Brunswick in 1899 when, together with G. U. Hay, he carried out a survey of the upper St. John River as far south as the Aroostook River. For the most part, his work across the west was extensive, while in the Maritimes his efforts were directed towards Nova Scotia, Cape Breton, and Prince Edward Island. Between 1883 and 1892, he published a list of Canadian plants resulting from his work across the country; but for New Brunswick, he drew extensively from the plant lists prepared by Rev. James Fowler.[421]

Plant exploration was always starved for funds, as was the Victoria Memorial Museum. Both were dependent on the Geological Survey, which was responsible for allotting financial resources voted by Parliament. In 1920, the Museum became a separate branch of the federal Department of Mines, but still operated at the financial pleasure of the Geological Survey. On the death of the first museum director, William

McInnes, in 1925, his duties were assumed by the director of the Geological Survey, William Henry Collins.[422] He was an enthusiastic geologist who put geological exploration and geological mapping ahead of all other areas in assigning funds.[423] In his 1926 report, Collins pointed out the challenge they faced as "the only government organization equipped for the survey and investigation of natural resources."[424] This kind of problem had plagued the Geological Survey from its beginnings at Confederation. He referred specifically to the expansion of duties arising from the purchase of the Hudson's Bay Company lands. It is hardly surprising that John Macoun was rarely in New Brunswick and that the greater part of his New Brunswick list of plants was drawn from Fowler's lists. He supplemented the list with information from other well-known New Brunswick naturalists: L. W. Bailey for the Fredericton area; James Vroom for St. Stephen; John Brittain for King's County; Robert Chalmers for Campbellton and the Restigouche; James Matthews for Saint John and Rothesay; and G. U. Hay for observations from many parts of the province.

The difficulties of the Survey botanists in keeping pace with the enormous amount of work expected of them was clear when James A. Macoun reported in 1914:

> As time permitted, and chiefly at night, collections of previous years were worked over and specimens taken out for mounting and by the end of April this work was completed. For the first time in twenty-five years I went to the field leaving practically no unexamined material behind me.[425]

During that year, the Survey botanists mounted 2,307 sheets of dried plants for the herbarium and distributed 1,835 to other herbaria.[426] It is hardly surprising that they spent little time in eastern Canada since so much work had already been done by local naturalists and botanists.

Malte Oscar Malte, the chief botanist of the Geological Survey from 1921 until his death in 1933, had botanized in the Saint John area of New Brunswick before he joined the

Figure 25. Carrion-flower, *Smilax herbacea* L.

Survey.[427] Under the auspices of the Survey, Malte was in New Brunswick again in 1926 when he spent two months exploring around the Bay of Chaleurs between Bathurst, Campbellton, Petit Rocher, and Belledune.[428] Of the 250 plants found at this time, 80 proved to be native plants not previously represented in the national collection.[429] Malte returned to New Brunswick, accompanied by his student assistant, W. R. Watson, in 1927 and 1929. They examined the St. Leonard and St. Andrews areas and returned to Ottawa with many plants.[430] In eastern Canada, Malte examined Bent Grasses (*Agrostis* sp.), which he hoped might be a valuable source of seeds for replacing expensive seed imported from Europe.[431]

The year 1927 was a watershed for the Museum. The division of the National Museum and the Geological Survey was completed and the Museum was free to determine its own direction. Even so, the Depression years 1933–1935 brought further funding cuts so that no field parties were sent out. Moreover, no botanist was hired as a replacement for Malte until 1936, when Alf Erling Porsild was appointed.[432]

For many years, the botanical section of the Geological Survey and National Museum appears to have been something of a Cinderella, and it is equally evident that New Brunswick was the Cinderella province. The World War II years were also marked by lack of funds. The national collection was scandalously neglected. Plants found by Malte in New Brunswick in 1926 were not named until Homer John Scoggan worked on them in 1950.[433] This type of neglect was also mirrored in at least one provincial institutional collection in the same period.[434] Even so, this does not compare unfavourably with reports of many national collections in British museums where specimens have been awaiting cataloguing for 200 years.[435]

The second full-time director of the National Museum, F. J. Alcock, was appointed in 1947.[436] Under his direction, more funds became available for plant exploration, and work at the National Museum picked up momentum. The chief botanist from 1946 to 1967, Alf Erling Porsild, born in Copenhagen, Denmark, was familiar with Greenland and the Arctic areas of Canada. He concentrated largely on the arctic flora, but the assistant botanist, Homer John Scoggan, who was interested in writing a Maritime flora, revised and catalogued herbarium material relating to eastern Canada.[437] Scoggan also spent the best part of three summer months in 1954 and 1955 finding plants in New Brunswick. This work resulted in a collection of 1,461 specimens of ferns and flowering plants.[438] The Maritime flora never materialized, but in 1978, Scoggan produced a masterly four-volume flora of the whole of Canada.[439]

For most of the twentieth century, the biological collections housed in the Victoria Memorial Museum in Ottawa withstood many vicissitudes, ranging from problems of storage and display to extreme shortages of money and personnel for fieldwork and curatorial duties.[440] The chronic lack of funds which had been a rallying point for museum scientists from the early period was still a focal point for criticism in 1968, when Alexander William Banfield declared that the National Science Museum was in dire need of funds, staff, and facilities.[441] The various administrative changes also had some impact on decisions to send out field parties and on the accumulation and care of specimens.

In 1968, the plant collections became a part of the National Museums of Canada, a Crown corporation, reporting to the Minister of Communications.[442] Four years later, the Secretary of State announced the Museums Assistance Program, giving subsidies and other help to local museums throughout the country. A greater liaison grew between the National Museum in Ottawa and the New Brunswick Museum. Provincial and national curators exchanged duplicate plant specimens, supplementing their individual collections, and ensuring that collections were not totally concentrated in one place in the event of fire.

The spirit of cooperation occasionally led to joint plant explorations. In New Brunswick, provincial museum curator of natural history David S. Christie was joined by J. A. Forsythe, a summer student hired through the National Museum, in a special project (1978–1979). Analysis of collections housed in the National Museum in Ottawa and in the New Brunswick Museum showed the need for a survey to cover the neglected areas of the province.[443] In particular, there was a need to explore

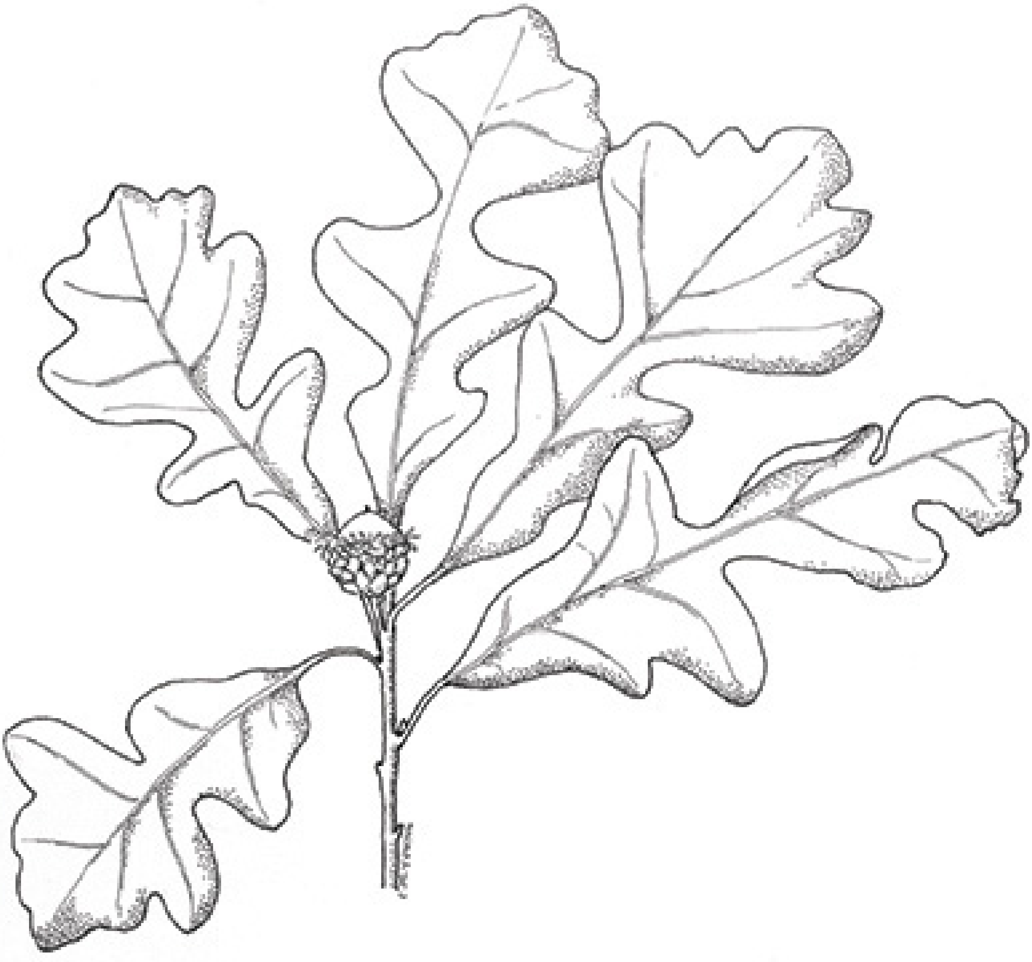


Figure 26. Bur Oak, *Quercus macrocarpa* Michx.

the central and northern highlands and a small south-eastern area of the province.[444] The botanical journeys of Christie and Forsythe took them from Glazier Lake in the extreme northwest corner of the province, across the north via Forty Mile Brook and the Kedgwick River, to the mouth of the Restigouche River. During the late twentieth century, these same areas were part of the fieldwork of the National Museum.[445] In the south, the field parties of the National Museum concentrated on the area around Alma in Albert County.

Plant exploration at the national level has always been viewed in the light of its apparent usefulness and funded accordingly. In the early years, the lack of funds together with the many administrative changes, were detrimental to botanical exploration in this part of the country. It was fortunate that this province had so many able university and local volunteer society workers in this field.

A further problem for field naturalists has been the attitude among many professional biologists. From the 1950s onward, the rift which occurred at the beginning of the twentieth century between experimental biologists and the field naturalists grew ever wider.[446] The experimentalists, not always aware of the contributions of the descriptive biologists and not necessarily conversant with the conditions of natural populations in the field, often condemned field biologists and their practices. This superiority of spirit led to a downgrading of the importance of descriptive, comparative, and taxonomic biology to such a degree that fields such as plant exploration were not considered worthwhile occupations. University departments often adopted a policy of hiring only experimental biologists and national collections often suffered.[447] The Quebec botanist Pierre Dansereau noted the deleterious effect of this attitude when he wrote, "La montée récente de la biologie moléculaire a eu comme premier effet de monopoliser à ce point les talents et les energies (et les resources financiers!) qu'il menace actuellement de paralyser le progrès sur autres fronts."[448]

Since the end of the twentieth century, botanical work at the National Museum has been assuming greater importance. The discovery of the structure of genes and the ability to analyse

DNA has led to the use of this knowledge in discovering plant relationships. Members of the museum staff have been actively using this approach. They have discovered, for instance, the relationships of the species of Arctic meadow grasses of the genus *Poa*. There is now a drive both to document the biological diversity of Canadian plants and to examine how various species in a family could have arisen. This approach has various practical applications.

[page left intentionally blank]

Chapter 12

Agricultural Imperatives

The federal Department of Agriculture was established in 1868 to encourage farming and to help farmers with the problems they faced in the newly federated land.[449] It would appear then that there would have been little need for any wild plant exploration. However, there was a need to know about weeds, plants which were the hosts of pests and diseases of crops, or grasses and their value in the dietary needs of stock. Occasionally, a search for plants useful in plant breeding and crop improvement extended to other countries. There was a hunt, for instance, for wild potato plants in South America.

The Department opened an experimental farm in Ottawa in 1881. It was designed to serve Ontario and Quebec and to be a central research station and advisory centre for the country. Subsidiary farms for the Maritimes were opened in 1891 in Nappan, Nova Scotia, and later, in 1912, in Kentville, Nova Scotia, and Fredericton, New Brunswick. These were local stations serving the needs of their immediate neighbourhoods.[450]

The chief assistant to the first director of the experimental farm at Ottawa was James Fletcher. He was born and educated in Britain and was "genial and courteous." He had been employed by the British Bank of North America and was sent by them to Montreal. After transferring to Ottawa, he obtained a post as accountant to the Parliamentary Library.[451] At the same time, he pursued his interests in entomology and botany. Later, as entomologist to the experimental farm, he was concerned with the practical aspects of pest control, but he was also expected to collect information on grasses, fodder crops, weeds, poisonous

Figure 27. Beachhead Iris, *Iris setosa* Pallax ex Link.

plants, and plant diseases.

Immigrants arriving in Canada brought some of their crop plants with them and inadvertently introduced many European weeds. Weed surveys were some of the first investigations undertaken in eastern Canada. James Fletcher's work culminated in an impressive manual of Canadian weeds, which ran into a second edition after his death. He also acquired land for an arboretum and searched for grasses which would make vigorous growth under poor climatic conditions.[452] As an aid in his work at the experimental farm, Fletcher began to make a reference collection of plants. The nucleus of this collection comprised 3,000 specimens of Canadian plants from his private collection.[453] In 1895, J. A. Guignard was appointed to assist Fletcher in looking after the herbarium.[454] Fletcher made a few forays into New Brunswick. In the early 1900s, he was at Youghall Beach near Bathurst. There he found the Iris (*Iris setosa*), which is more usually associated with Alaska and the Aleutian Islands, but is also present around the Gulf of St. Lawrence.[455]

On James Fletcher's death in 1909, botany was divided from entomology, and Hans Theodore Gussow succeeded Fletcher in the botany section. Gussow, born and educated in Breslau, Germany, had spent time at the Royal Botanic Gardens at Kew and was later an assistant curator at the British Museum.[456] He recognized the need for a good national reference collection. He rearranged the specimens already in the Department of Agriculture herbarium and introduced Heinrich Gustav Adolph Engler and Karl Anton Eugen Prantl's classification system.[457] These German scientists devised a "natural" classification based on inherited relationships. The families were arranged in a progressive sequence with the most structurally simple plants placed ahead of the most complex. The monocotyledonous plants (i.e., those with single seed leaves and parallel veined leaves) were placed ahead of the dicotyledonous plants (i.e., those with two seed leaves and net veined leaves) and the catkin-bearing plants ahead of other forms. Gussow encouraged farmers to send plant specimens to Ottawa for identification. In 1917, for instance, 1,439 specimens were received, which gave the Department specimens and information about plant distribution, and at the same time offered a service to farmers. When problems of identification arose and there were no similar specimens in the herbarium for comparative purposes, the plants were forwarded to the Royal Botanic Gardens at Kew for advice.[458] Later, herbarium exchanges of specimens were made with institutions such as the National Museum. Interested individuals also sent in specimens. Charles W. Weatherby sent the Mustard (*Bunias orientalis*), a well-established weed on Grand Manan Island that had not previously been reported.[459](It has not been seen there since.) A botanical analysis of pastures and pasture plots extended over ten years between 1927 and 1937, and eastern regions were examined for the presence of ragweed.

Over the years, there were many changes in the administration of the Department of Agriculture. The botanical section became part of the Science Service of Canada (1939), and botanical research and investigations received a new impetus.[460] The herbarium was expanded, and the director of the Science Service, James Malcolm Swaine, outlined the advances being made in plant physiology, plant pathology, weed control, soil microbiology, and the contributions of cell biologists and plant breeders in the production of new and disease-resistant varieties of plants of agricultural importance. In an address to the Royal Society, Swaine pointed out the "very incomplete knowledge of our assets in native plants." He suggested that great contributions could be made by a search for native grasses, small fruits, medicinal plants, and fibre plants and at the same time the expansion of our knowledge of the Canadian flora might prove profitable.[461]

World War II presented the federal Department of Agriculture with new challenges, not all of which were directly related to agriculture. There are many plants which are inordinately important in the world economy. During the war, rubber became a much-sought-after product. Rubber can be obtained from several different species of tree, but the tropical Rubber Tree (*Hevea brasiliensis*), native to the Para region of the Amazonian forest, proved to give the best quality rubber.

The story of how rubber trees came to be exported from Brazil and grown in other parts of the world is one surrounded by myth and intrigue. In the late nineteenth century, Britain was anxious to grow rubber trees in India and to open up a new industry there, but early attempts to introduce South American rubber trees failed. There was difficulty, too, in obtaining seeds or young trees from Brazil. According to the romanticized account, 60,000 seeds were spirited out of Brazil in 1876.[462] The seeds were germinated at the Royal Botanic Gardens at Kew, the young trees cultivated and transmitted to satellite botanic gardens in Sri Lanka and Malaysia. Plantations were eventually established and Malaysia became the most important world source of rubber.

The sudden and unexpected loss of Malaysia to the Japanese in World War II left the western Allies in a precarious position. Without rubber, the Allies could not produce tires for the army or waterproof fabrics. At one point, the rubber situation became critical, and the United States had a mere three months' supply.[463] The Americans began an intensive search for high-yielding varieties of rubber trees in the Amazonian forests, while on the home front there was a search for alternative sources.

The Canadian Department of Agriculture also launched a search for native plants which might yield rubber. Among plants common in Canada, milkweeds and dandelions with their milky sap were possible sources. Schoolchildren were dispatched into the surrounding countryside to search for milkweeds. While the sap was examined, the fluffy seed heads were useful as a substitute for kapok to fill life jackets. This systematic search was supplemented by experimental work at the Ottawa Experimental Farm. Laboratory experiments were designed to discover productive strains of milkweeds which could be reproduced rapidly. Later, it was found that the Russian dandelion (*Taraxacum kok-saygyz*), native to the Ukraine, contained a promising latex-type sap.

Russian dandelions were then cultivated in plots at experimental farms in western Canada, Ottawa, Kentville, and Fredericton.[464] The American government was also cultivating Russian dandelions in forty-one states.[465] The cultivation of enormous numbers of plants necessary to yield any quantity of rubber was a long process; approximately 5,000 pounds of roots were required to yield 175 pounds of rubber.[466] By the time a sufficient quantity of dandelions had been raised to start production on a commercial scale, chemists had invented a satisfactory synthetic rubber, but natural rubber was still required to initiate the manufacturing process.

Other wartime investigations were more directly related to food production or to particular agricultural problems. In New Brunswick, biologists examined the distribution of wild plants that were hosts for vectors of virus diseases of potato crops.[467] Raymond Paddock Gorham of the Fredericton experimental station undertook surveys of Wild Plum (*Prunus nigra*) and of Buckthorns (*Rhamnus catharticus*, *R. frangula* and *R. alnifolia*). The results were reported in the newly established *Acadian Naturalist* for 1943–1944.[468] In 1941, the Wild Plum was common in York and Carleton counties and parts of Northumberland towards the mouth of the Miramichi River. The Buckthorn Survey was of interest not only because buckthorns are the winter host of aphids, which were responsible for transmitting virus diseases, but also because they were the host plants for the fungus (*Puccinia coronata*) that caused crown rust of oats.[469]

From time to time, federal and provincial agricultural botanists made general plant surveys. In a cooperative effort in 1945, William George Dore and E. Gorham collected plants from Shippegan, Caraquet, and Pokemouche to Fredericton, the Nerepis, and Sackville. They sent duplicate specimens to the New Brunswick Museum, Saint John, and to the Royal Botanic Gardens at Kew. They did not limit themselves to plants of agricultural importance, because among their specimens were Winterberry (*Ilex verticillata*), Labrador Tea (*Rhododendron groenlandicum*), and the Grasspink Orchid (*Calopogon tuberosus*). Duplicate specimens of the one-flowered Pyrola (*Moneses uniflora*) and Lambkill (*Kalmia angustifolia*) are in the Kew herbarium. Other work included a biosystematic study of blueberry varieties and an ecological survey of the blueberry growing area of Tower Hill in southern New Brunswick.[470]

The work of the Department of Agriculture was oriented towards "changing conditions and new problems of economic significance" in all parts of the country. It was also realized that it was "necessary [to study] and [to apply] this knowledge in arriving at practical solutions."[471] In 1960, the Division of Botany and Plant Pathology was absorbed into the new Plant Research Institute under the leadership of Dr. Harold Archie Senn.[472] The wartime research on Russian dandelion and milkweeds had involved the use of new techniques that proved to be useful. Similar investigations were made on many other plant groups. Some of these were plants of agricultural importance (e.g., grasses and thistles), while others were of horticultural or possibly medicinal value (e.g., Lobelia).[473]

Other reorganizations of Agriculture Canada led to the transfer of Forest Biology from the Research Branch to the Department of Forestry in 1960. There had been a gradual expansion of all services so that, by 1962, nine research institutes, nine research stations, twenty-seven experimental farms, six laboratories, and a number of substations existed. The research programs were frequently revamped to meet the changing conditions and new problems.[474]

The Department of Agriculture sometimes cooperated with other federal or provincial agencies. From 1977 to 1978, Derek Munro of Agriculture Canada cooperated with Parks Canada in surveying Kouchibouguac National Park. With its long shelving shores, coastal islands, sand spits, sandy beaches, salt marshes, peat bogs, and forests, Kouchibouguac is representative of the Maritime plain of the St. Lawrence estuary. Among the many plants found was the delicate southern orchid, *Listera australis*, known at that time from only eight other places in eastern and central Canada.[475] William J. Cody and Derek Munro of Agriculture Canada then examined the provincial distribution of all *Listera* species of orchids. They found *L. convallarioides* and *L. cordata* along the St. Lawrence shore, while *L. auriculata* was present only in the northern part of the province. Some orchids hybridize readily, provided that conditions are suitable. A putative hybrid, *Listera X veltmanii*, derived from *L. convallarioides* and *L auriculata*, occurred at two sites in Madawaska County, northern New Brunswick.[476]

While the numbers of specimens in the reference collection housed in the agricultural herbarium in Ottawa grew at a rapid rate, new ideas of taxonomy were introduced. By 1960–1961, the Biosystematics Research Institute had been set up and was actively introducing new methods. This specialist unit would determine the relationships of plants and how species had arisen. Plant relationships are important in agriculture because closely related species often have similar properties, and because relationships are important in plant breeding and the production of better crops. In classical taxonomy, the classification and naming of a plant was based on its morphological features (i.e., its obvious physical features) with some features carrying more weight than others. As the twentieth century progressed, the definition of taxonomy broadened to include the physiological, genetic, and chemical features of a plant. The dilemma for taxonomists has always been variation. Wade Davis, in his book *One River*, expresses this succinctly: "Within any species there will be variation, and the one key element of the art and practice of taxonomy is the ability to distinguish such differences and characteristics that are sufficiently distinct to warrant the delineation of separate species."[477]

One of the new approaches of the 1960s hearkened back to an idea first suggested by the eighteenth-century French botanist Michel Adanson. He maintained that a wide range of morphological features should be examined and measured.[478] With measurements in hand, a computer analysis was then used to determine plant relationships. The Biosystematics Research Institute of Agriculture Canada employed this method to examine plants of the Saxifrage family in the early 1960s.[479] Since the 1960s, the methods of determining plant relationships have proliferated. Some taxonomists looked for primitive or advanced features and by this means determined the shared, inherited characteristics of the most closely-related species. Other methods included looking for similarities and differences in chemical and physiological features. Chromosomes were frequently counted, but since many plants have the same chromosome numbers, this did not often provide critical evidence for separating species. Some of these methods were hailed as the definitive answer to achieving an objective determination as opposed to the classical taxonomic methods. However, none were totally satisfactory. Today, the extraction and analysis of the plant's genome or genetic structure provides a clearer indication of relationships with closely allied species.[480] Recently, in 2003, a federal biodiversity information partnership was established to coordinate the work of many institutions on biodiversity. There has already been work done on members of the plant family Brassicaceae, to which many vegetable crops and rape, the source of canola oil, belong. Studies of wild plant members of this family are providing genes for plant breeding.[481]

The work of the Department of Agriculture at Ottawa has necessarily been directed towards practical problems; the knowledge acquired has added a distinct increment to the total understanding of our flora. The Biosystematics Research Institute's use of new techniques in examining species and variability has been rewarding. Today there is a trend towards determining the way in which evolution has led to our modern plants. The recent increase in our knowledge of the genetic code adds to many new plant breeding techniques, while the ability to transfer genes from one species to another opens up a new concept. How will we then define species?

[page left intentionally blank]

Chapter 13

Towards Conservation

One morning we awake and thou art here.
And thousands of frail-stemmed hepaticas,
With their crisp leaves and pure and perfect hues,
Light sleepers, ready for the golden news,
Spring at thy note beside the forest ways—
Next to thy song the first to deck the hour—
The classic lyrist and the classic flower.
— Archibald Lampman, "The Song Sparrow"[482]

By the early twentieth century, many university scientists regarded experimental science as the only true science. This led them to question the value of biological collections on which their predecessors had lavished such devoted attention. Taxonomy was declared to be out of style, and for them there appeared to be no future in traditional systematics. Their attitude, together with the Depression, two World Wars, and the subsequent lack of funds and trained personnel, all combined to channel available resources to other fields. In contrast, a dramatic change began to appear in the 1950s. Ecologists, earth scientists, climatologists, and scholars, excited by significant discoveries about the nature of life itself, began to examine biological collections in their search for answers to the new questions they were asking.

During the era when plant collecting was in eclipse, there were at least two places in New Brunswick where it continued to be taken seriously. One of these was Woodstock, where the dentist George F. Clark became a central figure in a group of

Figure 28. Himalayan Balsam, *Impatiens glandulifera* Royle

enthusiastic natural scientists that included Katherine Connell. In the 1960s, she made a study of the vascular plants of Carleton County as a centennial project. Her specimens now reside in the Connell Memorial Herbarium at the University of New Brunswick. The other place where an interest in plant exploration remained truly alive was at the New Brunswick Museum in Saint John.

Fredericton native Austin Squires, educated at the University of New Brunswick and Ohio State University, joined the museum staff in 1939. He was a first-class naturalist. His passion was bird biology, but he also maintained the museum herbarium. He combed the countryside from Tabusintac to Bocabec and Jolicure for plants and animals. Travelling by automobile, on foot, and sometimes by canoe, Squires investigated many different plant communities from the sands and bogs of Grande Plaine, Miscou, and the peak of Mount Carleton, to Glazier Lake, Nictau Lake, and the marshes of the Tantramar. He hunted for Skunk Cabbages along the Milkish Creek and Cardinal-flowers along the Canoose River.[483] He photographed, observed, and wrote about matters of interest to naturalists throughout the province. In 1955, he reported finding that harbinger of spring, the Round-leaved Hepatica (*Anemone americana*) near Stanley and at Nashwaak Bridge.[484] He also found the Asian Touch-me-not [Himalayan Balsam] (*Impatiens glandulifera*).[485] This foreign plant, discovered on wasteland near the harbour at Saint John, was probably introduced from ship's ballast. Squires noted that the cool Bay of Fundy summer climate was particularly suitable for its growth; here it reached a height of six feet.[486] His infectious enthusiasm spurred other naturalists in the province to found naturalists' organizations at Fredericton, Saint John, and Moncton.[487]

In contrast, from 1912 to the 1940s, biological collections at the University of New Brunswick did not receive the attention they deserved.[488] The neglect became complete during World War II when both the space where herbarium specimens had been stored and the one room available for student study were taken over for services considered essential to the war. By 1946, specimens were scattered or stored haphazardly in the attics and other nooks and crannies of the Old Arts Building with no rooms set aside as a natural history museum.[489] The need for teaching material to serve the dramatic increase in students in the late 1940s and 1950s provided the incentive to restore the old and historically valuable specimens found in the Old Arts Building.[490] Fresh plants were also added from summer collecting expeditions undertaken by two University of New Brunswick biology professors, A. R. A. Taylor and E. O. Hagmeier.

The most striking of the significant events that changed the course of biological investigations in the 1950s was the discovery of DNA and the structure of genes by James Watson and Francis Crick; the most surprising feature was the commonality of DNA in all living things. Second, cell biologists were working towards a better understanding of the structure and function of cells and the part they played in complex physiological functions of plants and animals. Third, naturalists and botanists were motivated by a new awareness of the importance of inter-relationships among all living things. This led to an emphasis on biodiversity (the species richness of an area); conservation of special areas became a goal of many biologists.

In New Brunswick, there had been early attempts to have land set aside for conservation. In 1883, surveyor and sometime Crown Lands official Edward Jack had proposed that a conservation area of 1,881 square miles—incorporating the headwaters of the Tobique, Nepisiguit, and southwest Miramichi Rivers—would be a fitting memorial to commemorate the arrival of the Loyalists.[491] This proposal was supported by the New Brunswick botanist and wilderness explorer William F. Ganong. In 1901, the House of Assembly passed a bill authorizing the Governor-in-Council to set aside land of not over 900 square miles for this purpose. The wheels of government moved slowly, and it was another sixty-seven years before an area of 72 square miles was declared a reserve as Mount Carleton Provincial Park.

Rachel Carson's critical assessment of life in New Brunswick's forests in her book *Silent Spring* served to heighten the awareness of the inter-relationships of all forms of life and the

Figure 29. Cardinal-flower, *Lobelia cardinalis* L.

need for conservation.[492] The University of New Brunswick ecologist and fire scientist Ross W. Wein, together with teams of students, surveyed the plants of many areas of Crown Lands. In 1975, he produced a report recommending sixty-five areas for preservation.[493] It was many years, however, before any of these were declared ecological reserves. Three were declared between 1979 and 1985 and five additional reserves were slated to be added in 1992.

During the 1960s and 1970s, Austin Squires was joined at the New Brunswick Museum by assistant curator David S. Christie, who was later appointed curator. Christie collected plant samples from many areas of the province and with J. A. Forsythe, a student employee of the National Museum, made a special survey of previously neglected areas.[494] Their pressed and dried plants were added to those obtained by members of the Natural History Society of New Brunswick in earlier times.

The New Brunswick Museum curator of botany, Stephen R. Clayden, has actively sought plants from all parts of the province. He has made special observations of rare plants and published an informative series of booklets on those of the province.[495] He wrote, for instance, of the Furbish Lousewort: "The discovery of this remarkable St. John River endemic in the late 1800s, its apparent extinction by the 1940s, and its celebrated re-discovery in 1975, are elements of a fascinating story."[496] The Furbish Lousewort was first found in 1878–1879 by John Moser and George U. Hay, but they failed to recognize that their specimen was not the common lousewort. It was the remarkable Maine botanist Kate Furbish who first recognized its significance while botanizing along the upper reaches of the St. John River. Stephen Clayden relates how in 1976 this plant, listed as an endangered species, played a part in defeating the proposal for the Dickey-Lincoln hydroelectric dam. He also outlined the life-cycle of the plant and discussed the vagaries of its habitat.[497]

The new philosophy based on the inter-relationships of plants and animals in the 1960s occurred at the same time as the expansion of the universities and the employment of many more specialists. At the University of New Brunswick,

Figure 30. Myrtle-leaved Willow, *Salix myrtillifolia* Anderss.

two individuals added immeasurably to our knowledge. In the 1960s, Patricia Roberts-Pichette, a New Zealander who trained in New Zealand and the United States, began a focused program of province-wide plant hunting. She revitalized the university herbarium, and her collections provided a more comprehensive background of the provincial flora. Together with student assistants, she travelled throughout the province inventorying the plants they found. She published a checklist of plants of the Fredericton area in 1966.[498] Her discovery of two arctic species—*Salix myrtillifolia* (Myrtle-leaved Willow) and *Solidago multiradiata*—in the gypsum cliff area of Albert County, together with *Dryas integrifolia*, discovered earlier by R. P. Gorham, were recorded in the New England botanical journal *Rhodora* in 1965.[499] This discovery was akin to those of Merritt Lyndon Fernald because these were disjunct species: they were small populations of arctic plants of western and arctic origin isolated from their nearest relatives.

A second period of rapid growth in the knowledge of provincial plants and their distribution began when Harold R. Hinds took on the responsibility of curator to the University of New Brunswick herbarium (1979–2000). He searched for New Brunswick plants with unabated enthusiasm, increasing our knowledge of plant diversity, distribution, and plant habitats. Trained at the University of Massachusetts and Smith College, he had previously made a study of the plants of Cape Cod. In New Brunswick, he tramped woods roads and trails and canoed on rivers and lakes. He investigated wharves, railway sidings, cemeteries, and vacant city lots, everywhere having a keen eye for both rare and well-known plants. He also searched for hybrid forms and for species that evade less persistent seekers.

For the plant hunter, there can be magical moments when a special plant is discovered or re-discovered. The Alpine Bilberry (*Vaccinium uliginosum* L.) had been found by George U. Hay on Bald Mountain in 1898, but until the 1980s had not been seen again. After searching unsuccessfully for this plant on Little Bald Mountain and Big Bald Mountain, Hinds decided to try Mount Denys. He waded across the Nepisiguit River, clothes on top of his head. Once on the other side and suitably clad, he clambered through thick brush and across a boulder field. He found the summit covered with low shrubs and there his exuberance could hardly be contained:

> I circled the brush feeling excited and anxious at the same time. Then I noticed a patch of ground cover under some shrubs on the absolute highest part of the summit. I let out a loud whoop as I recognized my long-sought bilberry, about 15 dwarf shrubs sprawling over three or four meters. Some plants were still in pink blossom but most showed greenish fruit. The leaves were bluish-green, elliptical in outline and with lighter veins.[500]

This bilberry, an "arctic relic," is usually found further north on mountain summits or in coastal bogs. Relict populations are also found on mountains in the Gaspé Peninsula; Mount Katahdin, Maine; and on the high parts of Cape Breton, Nova Scotia. This plant has more recently been found on Miscou Island and on Bald Mountain in northern New Brunswick.

The many technical reports of New Brunswick plant hunters add to our knowledge. For instance, Hinds's specialist knowledge of plant distribution echoes through his articles. He wrote, for instance, of the lower Eel River valley:

> This lower part of the river valley is inhabited by a large assemblage of rare and endangered plants including New Brunswick's only known extant site for the Thin-leaved Sunflower (*Helianthus decapetalus*); the second known locality in the province for the Smooth Alder (*Alnus serrulata*); one of the very few sites for the aquatic Threadfoot (*Podostemum ceratophyllum*); the endangered eastern North American Pine Drops (*Pterospora andromedea*); one of two known populations of the Barren Strawberry (*Waldstenia fragarioides*); and the only known extant population of Bottlebrush Grass (*Elymus hystrix*) in the province.[501]

Other publications describe the plants of Carleton County, the provincial woody plants, and the rare vascular plants of the province.[502] In 1995, Hinds, together with George H. Flanders, re-examined the flora of Grand Manan Island and compared the results with those of Charles Weatherby and John Adams.[503] Certain areas received intensive scrutiny. Hinds and his assistant Mark Lulham also investigated the plants of the St. Croix waterway as part of a 1987 survey in recognition of the declaration of the St. Croix as a "heritage river."

Today, the New Brunswick Museum and the University of New Brunswick collections of vascular plants are a valuable resource. Together with plants in Canadian national and American herbaria, they provide a substantial amount of information on our flora. The information is being recorded in a database linked to distribution maps of each species. The maps add another dimension to our knowledge, because here are ready visual references of plant rarity, or of the northern or southern limits of some species, or of the distribution of salt-loving plants both on the coast and in the interior parts of the province.

By reference to these valuable sources of data, Hinds was able to publish a flora of New Brunswick (1986), followed by a revised and much expanded second edition in 2000.[504] Although it falls within an area covered by several general floras, New Brunswick, unlike other mainland Canadian provinces, has previously had no specific regional flora.[505] Hinds's book serves both as a stepping stone to further botanical studies and a tribute to the work of many botanists and naturalists who gave so much time, energy, enthusiasm and expertise to accumulating this body of information. Over the years, Hinds became acutely aware of the heritage value and the genetic reservoir of New Brunswick's plants, and his infectious enthusiasm led to his central role in the founding and work of several conservation organizations, among them the Nature Trust of New Brunswick.

A need for conservation became increasingly apparent, and many areas were recommended to be set aside, frequently by private conservation organizations. The diversity of

Figure 31. Alpine Bilberry, *Vaccinium uliginosum* L.

New Brunswick flora and its conservation became of interest to governmental environment and natural resources departments, as well as non-governmental conservation organizations. The subsequent need for detailed plant surveys became imperative, which resulted in yet more exploration. Some stakeholders have examined the flora in response to requests for environmental assessments; some have examined it in relation to particular projects, such as the laying of the natural gas pipelines or road construction; others still have examined the flora to determine its diversity and value for conservation. It is typical of exploration that certain areas receive greater attention than others. An analysis of provincial plant collections by Stephen Clayden showed that the most accessible areas around Saint John and Fredericton have been the "hot spots" for observations, while the northern and central areas of the province have been the most neglected.[506] In recent times, exploration of these areas has been the focus of a number of special expeditions, but it is only possible here to examine a few representative examples.

An in-depth study of the New Brunswick Appalachian hardwoods, undertaken by Andrew MacDougall for the Nature Trust of New Brunswick, revealed remnants of this forest surviving in scattered patches on farm woodlots.[507] MacDougall and others maintained that this forest had been extensive at one time in the distant past. They suggested that the rise in ocean levels, changing climatic conditions, interference by man, and the inability of many forest herbaceous plants to disseminate their seeds over a wide area have all contributed to the present fractured nature of the forest. Many species that were rare elsewhere are represented, and new sites were discovered for some species listed by the New Brunswick Committee on Endangered Species.[508] This survey led to recommendations for conservation through careful husbandry and forest management.

In 1994, a team of New Brunswick Museum scientists walked approximately forty miles along the route of the proposed Fundy trail. They negotiated rugged cliff tops, gullies, and beaches between St. Martins and the Fundy National Park. Beyond the cliff tops, logging had taken its toll, while old growth forests

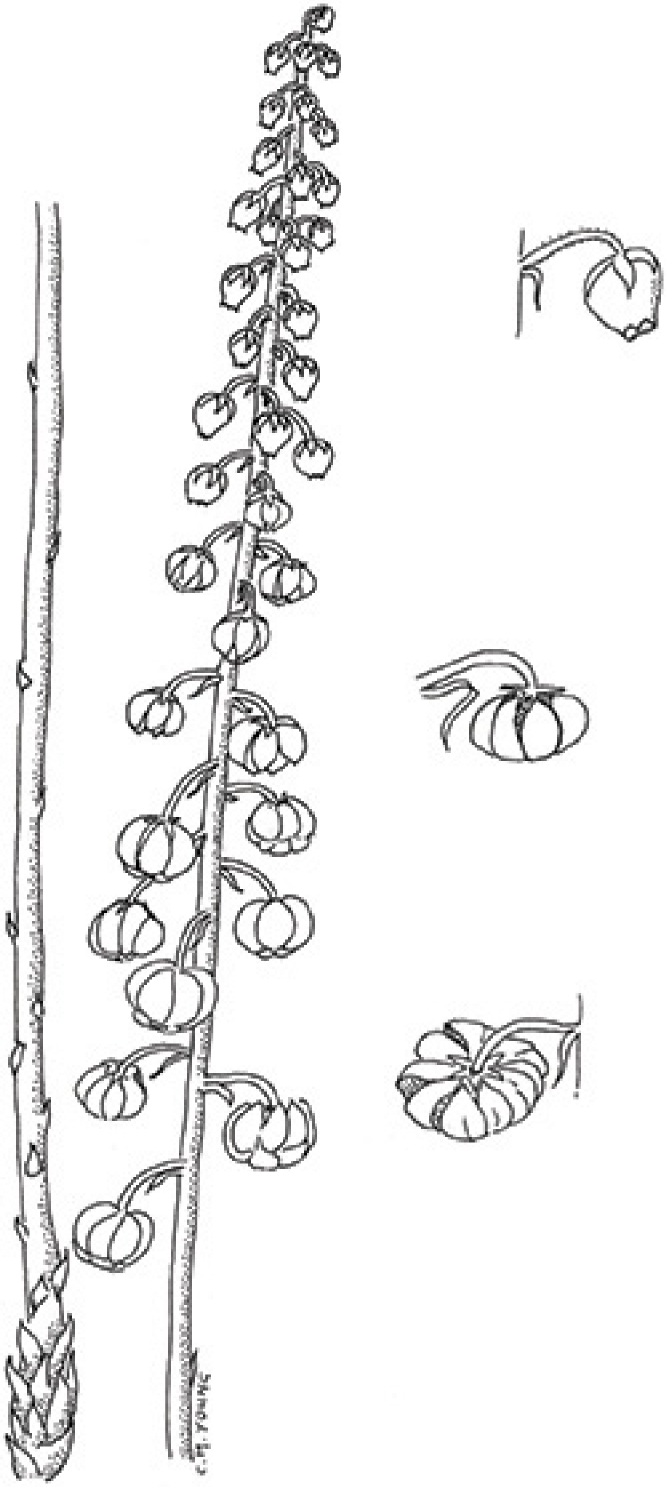


Figure 32. Pine-drops, *Pterospora andromedea* Nutt.

hung precariously along and over the sides of the cliffs. The museum scientists were anxious to catalogue the "diverse flora and fauna which is nurtured by a network of microclimates." The dominant trees were the common Red Spruce, Balsam Fir, Yellow Birch, Paper Birch, and Red Maple, but there were also rare plants. A bog on the plateau near Big Salmon River proved to be unusual. There Clayden found the Curly Grass Fern (*Schizea pusilla*), previously discovered in two places in the province, and the Screw-Stem (*Bartonia paniculata*). The significance of these plants lies in their origins. They are more characteristic of the American coastal plain and are typically found in New Jersey and New York and in a few isolated places elsewhere. Clayden, a specialist in lichens—those indicators of pollution—also found a species that was previously known only from the southern Appalachians. At the same time, the cliff tops were home to sub-arctic and boreal species.[509]

Other individuals who have contributed significantly to our botanical knowledge in recent years include James Goltz, Sean Blaney, and the team of Gart Bishop and Bruce Bagnell. Goltz, for instance, searched out rare plants. An attempt to find the "elusive" annual Laurentian Aster (*Symphyotrichum laurentianum*) along the Northumberland Strait shore of the Gulf of St. Lawrence led to its rediscovery at Val Comeau. This species is part of an endemic complex of asters that appear to be actively evolving into other varieties and species. With Dr. Donald M. Britton of the University of Guelph, Goltz also found the rare Maritime-endemic Quillwort (*Isoetes prototypus*) and ensured that the "type specimen" was described and recorded.[510] On another expedition, the Curly Grass Fern (*Schizea pusilla*) was discovered at Chance Harbour.[511] Goltz has brought the need for conservation to the public notice on many occasions and has emphasized the loss of critical habitat in his writing. For instance, when considering the Calypso Orchid (*Calypso bulbosa*) in the old growth forests of New Brunswick, Goltz wrote:

> In the past three years I have witnessed the loss of several significant stands of old growth forest…

> In Fredericton, a majestic hemlock forest has been replaced by a parking lot and an addition to a local mall. In Carleton County, a stand of mature hardwoods containing showy orchid (*Galearis spectabilis*), Goldie's fern (*Dryopteris goldiana*), and a rare sedge (*Carex sprengelli*) has been logged for firewood. It is likely that the decreasing canopy will allow the proliferation of shrubby species which will overgrow the rich herbaceous understory. A beautiful old cedar woods which formerly grew along the edge of a small boggy lake has been clear cut, creating an eerie lunar effect in the place of a pristine natural area.[512]

Sean Blaney (of the Atlantic Conservation Data Centre in Sackville), Gart Bishop, and Bruce Bagnell explored the previously neglected far northern reaches of the province. They canoed long stretches of the Kedgwick, the northwest Upsalquitch, and the Upsalquitch and Restigouche Rivers, examining the flora along their banks and rocky outcrops. A surprisingly large number of sub-arctic species have survived in that region. Many of these plants, such as theMaidenhair Spleenwort (*Asplenium trichomanes*), are found on calcareous ledges; the insectivorous Butterwort (*Pinguicula vulgaris* L.) occur on ledges and on the river gravels; and the few-flowered Spike Rush (*Eleocharis quinqueflora*) are found on boggy shores. Other expeditions took them to the upper St. John River and to Sugarloaf Provincial Park near Campbellton. In the south of the province, Bishop and Bagnell found a wealth of new species on Long Island in the Kennebecasis River. Crevices on Minister's Face, Long Island, proved to be a rich site for arctic plants, such as the smooth Draba (*Draba glabella*) and the Livelong Saxifrage (*Saxifraga paniculata* P. Miller). The rare Wall-rue Fern was found on Long Island; its next nearest site being on Manitoulin Island in Ontario. During a recent investigation of the southern lakes and ponds, Blaney re-discovered the Lesser Purple Bladderwort (*Utricularia resupinata*). This plant had evaded Harold Hinds, despite his search for it over a period of many years.[513]

There have been many other explorations worthy of mention, but these few serve to show how our knowledge of the local flora is increasing so that we now have a more complete picture of the provincial plants and their distribution. It has become clear that we live in a transition zone where northern and southern plants meet and intermingle. Some northern plants reach only into the northwestern corner of the province, while some southern species are limited to the southwest. Superimposed on this distribution are the disjunct plants. Some originate in the Arctic, some are from the American coastal plain, and some from the western cordillera. Climate change has profoundly affected the provincial flora in the past. In order to understand the presence of many unusual plants, it is necessary to understand the extent of the glaciation, the retreat of the glaciers after the ice age, and the subsequent climate changes. Although recent explorations give us a more complete picture, they do not fully resolve the problem of how disjunct plants arrived or persisted here. Our current knowledge provides us with a baseline against which future changes can be measured, but we do not know what that future will bring. Perhaps areas set aside for conservation will provide a reservoir of diversity, should there be a need.

Chapter 14

The Fruits of Their Labours

> Science is built up with facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house.
>
> —Jules Henri Poincaré, *La Science et L'Hypothèse*[514]

Our ideas of the earth as a living planet have been tempered by our familiarity with satellite images where the patterns of the oceans and vegetation on the earth's surface appear as a mosaic of colour with highlights and shadows. The constituent elements of this mosaic can be identified on the ground by ecologists, geographers, cartographers, naturalists, and botanists who are familiar with the forests, grasslands, and open areas of the earth's surface.

Like the satellite view of the earth, our perspective on the activities of plant hunters and explorers reveals a chequered play of light and shadow. There have been periods of little progress; at other times, exploration has been rapid and has given rise to new ideas. It is possible to trace these advances through the centuries. For some explorers, naturalists, and plant hunters, the discovery of a useful plant or a new species was a sufficient reward. Others searched for order and pattern and for laws governing the natural world. The European discovery of North America and other regions led to a swift development of botanical knowledge and ushered in new interpretations of the natural world and humankind's place in it.

As the cosmopolitan world of natural science entered the second half of the nineteenth century, the accepted methods of description and classification continued to be based on the biblical premises of creation and the fixity and immutability of species that had been accepted for centuries. Not only was each species an entity with certain characteristics determined by a rational creator, but each was perfectly fitted to its niche in life. Such perfect adaptations of plants and animals provided natural theologians with visual proof of creation by God.

The various systems of botanical classification were all attempts to find the plan of creation. It was assumed that such a plan would be rational and would obey well-defined principles. The search for a plan was dominated by the idea of pattern that would reveal God's design; once discovered, any plant or animal would fit into the appointed slot in the classification. Linnaeus believed that he had been privileged to be a party to the revelation of this divine plan.[515]

The search for a totally satisfactory pattern proved, however, to be illusory. Although the concept of a species having clearly defined characteristics that separated it from others by "bridgeless gaps" was largely true, it was an incomplete thesis. It was sometimes the antithesis of field observations where plants showed great variation.

The creationist canon, including the idea of the fixity of species, was jolted to its foundation in 1858 when the theory of evolution by natural selection was presented by Charles Darwin and Alfred Russell Wallace before the Linnean Society in London.[516] Immediately, scientists and clerics in Britain and America became engaged in a heated debate. A particularly acrimonious and famous debate took place at the British Association for the Advancement of Science meetings in Oxford in 1860. The main adversaries were Bishop Samuel Wilberforce of Oxford, representing the Church of England, and Thomas Henry Huxley and Joseph D. Hooker, presenting the Darwinian ideas.

Most clerics were dismayed and bitterly opposed to any theory that appeared to lead logically to the conclusion that man evolved from monkeys. But a debate raged on in Britain within the Church of England through the 1850s and into the 1860s in spite of a religious revival. Seven eminent clergymen wrote a series of *Essays and Reviews* warning of the dangers of a too literal interpretation of the Bible. The response of some clergy was like that of the country parson and social reformer Charles Kingsley, who advised his newly qualified curate not to read *Essays and Reviews* because "they will disturb your mind with questions… . Do not darken your mind with intellectual puzzles which may breed disbelief, but can never breed vital religion."[517] The British historian G. Kitson Clark searched for a common element in the response of the British public to Darwinism and maintained, "the majority of educated people believed, or made as if to believe, that the world had been created in six days, that our first parents were Adam and Eve, that there had been a worldwide flood and that Noah had preserved selections of all living things in the ark."[518]

Darwin's ideas presented a challenge. Variation, according to Darwin, was evident in all living things. Each individual in a population showed slight differences from others of the same species. His ideas on the survival of those individuals most fitted to their environment and their ability to reproduce and ensure their genetic continuity were not compatible with the Biblical view of creation. Darwin's thesis arose out of his explorations, his contemplation of the distribution of species, and from his examination of a vast body of data. His work on the plants and animals of the Galápagos Islands, for instance, led him to conclude that they were a part of the total South American complex of species which, by isolation on oceanic islands, had been subjected to different forces of natural selection leading to the establishment of different but closely allied species on each island.

The Darwinian thesis did not change the drive to search for plants of economic or medicinal importance. Among the scientific community, however, there was a change in the way plant distribution and classification were considered. The study of variation took on a new significance.

Both Alphonse De Candolle in Europe and Asa Gray in the United States observed that when large numbers of plants were examined the extent of the variation became apparent.[519] Recognition of these variations often required a reassessment of the classification. In 1867, the scientific community officially recognized the categories of "subspecies" and "variety" when these were adopted by the International Botanical Congress at the instigation of Alphonse De Candolle.[520] But did this mean an immediate change in the working procedures of those who were concerned with making plant inventories? Old methods of determining species and classification were often retained by renowned botanists.[521] They recognized "discontinuous variation" and noted that, for the most part, species were distinct with certain characteristics which could be defined and described. The useful concept of "type specimen" was thus retained.[522] A type specimen was the first specimen or collection of that species to be scientifically described and its distinguishing features determined. It gave a standard against which other plants could be examined and named.

Among Canadian scientists, the Darwinian thesis received an icy or even hostile reception. In particular, the Presbyterian palaeontologist William Dawson was an ardent antagonist. As principal of McGill College in Montreal, his influence was critical. Luc Chartrand and others point out that, in Quebec generally, there was a strong anti-Darwinian movement led by thinkers and priests of the ultramontane persuasion. Their anti-Darwinian sympathies were enhanced by the 1864 encyclical, *Quanta Curia*, of Pope Pius IX, which was accompanied by a syllabus of the principal errors of the time—socialism, materialism, rationalism, and liberalism. Thinkers and scientists who, as members of the Canadian Institute, followed the Darwinian line too closely were excommunicated.[523] The response of other members of the Canadian scientific community was less heated and tempered with caution, but nevertheless critical. One reviewer of Darwin's *On the Origin of Species* wrote in the *Canadian Journal* in 1860: "If we have been compelled to record our protest against the reception of what we believe to be an unfounded theory, no one, we may safely affirm on the other hand, can lay down Mr. Darwin's book, so remarkable in many points of view, without feeling that a large accession of new thought has been added to the common store."[524] Similar sentiments were expressed by William Hincks in his presidential address to the Canadian Institute in 1876: "I am obliged to confess that if my reason compelled me to adopt the Darwinian hypothesis, its opposition, as I understand it, to cherished and valued sentiments respecting creative wisdom and goodness, and a perfect divine plan in nature, would cause me great pain."[525]

New Brunswick biologists and naturalists greeted the Darwinian hypothesis with a poignant silence. In a province where the Christian religion was a mainstay of thought and morals, it would have been a brave man who would have openly embraced the Darwinian ideas. There is no evidence that James Robb or Loring Woart Bailey discussed the subject. One might argue that living in a relatively remote part of the world, New Brunswick naturalists were unfamiliar with Darwin's work, but they were remarkably in touch with scientists in other communities.

The members of the New Brunswick Natural History Society carried on collecting and naming plants the way they had always done. However, the theory of evolution was addressed occasionally in the meetings of the society. In 1863, Dr. James Sinclair gave a paper entitled "Remarks on certain theories concerning the origin of species," while in 1882, James Estey contributed a talk entitled "The Dead Naturalist, a sketch of the life and writings of Charles Darwin."[526] Unfortunately, we do not have any indication of the line of argument of these speakers. George F. Matthew was obviously troubled by accepting a literal interpretation of the biblical account of creation because in 1862 he wrote to Loring Woart Bailey of the difficulties in reconciling the evidence provided by the geological record with the biblical account of creation as given in Genesis.[527] Rev. James Fowler faced criticism of his teaching at Queen's University for his failure to enlighten students on the Darwinian thesis.[528] But he, too, was skeptical of some of the accepted beliefs. Writing in the *Queen's Quarterly* in 1896, Fowler stated:

> The belief in the fixity of species adopted and explained by Linnaeus, became an article of faith among men of science and theologians. Every

> species was believed to owe its existence to a special creative act… . Systematists were unable to resist the feeling that affinity existed but what could it mean in the presence of the belief in an absolute difference of origin of species? … Thoughtful workers felt compelled to doubt the truth of their own acknowledged principles.[529]

Fowler realized that affinity was a relationship dictated by inheritance.

The newly elected president of the New Brunswick Natural History Society also raised the topic in 1902. In his annual address, the Honorable John Valentine Ellis spoke of the changing ideas in the biological sciences from the 1850s and of the challenge of the theory of evolution. While he recognized the "true value of the religious instinct in its place," he noted, "One of the surprises which greets the ordinary mind in dealing with the Darwinian work is the extent of the variations which are possible and probable under the one general law."[530]

For many biologists, the Darwinian revolution imposed a new set of values. Evolution was a historical process; no longer were species seen to have remained without change from the time of creation. Along with this vertical component of change with time, evolution also embraced a horizontal component—that of the geographical distribution of species.

Before the period of European exploration and expansion, it was generally conceded by Europeans that God had created all types of plants and animals specifically suited to the tropical, temperate, or arctic zones and environments. They expected to find the same species in similar zones throughout the world. The vast array of unfamiliar plants and animals discovered as they explored other continents surprised and amazed them.[531] This great diversity of forms in different geographical areas was brought to light time and time again by collectors and field biologists. How and why did so many forms of life exist, all perfectly adapted to their habitats?

The end of the nineteenth century was a period of doubt and confusion concerning the Darwinian hypothesis. At one extreme were the concepts of "hard" heredity of the German scientist August Weissmann, in which the inheritable material or "germ plasm" is passed from one generation to the next, while the body or "soma" is merely the means of transference. At the other end of the spectrum were the ideas of "soft" inheritance of the neo-Lamarckians who, like Lamarck, believed that acquired characters could be passed to the next generation and in that way the parents could have some directive influence.[532]

The turn of the century witnessed dramatic changes in the ideas of the global scientific community. In particular, there was a recognition that the cutting edge of biological science lay in experimental laboratory studies. The discovery of the function of the chromosomes in cell division by Edouard van Beneden in 1882, followed by the rediscovery of Gregor Mendel's laws of heredity by Carl Correns and Hugo de Vries in 1900, finally gave the material evidence of inheritance. The discovery of mutations or changes in the structure of the chromosomes by Hugo de Vries and Thomas Hunt Morgan provided the source of variation.[533]

Laboratory researchers were convinced that mutations were the only source of variation. Since many mutations were deleterious they would be eliminated. New mutations arise infrequently so the development of new species by this route alone would happen very slowly. To many researchers, speciation appeared to be a faster process. In the meantime, biologists and mathematicians were looking at variation in large populations and constructing models to determine the effect of selection. It was quickly shown that new species could arise through the geographical isolation of a group of individuals (allopatric speciation), provided conditions and selection were favourable. Geographical isolation was recognized as an important driving force in evolution. However, a debate raged as to whether new species could arise in two overlapping large and apparently similar populations (sympatric speciation). Field biologists made practical observations of variation and geographical distribution in both widespread and isolated groups of plants and animals.

New Brunswick plant collectors of the nineteenth century paid scant attention to the details of variation, yet Darwinian ideas of variation crept into their way of looking at life. One source of influence was the Harvard University botanist Merritt Lyndon Fernald, for whom the study of variation became absorbing. He noticed that many of the isolated populations of disjunct plants he found in the Maritime region were varieties of more widely distributed types. He distinguished three groups according to their closest relationships and probable origin: first, there were the circumpolar arctic-alpine plants; second, southern plants more typically found along the coastal plain of the United States; and third, Cordilleran plants that were native to the coasts and mountains of western Canada, Alaska, and the Bering Strait region. He explained their presence as being the result of past climatic changes. Each of these groups he believed had a different history.

The idea that circumpolar arctic-alpine plants moved southward ahead of the advancing ice sheets in the ice age and their progeny returned northward again as the ice retreated appears to have withstood the test of time. In the Maritimes and the northern United States, some of these plants were left isolated as the ice retreated. Plants of this type are found today in open habitats on calcareous soils or in gypsum areas where the substrate is a little unstable and unsuitable for competitive species to become established. According to geologists, the ice retreat began about 14,000 years before the present. The retreat was not uniform along a front but rather had "local asynchronous advances and recessions."[534]

Modern geologists have noted that there were also climatic changes after the glaciers retreated. The initial warming phase was followed by cooler periods. The most striking of these is known as "the Younger Dryas Event." Approximately 10,800 years before the present, arctic shrubs and herbaceous plants replaced the spruce forests which had already penetrated New Brunswick. The evidence comes from critical work done by Frances E. Mayle and Les C. Cwynar in which they examined plant pollens from lake-bottom cores in two parts of southern New Brunswick and several areas of Nova Scotia.[535] There were residual ice caps over the highlands of northern New Brunswick, Cape Breton in Nova Scotia, the eastern part of the Northumberland Strait, and much of Prince Edward Island. It would seem reasonable to hypothesize that the arctic-alpine plants followed the ice front towards these residual ice caps and that when the ice melted they were left isolated and surrounded by the fast approaching forests. This would explain the presence of arctic-alpine plants in New Brunswick's northern highlands, together with the upper Restigouche and St. John River valleys, as well as in the southeast corner of the province.

Southern coastal plain species found on the Northumberland Strait coast made up a second group identified by Fernald. Could they have arrived on the beaks or feet of birds? This is a possibility, since the Northumberland Strait populations are on the bird migration routes. But it seems improbable, because many of them depend on the wind to distribute their seeds. An alternative explanation is that they could have migrated from the south along the raised and exposed continental shelf during and just after the last ice age. This certainly appears to be the case for many plants which migrated into southern Nova Scotia. The continental shelf route to the Northumberland coast, however, would have been tortuous. The logic of Ockham's razor dictates that this explanation should be rejected.[536] The most probable explanation is that they spread into the area from southern New Brunswick, perhaps following the glacial gravels, outwashes, and waterways left by the melting ice. Stephen R. Clayden suggests there is evidence of their arrival by a southern route. Certainly, some of these coastal plain species are found in southern New Brunswick today. The Curly Grass Fern (*Schizaea pusilla*) and the Button-Bush (*Cephalanthus occidentalis*) are examples. Once here, Fernald suggested, they were cut off from their southern relatives by changing conditions. In their Northumberland Strait sites, they have evolved into forms and varieties that differ in details of structure from their southern relatives. The Bathurst Aster is an example; it is a variety (var. *obtusifolius*) of the Saltmarsh Aster (*Aster subulatus*).

Fernald's third group, the Cordilleran plants, are found in isolated colonies around the St. Lawrence estuary, western Newfoundland, and parts of Labrador. He believed that Cordilleran plants had an ancient history migrating from the

Figure 33. Hair-like Sedge, *Carex capillaris* L.

northwest along an interglacial corridor and remaining in ice-free refuges or nunataks during the ice age. This theory has received both criticism and support.

In Fernald's time, geologists thought that the last ice age was more benign than previous glaciations and that some parts of the Maritimes were not ice covered. As vigorous plants migrated into the area from the south following the retreat of the ice sheets, the Cordilleran plants clung to their ancient refuges despite competition from the newcomers.

The fieldwork of the Quebec botanist Frère Marie Victorin supported Fernald's nunatak theory. Victorin also maintained that certain areas of Quebec, Labrador, and the Maritimes where relict plants are found had remained ice free. Others attacked the nunatak theory because, as V. C. Wynne-Edwards noted, plants would have to be exceptionally hardy to withstand the ice age climate and this was not the case with the Cordilleran plants. Wynne-Edwards believed that both the Cordilleran and the more widespread arctic-alpine plants have had a common history since before the Wisconsin glaciation, but that the Cordilleran plants prefer alkaline soils where they are found today.[537]

Modern geologists think that about 24,000 years ago, the whole region was buried under a thick ice sheet extending out to Georges Bank at the edge of the continental shelf. No areas would have escaped the scourges of the ice, leaving little doubt that the nunatak theory is untenable.[538]

Curiously, some of these Cordilleran plants are found around the northern end of the Great Lakes. They provide some evidence that their forbears may have arrived from the west by that route. During the last ice age, a large ice sheet formed over the southern end of Hudson's Bay; it depressed the St. Lawrence and Ottawa River valleys. At the end of the ice age, melting ice permitted the sea from the St. Lawrence estuary to connect with parts of the Great Lakes system and possibly also with Hudson's Bay.[539] Was this the route taken by these plants? Much work needs to be done on their precise relationships and genetic connections with similar plants in the west.

Biologists generally concede that very small isolated populations of plants and animals will die out. Much depends on the variability of a population and the conditions to which it is subjected. Yet, surprisingly, some of these small populations of arctic-alpine plants in New Brunswick appear to have existed here since the ice age. Where disjunct populations have little variation (e.g., the Furbish Lousewort), the risk of extinction is increased.[540] Other isolated plant populations appear to be flourishing. The Seabeach Groundsel, occurring in New Brunswick only in the Grand Manan archipelago, has thousands of plants extending for more than half a kilometre along the shore.

Whatever the merits or faults of the arguments on plant distribution, isolated plant communities have played an important part in the development of ideas about "genetic drift" and of the development of new species. Twentieth-century botanists recognized that variation is a crucial element in the process of speciation. Variation, however, has two principal interacting components, commonly referred to as "nature" and "nurture." Late nineteenth- and early-twentieth-century ecologists (e.g., Göte Turesson) pointed to the importance of environment as a factor in the expression of plant morphology.[541] The plasticity of many plant species was demonstrated by experiments in which plants of the same species, showing different morphology and taken from diverse habitats, were grown under the same carefully controlled conditions.[542] In this way, researchers were able to determine how much variation was due to environmental conditions and how much to their genetic constitution.[543]

Many of the variations which Merritt Lyndon Fernald and his colleagues discovered around the Maritime region were notdue to the environment. They were due to the genetic background of the plants.[544] How could this have arisen? Isolated populations of plants might be remnants of a once widely distributed species, or they could have been derived from small "founder populations," which became established by chance seed distribution. In either case, they would be the descendants of relatively few individuals split off from the main population. By the laws of chance, such isolated

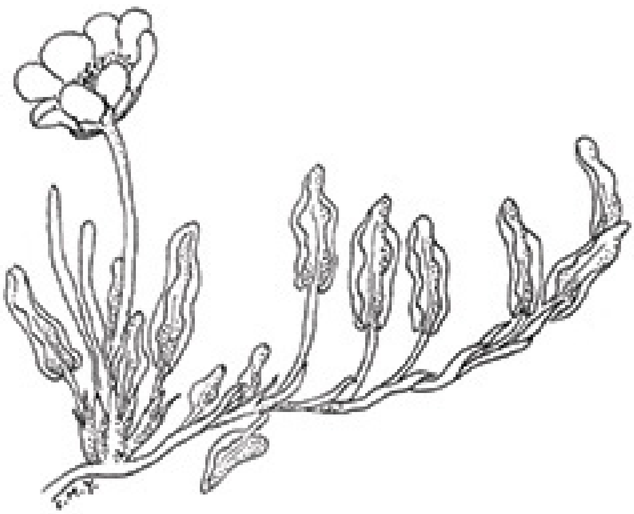


Figure 34. Mountain Avens, *Dryas integrifolia* Vahl.

populations might have a unique set of genes. Their response to selection pressures would determine their ability to survive and prosper. In some cases, small isolated plant populations become so different from their ancestors and closest relatives that interbreeding with the original population may no longer be possible.

In the broader scientific world, by the mid-twentieth century, there was a reassessment of the work of geneticists, cytologists, and population and field biologists leading to an amalgam of information known as the "modern synthesis." The contributions of many different ideas to the theory of evolution were recognized. This was followed by laboratory studies leading to the discovery of the structure of the thread of life and continuity between generations, the DNA (James D. Watson and Francis Crick, 1953).[545] Examination of small plant populations became an important component of work enabling scientists to understand the formation of new species by geographical isolation of a founder population. The search for plant relationships by examining probable evolutionary pathways and the examination of the DNA structure of the genes together with botanical field observations all point to the complexity of plant relationships, reproduction, development, and plant distribution.

There may be physical isolating mechanisms affecting fertilization or differences in the ripening time of pollen and the receptivity of the stigma. Self-pollination may be an important factor in the rapid expansion of some plant populations. Polyploidy (the doubling of the chromosome number) is now recognized as a way in which speciation can take place suddenly. The marriage of the disciplines of genetics, cytology, ecology, population biology, and traditional plant systematics based on the morphology and anatomy of plants has led to a greater understanding of the evolutionary process.

Over the four centuries of plant collecting in New Brunswick, there has been a gradual accumulation of knowledge, while changing ideas of science have affected the way in which information has been interpreted. In the words of Frère Marie Victorin, how different is our view of the world from that of de

Champlain and the first botanists who visited our shores?[546]

From the practical viewpoint, plant exploration has provided the working material for scientists interested in the diversity of our natural world. Incidentally, it also provides benchmarks against which future changes can be measured. The breeding of superior races of plants has obvious practical applications in improving our forest trees and plants of horticultural importance. The need to maintain wild populations with a wide degree of variation from which future selections can be made is an important facet of plant discovery and conservation. The search for plant races which can withstand unfavourable conditions has widespread uses. For example, grass varieties which grow under extreme environmental stress have been used to colonize slag heaps and other undesirable pieces of landscape.

From the historical viewpoint, our exploration of plant diversity is a part of our cultural heritage. It provides a record of the past activities and methods of botanists and naturalists. Where collections are adequate, the plants themselves give a physical proof of past plant distribution.

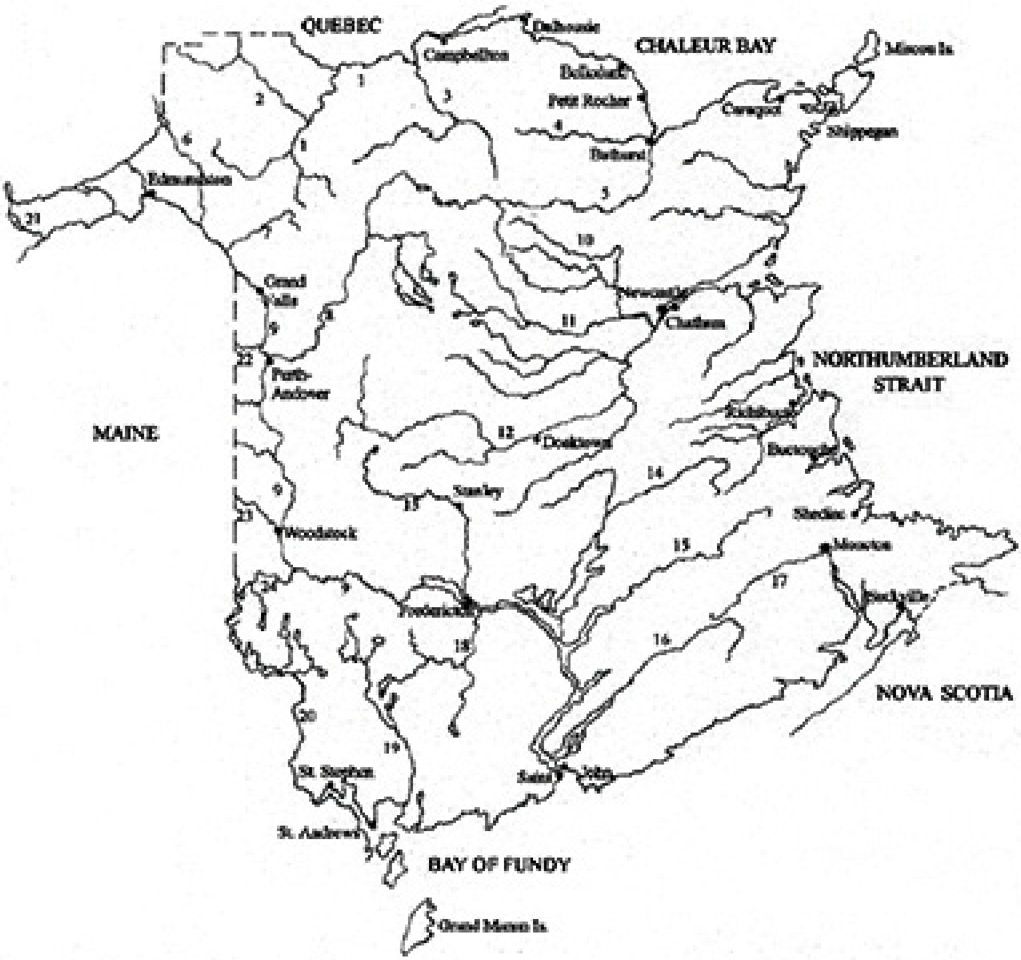
From the purely scientific viewpoint, the species of New Brunswick provide us with rich material for investigations both in the field and laboratory. Here is an opportunity for combined ecological, genetic, and taxonomic studies. While the forests of the Amazon and Central America have become a botanist's paradise because of the large pool of different species of those regions, New Brunswick has its own source of botanical wealth. The province is richly endowed with plants and trees that show a great diversity of forms *within* species. The complexity of their genetic make-up and reproduction and their relationships with the environment have not been adequately studied. Such studies could be significant because here we have variation, the basic substrate on which selection acts, and an opportunity for the study of the causal elements and forces of evolution.

In the twentieth century, there was a tendency to regard only laboratory studies as significant science. The detailed study of biological components under closely regulated conditions is fundamental, yet these components are of greater value when their relationships in the wider natural world are known. In the final analysis, it is the world in its fullness that is the ultimate enigma as well as a stimulus for further exploration and inquiry.

Appendices

Maps of New Brunswick

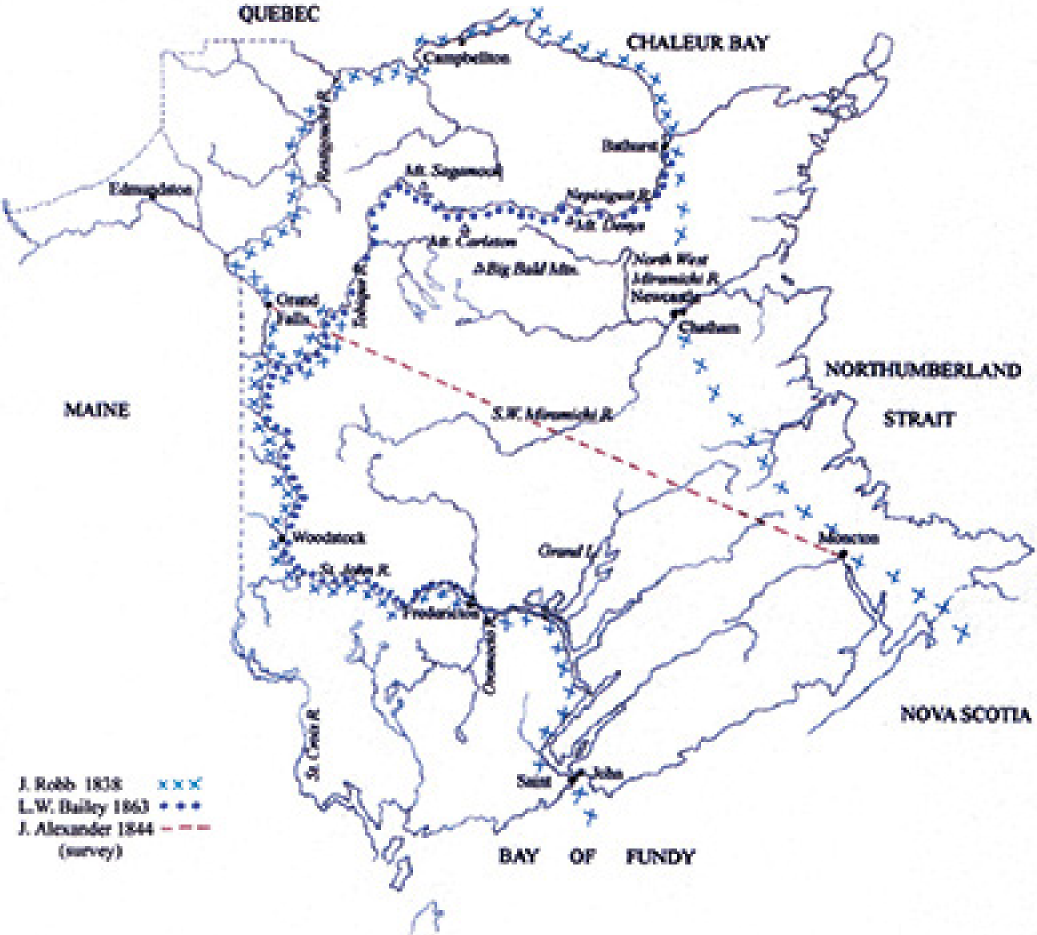
[page left intentionally blank]



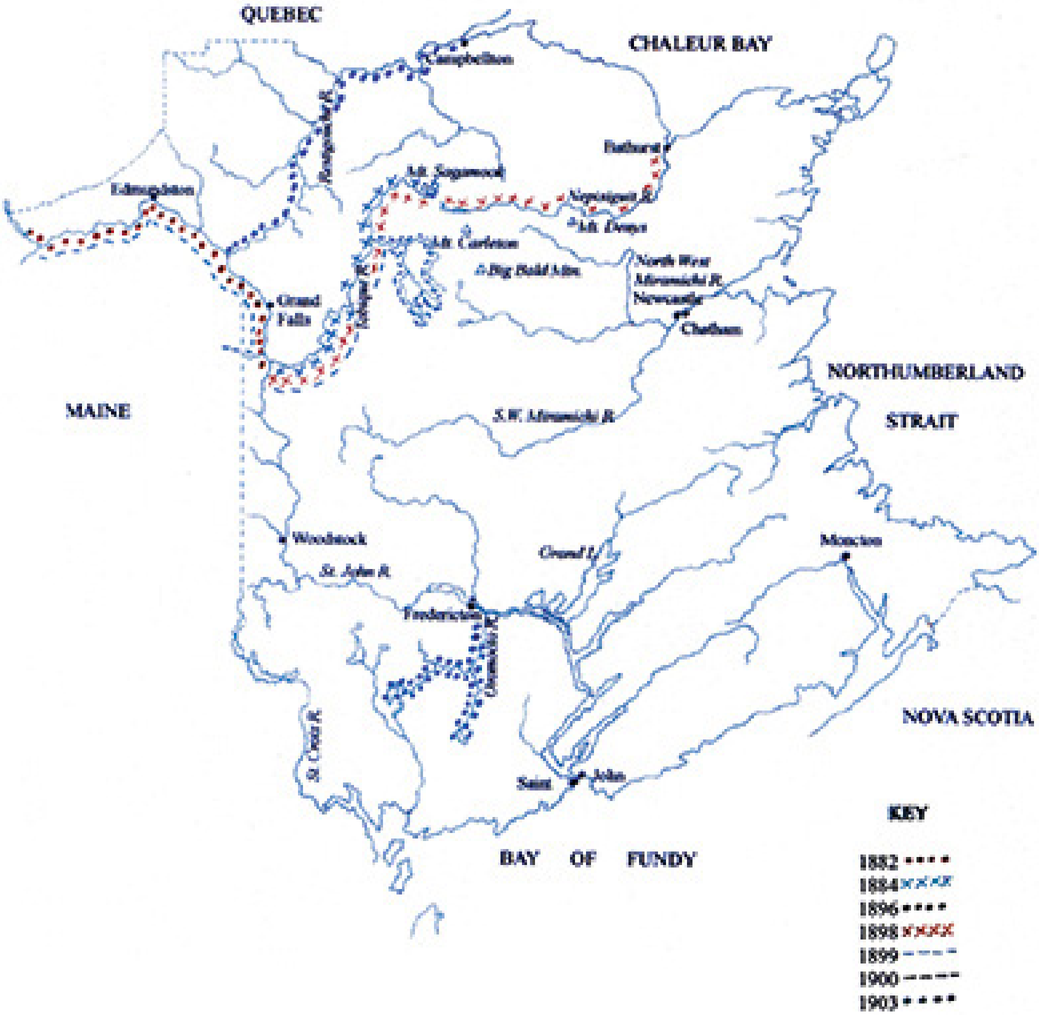
MAJOR RIVERS

1. Restigouche R.	7. Grande R.	13. Nashwaak R.	19. Magaguadavic R.
2. Kedgwick R.	8. Tobique R.	14. Salmon R.	20. St. Croix R.
3. Upsalquitch R.	9. St. John R.	15. Canaan R.	21. St. Francis R.
4. Tetagouche R.	10. N. W. Miramichi R.	16. Kennebacasis R.	22. Aroostook R.
5. Nepisiguit R.	11. Little S. W. Miramichi R.	17. Petitcodiac R.	23. Meduxnekeag R.
6. Rivière Vert	12. S. W. Miramichi R.	18. Oromocto R.	24. Eel R.

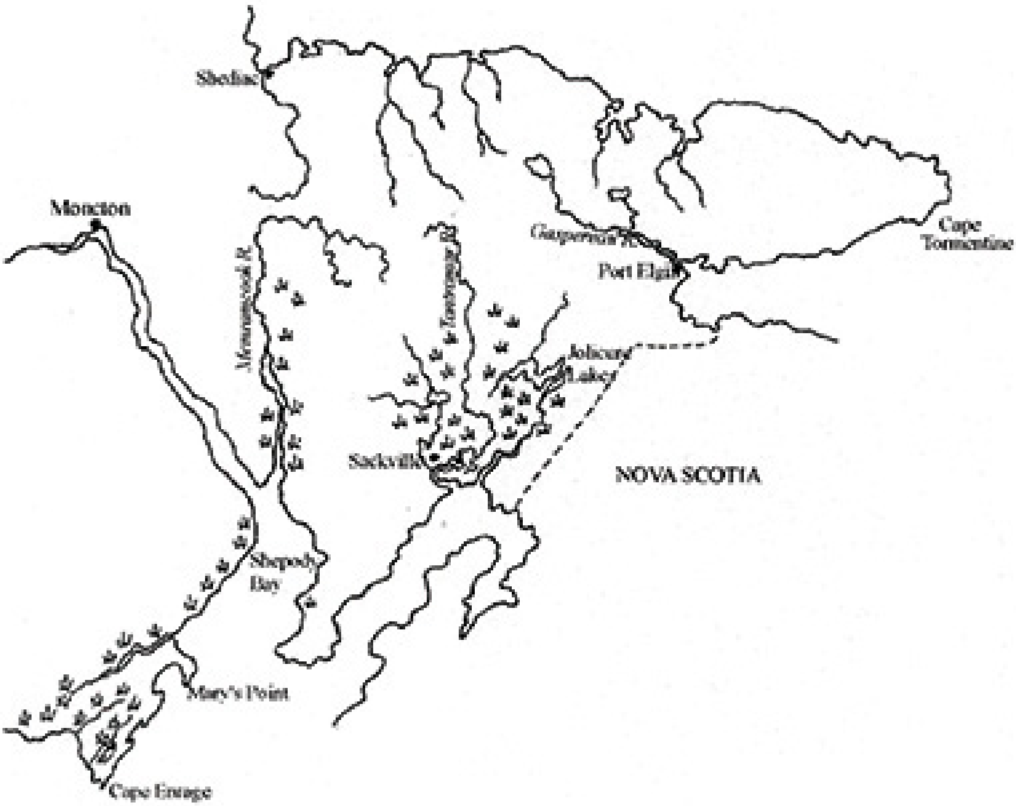
Map 1. Rivers and Towns of New Brunswick



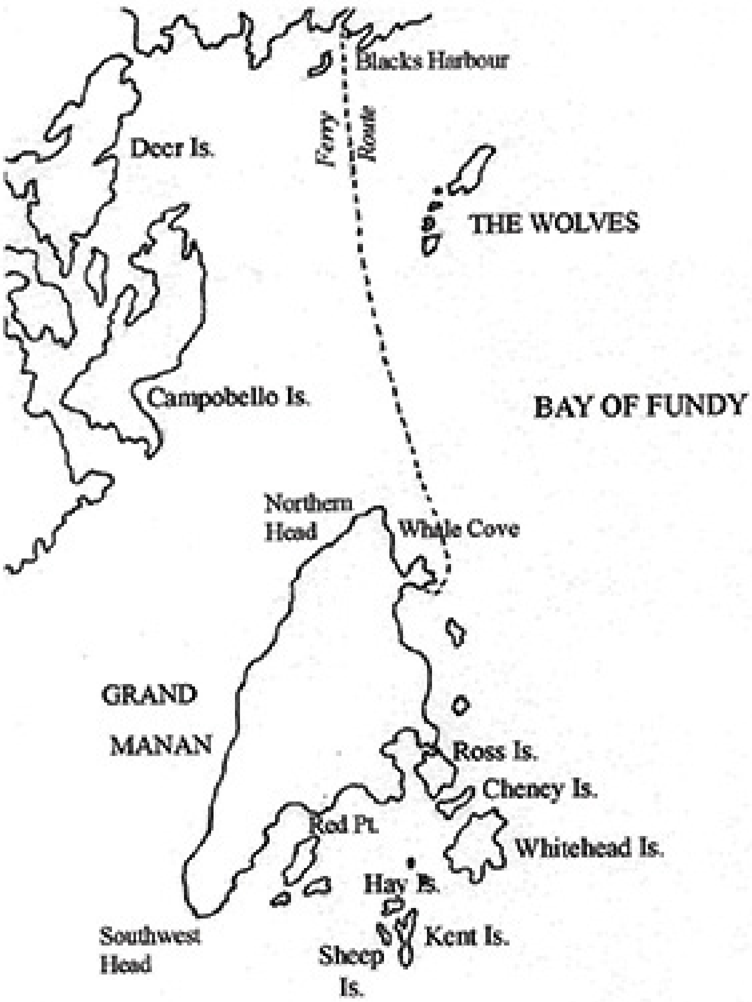
Map 2. Routes of Expeditions of James Robb,
Loring Woart Bailey, and James Alexander



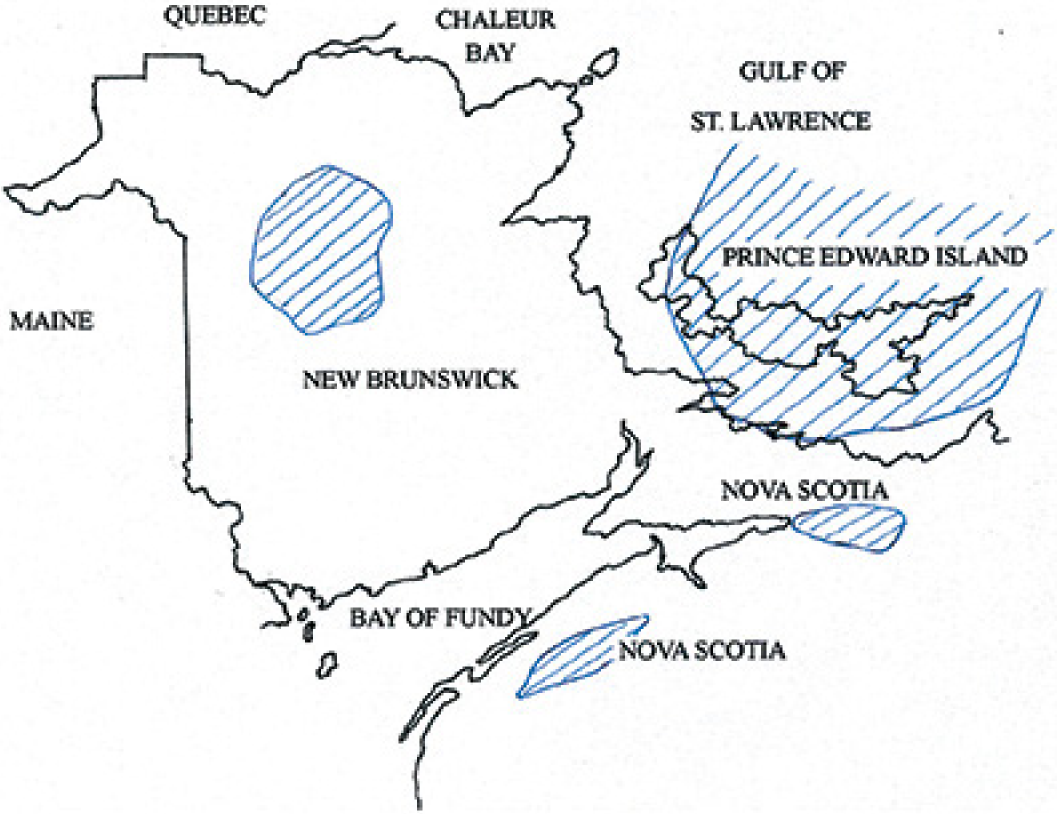
Map 3. Routes of Expeditions of George Upham Hay



Map 4. Marshes of the Upper Bay of Fundy



Map 5. The Grand Manan Archipelago



Map 6. Position of New Brunswick Ice Caps

Endnotes

1. *Senecio pseudoarnica* is also found in southern Nova Scotia near Yarmouth and on Sable Island.

2. M. L. Fernald, "Persistence of Plants in Unglaciated Areas of Boreal America," *Memoirs of American Academy of Arts and Science* 15, no. 3 (1925): 241–342. See also M. L. Fernald, "The Geographic Affinities of the Vascular Flora of New England, the Maritime Provinces and Newfoundland," *American Journal of Botany* 5, no. 5 (1918): 219–47.

3. Laura J. Snyder, *The Philosophical Breakfast Club* (New York: Broadway Books, 2011), 113-14.

4. There are several excellent accounts of continental drift. See Robert A. Fensome and Graham L. Williams, eds., *The Last Billion Years* (Halifax: Atlantic Geoscience Society and Nimbus Publishing, 2001), 52–114. There is an easily readable account in Simon Winchester, *Krakatoa* (New York: Harper Collins, 2003). An account of particular interest to Maritime readers on both continental drift and plants is Stephen R. Clayden, "History, Physical Setting and Regional Variation of the Flora," in Harold R. Hinds, *The Flora of New Brunswick*, 2nd ed. (Fredericton, NB: University of New Brunswick, 2000), 25–73. See also Richard Corfield, *The Silent Landscape: The Scientific Voyage of HMS Challenger* (Washington: Joseph Henry, 2001).

5. The earth's crust is made up of a series of plates which constantly move in relation to each other.

6. Clayden, "History, Physical Setting and Regional Variation," 35–73.

7. Letter from Port Royal in Acadia in Reuben Gold Thwaites, ed., *Jesuit Relations and Allied Documents II Travels and Explorations of the Jesuit Missionaries in New France 1610–1791* (Cleveland, IL: The Burrows Company, 1896); and Reuben Gold Thwaites, ed., *Jesuit Relations and Allied Documents IV Acadia and Quebec 1612–14* (Cleveland, IL: The Burrows Company, 1899), 78.

8. Keith Thomas, Man and the Natural World (New York: Pantheon Books, 1983), 194.

9. Richard Henry Bonnycastle, *The Canadas in 1841* (London: Henry Colburn, 1841, republished by the Social Science Research Council of Canada 1968), 141. Bonnycastle (1791–1847) was commanding royal engineer in Upper Canada 1837–1839, and later in Newfoundland. He wrote a number of papers and books on Canada, including *The Canadas in 1841*, 2 vols., and *Newfoundland 1842: A Sequel to the Canadas in 1841* (London: Henry Colburn, 1842).

10. James E. Alexander. *L'Acadie or Seven Years' Explorations in British North America*, vol. 2 (London: Henry Colburn, 1849), 78.

11. Thomas Baillie, "Map of the Province of New Brunswick in Illustration of a Report of the Commissioner of Crown Lands and Forests," 1829. Public Archives of Canada, Map Division. I am indebted to D. Murray Young for this reference.

12. William Francis Ganong, "Notes on the Natural History and Physiography of New Brunswick, 23. Forestry Problems in New Brunswick," Natural History Society of New Brunswick *Bulletin* (hereafter NHSNB) 18 (1900): 239.

13. A. Leith Adams, *Field and Forest Rambles with Notes and Observations on the Natural History of Eastern Canada* (London: Henry S. King & Co., 1873), 290.

14. Broad statements of this kind were often made by travellers when they first arrived in this country. The French collector Eugène Bourgeau, for instance, was impressed by the majestic forests and prairies, but his first impression was one of the paucity of species relative to the vastness of the area. Marcel Raymond, "Bourgeau, Eugène," *Dictionary of Canadian Biography* (hereafter *DCB*) X, 81-82.

15. Both David Douglas and Robert Fortune were well known plant collectors (Douglas in BC [Douglas Firs] and Fortune in China). Fortune sent good varieties of tea plants to the British East India Company who established the lucrative tea trade between India and Britain.

16. The vasculum, first used in 1704, was a flattened oval tin box used to carry collected plant specimens. See David Elliston Allen, *The Naturalist in Britain: A Social History*

(London: Allen Lane, 1976), 6. The vasculum has been replaced in modern times by the plastic bag. Cartridge paper is used to mount pressed and dried plants for further study. Occasionally taken into the field together with the plant press, it is more frequently used in the herbarium.

17. H. P. Biggar, ed., *Voyages of Jacques Cartier 1491–1527*, no. 11 (Ottawa: Public Archives of Canada, 1924). See also W. D. Hamilton and S. A. Spray, eds., *Source Materials Relating to the New Brunswick Indian* (Fredericton, NB, 1976), 19: "[N]ot the smallest plot of ground bare of wood and even of sandy soil, but is full of wild wheat, that has an ear like barley and the grain like oats, as well as of peas as thick as if they had been sown and hoed; of white and red currant bushes, of strawberries, of raspberries, of white and red roses and of other plants of a strong pleasant odor likewise there are many fine meadows with useful herbs."

18. Luc Chartrand, Raymond Duchesne and Yves Gingras, *Histoires des Sciences au Quebec* (Montreal: Les Editions Boreal, 1987), 45.

19. Marc Lescarbot, *Nova Francia: A Description of Acadia in 1606*, translated by P. Erondelle, (1609; reprint New York and London: Harper Bros, 1928), 34. "Anneda" is frequently thought to be white cedar, but its identity has been the subject of much discussion and even today is not known. See Raymond Duchesne, essay review, HSTC *Bulletin*, vol. V, no. 2 (18), (May 1981), 160.

20. Ethel M. G. Bennett, "Hébert, Louis," *DCB* I, 367.

21. W. F. Ganong suggests the "wild onions" were chives (*Allium schoenoprasum*). See W. F. Ganong, "The Identity of the Animals and Plants Mentioned in the Early Voyages to Eastern Canada and Newfoundland," Royal Society of Canada (hereafter RSC) *Proceedings and Transactions* 3rd ser., vol. III, sect. II, no. 5 (1910): 227.

22. Thwaites, *Jesuit Relations and Allied Documents III Travels and Explorations*, 259. The Chiquebi root was undoubtedly the groundnut (*Apios tuberosa*). *Apios tuberosa* is now known as *Apios americana*.

23. Ibid., 67. The "walnut" was almost certainly butternut and not walnut.

24. Nicolas Denys, *Description and Natural History of*

the Coasts of North America, edited by W. F. Ganong, (Toronto: The Champlain Society, 1908), 149.

25. Lescarbot, *Nova Francia*, 305.

26. Denys, *Description and Natural History*, 107.

27. Lescarbot, *Nova Francia*, 297.

28. Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana, IL: University of Illinois Press, 1970), 81. For an account of the Parisian apothecary Louis Hébert, see Bennett, "Hébert, Louis," 367–68.

29. Chartrand, et al., *Histoires des Sciences au Quebec*, 45, quoting Jacques Rousseau, appendix of *L'histoire véritable de la Nouvelle France* de Pierre Boucher.

30. John Evelyn, *Diary of John Evelyn, 1641–1706*, edited by William Bray, (London: Frederick Warne & Co. Ltd., 1818), 47.

31. B. Boivin, "Botany History," *Canadian Encyclopedia*, vol. I (Edmonton: Hurtig Publishers Ltd., 1985), 206.

32. Stearns, *Science in the British Colonies*, 47. See also fn. on p. 81, citing Jacques Rousseau. See also "Michel François Gaultier et l'Etude Prelinnéene de la Flora Canadienne," *Colloques Internationeaux du Centre National de la Recherche Scientifique* (Paris, 11–14 Septembre, 1956), 150–51, and Chartrand, et al., *Histoires des Sciences au Quebec*, 45.

33. Stearns, *Science in the British Colonies*, footnote 81, quoting Jacques Rousseau, "Michel Sarrazin, Jean François Gaultier et l'étude prelinnéene de la Flora Canadienne, Les Botanistes Français en Amèrique du Nord avant 1850," *Colloques Internationeaux du Centre*, 150–51.

34. Boivin, "Botany History," 206.

35. Denys, *Descriptions and Natural History*, 120.

36. Ibid., 199.

37. Ibid., 149.

38. Jacques Phillippe Cornut, *Canadensium Plantarum Historia* (Paris, 1635, reprint New York and London: Johnson, 1966).

39. Jean Robin, botanist to King Henry IV, established a medicinal garden at the eastern end of Île Notre Dame in Paris. Plants from this garden formed the nucleus of a new garden purchased in 1636, for Louis XIII. Vespasian Robin was

the curator of this garden. See Adrien Davy de Virville, *Histoire de la Botanique en France*, (Paris, Nice: La Comité Français du VIIIe Congrès International de Botanique, 1954), 33. See also Edward Hyams, *Great Botanical Gardens of the World* (London: Thomas Nelson & Sons Ltd., 1969), 83. The name of the Jardin Royal des Plantes Medicinales was changed to the Jardin Royal des Plantes in 1718 and to Jardin des Plantes after the revolution.

40. C. LaFlamme, "Jacques Phillippe Cornuti—Note Pour Server à l'Histoire des Sciences au Canada," RSC *Transactions*, 2nd ser., vol. II, sect. IV (1901): 57.

41. Virville, *Histoire de la Botanique en France*, 48. Lobel's classification was based on leaf structure.

42. Stearns, *Science in the British Colonies*, 82.

43. H. Trevor Levere and Richard A. Jarrell, eds., *A Curious Field Book: Science and Society in Canadian History* (Toronto: Oxford University Press, 1974), 4.

44. Alan G. R. Smith, *Science and Society in the Seventeenth Century* (London: Thames and Hudson, 1972), 84.

45. John Clarence Webster, ed., *Acadia at the End of the Seventeenth Century: Letters, Journals, and Memoirs of Joseph Robineau du Villebon 1690–1700*, Monographic Series No. 1 (Saint John, NB: New Brunswick Museum, 1934, reprinted 1979), 127.

46. Sieur de Dièreville, *Relation of the Voyage to Port Royal in Acadia, New France*, edited by John Clarence Webster, (Toronto: The Champlain Society, 1933).

47. Ibid., 189.

48. Jacques Rousseau, "Dièreville," *DCB* II,188.

49. The Diervilla was named in Latin in the unwieldy manner of the time, *Diervilla acadiensis fruticosa, flora luteo, Habitat in Acadia Noveboraco* (Acadian shrubby Diervilla, yellow flowers, habitat in Acadia, New York). See Dièreville, *Relation of a Voyage to Port Royal*, 3. *Chelone glabra* was named by Linnaeus in his *Species Plantarum* 1735. See Rousseau, 'Dièreville," 188–89.

50. Webster, *Acadia at the End of the Seventeenth Century*, 116.

51. Marie Claire Pitre and Denise Pelletier, *Les Pays Bas, Histoire de la Region Jemseg-Woodstock sur la Rivière*

Saint-John Pendant la Période Française (1604–1759) (Fredericton: Sociétié d'Histoire de la Rivière Saint-John, 1985), 102, fn. 4.

52. Ibid., 191.

53. Chartrand, et al., *Histoires des Sciences au Quebec*, 42.

54. Pehr Kalm, *Peter Kalm's Travels in North America*, edited and revised by Adolph B. Benson, 2 vols. (The English version of 1770; New York: Dover Publications, 1966), 374. Since La Galissonière sent troops to erect a fort at the mouth of the St. John River in 1749, it seems probable that plants would have been collected there. See Webster, *Acadia at the End of the Seventeenth Century*, 210. For an account of La Galissonière's interest in Acadia and his general interest in the advancement of botany and other sciences, see Étienne Taillemite, "Barrin de la Galissonière, Roland Michel Marquis de la Galissonière," *DCB* III, 26–32.

55. C. Laflamme, "Michel Sarrazin: Materiaux pour server à l'histoire de la science en Canada," RSC Transactions 1st ser. , vol. II, sect. IV, no. 5 (1887): 2.

56. Kalm, *Peter Kalm's Travels*, II, 505. Galissonière's deep interest in botany brought him into contact with the celebrated botanist Bernard de Jussieu, and he is also credited with making a botanic garden for himself at Nantes. See Taillemite, "Barrin de la Galissonière," *DCB* III, 30–31.

57. Ken Donovan, "A Letter from Louisbourg 1758," *Acadiensis* (Autumn 1980): 115.

58. Levere and Jarrell, *Curious Field Book*, 38, quoting a letter from Gaultier to Guettard, Quebec, 21 October 1752 (Paris Archives du Canada: Bibliothèque du Museum, Manuscrit), 293. P.A.C. copy, trans.

59. George Herriot, *Travels Through the Canadas* (London, 1807, reprinted Toronto: M.G. Hurtig Ltd., 1971), 225.

60. Bernard Boivin, "La Flore du Canada in 1708," *Provancheria* 9 (1978). The manuscript was found by the Quebec botanist Frère Marie Victorin, who also went to the *Jardin de Plantes* in Paris to find actual specimens referred to in the document.

61. Ibid.

62. Ibid., 225.

63. Ibid., 226.

64. Edmund Berkeley and Dorothy Smith Berkeley, *The Life and Travels of John Bartram from Lake Ontario to the River St. John* (Tallahasee: University of Florida Press, 1982), 165, quoted from John Bartram to Peter Collinson, Bartram Papers, 1, no. 36, The Historical Society of Pennsylvania.

65. W. F. Ganong, "An Outline of Phytobiology with Special Reference to the Study of its Problems by Local Botanists and Suggestions for a Biological Survey of Acadian Plants," NHSNB *Bulletin* XII (1894): 13.

66. David B. Quinn, *North America from the Earliest Discovery to First Settlements: the Norse Voyages to 1612* (New York: Harper and Row, 1977), 393, 400, 409. See also Virginia S. Effert, *Tall Trees and Far Horizons* (New York: Dodd Mead & Co., 1965), 15–16.

67. John Josselyn, *New England Rarities*, Edward Tuckerman, ed. (London, 1672; Boston, 1865). See also John Josselyn, *Account of Two Voyages*, Collections of the Massachusetts Historical Society (III), 211–396 (Republished Cambridge, MA: E. W. Metcalf & Co., 1833). His comment on "masculine virtue" probably referred to the strength of medicine derived from New England plants. Masculine virtue probably meant having stronger medicinal properties.

68. John Tradescant the younger, for instance, imported many plants from Virginia in 1637. Together with his father, he had a famous garden in Lambeth, a part of London, and also a natural history museum which attracted many visitors. Their large collections, known as "Tradescant's Ark," were later incorporated into the Ashmolean Museum at Oxford. See Stearns, *Science in the British Colonies*, 49. John Tradescant probably introduced the Swamp Maple (*Acer rubrum*) and the Butternut (*Juglans cinerea*) to Britain. See Stearns quoting Gunther, *Early British Botanists*, 333, in fn., p. 49.

69. Stearns, *Science in the British Colonies*, 94.

70. For information on John Bartram, see Henry Savage, *Lost Heritage* (New York: William Morrow and Co. Inc., 1970). See also David Scofield Wilson, *In the Presence of Nature* (Amherst, MA: University of Massachusetts Press, 1978). For information on Clayton, Petiver, Mitchell and Collinson, see Edmund Berkeley and Dorothy Smith Berkeley,

John Clayton (Chapel Hill: University of North Carolina, 1963). On John Clayton and John Bartram, see Sarah P. Stetson, "The Traffic in Seeds and Plants from England's Colonies in North America," *Agricultural History* XXIII (1949): 50–56. Also Stearns, *Science in the British Colonies*, 195–98. This is a good source of general information.

71. Stearns, *Science in the British Colonies*, 205.

72. Ibid., 210.

73. Today many of these American species can still be found in the garden at the Bishop's Palace, Fulham, London.

74. For information on Mitchell, see Stearns, *Science and the British Colonies*, 539–54, and on Clayton, see Berkeley and Berkeley, 554–59.

75. See Berkeley and Berkeley, *John Clayton*, 111. See also Stearns, *Science in the British Colonies*, 261.

76. James Petiver (1663–1718), a member of the Royal Society and a London apothecary, was a plant collector *par excellence*. Together with fellow members of the Temple Coffee House Botany Club in London, he assiduously cultivated friendships with ship's captains, colonials and travellers, encouraging them to bring or send botanical specimens to Britain. Sometimes he acted as a liaison between collectors in the field and the European scientific community. See Stearns, *Science in the British Colonies*, 261. Unfortunately, his passion for acquiring specimens left him little time to preserve and classify them. See Allen, *Naturalist in Britain*, 37. For an account of Peter Collinson's activities, see Stearns, *Science in the British Colonies* 515. A common plant of our Maritime forests, the Bunchberry (*Cornus canadensis*) was introduced into England by Collinson. See Ippolito Pizzetti and Henry Crocker, *Flowers For Your Garden* (New York: Abrams, 1975), 308.

77. Stearns, *Science in the British Colonies*, 124.

78. Ibid. See also entries for 15 October 1662 and 5 November 1662 in the *Diary of John Evelyn*, 289, 290.

79. Thomas, *Man and the Natural World* (New York: Pantheon Books, 1983), 199.

80. Stearns, *Science in the British Colonies*, 124.

81. Thomas, *Man and the Natural World*, 199.

82. Savage, *Lost Heritage*, 221. See also Frederick Brendel, "Historical Sketch of the Science of Botany in

North America from 1635–1840." *American Naturalist* 12 (1879): 751–61.

83. John Claudius Loudon, *In Search of English Gardens: The Travels of John Claudius Loudon and his wife, Jane* (London: Century, 1990), 160.

84. Ray Desmond, *Kew: The History of the Royal Botanic Gardens* (London: Harvill Press with the Royal Botanic Gardens, Kew, 1995), 125.

85. For a description of the lack of special scientific training in the English universities, see Lynn Barbour, *The Heyday of Natural History 1820–1870* (London: Jonathan Cape, 1980), 30. See also Michael Ruse, *The Darwinian Revolution* (Chicago: University of Chicago Press, 1979), 19–21 for a description of the general state of education at Oxford and Cambridge and particularly the emphasis on religious training.

86. Wilfred Blunt, *The Compleat Naturalist, A Life of Linnaeus* (London: Collins, 1971; 1984), 179.

87. Wilfred Blunt, *The Art of Botanical Illustration* (London: Collins, 1950), 146. See also Allen, *Naturalist in Britain*, 29.

88. Herbaria were probably started in the sixteenth century by Lucca Ghini (1490–1556) at Pisa, Italy. See Ernst Mayr, *The Growth of Biological Thought* (Cambridge, MA: Belknap Press, 1982), 166; and also Agnes Arber, *Herbals, Their Origin and Evolution: A Chapter in the History of Botany 1470–1670* (Cambridge: Cambridge University Press, 1912; reprinted 1938), 139.

89. Thomas, *Man and the Natural World*, 84.

90. Charles E. Raven, *John Ray, Naturalist: His Life and Works*, 2nd ed. (Cambridge: Cambridge University Press, 1950), 291.

91. Stearns, *Science in the British Colonies*, 526–27. See also Blunt, *The Compleat Naturalist*, 35, and Gunnar Eriksson, "Linnaeus the Botanist," in Tore Frängsmyr, ed., *Linnaeus, the Man and his Work* (Berkeley: University of California Press, 1983), 64–67, 70.

92. Frängsmyr, *Linnaeus*, 21.

93. Stearns, *Science in the British Colonies*, 566.

94. Allen, *Naturalist in Britain*, 42.

95. A form of the binomial system had been introduced

in 1623 by the Swiss botanist Caspar Bauhin (1560–1624).

96. Blunt, *Compleat Naturalist*, 184.

97. Allen, *Naturalist in Britain*, 31.

98. Bernard de Jussieu arranged the plants in the Trianon garden at Versailles according to the Linnean system at the instigation of Louis XV. See Virville, *Histoire de la Botanique en France*, 66. See also C. L. Porter, *Taxonomy of Flowering Plants* (San Francisco: W. H. Freeman & Co., 1967), 17; and Harold R. Fletcher and William H. Brown, *The Royal Botanic Garden Edinburgh 1670–1970* (Edinburgh: HMSO, 1970), 57.

99. The term "natural," when applied to plant classification, has undergone a change of meaning. Early in the nineteenth century, it meant an arrangement of plants which had similar features and were probably related. After Darwin's theory of evolution had been expounded, it came to mean plants which were linked to each other by having followed the same evolutionary pathway.

100. Stearns, *Science in the British Colonies*, 64, cites an early example, John Goodyear 1592–1664, who was a descriptive botanist with a garden at Droxford, Hants, in England.

101. A student of Linnaeus found a snapdragon with five uniform petals and five spurs. This form bred true and was known as peloria. This was a clear case of a species being changed. Linnaeus could not account for this, but suggested that it might be due to hybridization between *Linaria* and some other plant. See Frängsmyr, *Linnaeus*, 21. See also Eriksson, "Linnaeus the Botanist" in Frängsmyr, *Linnaeus*, 94–95 and D. Briggs and S. M. Walters, *Plant Variation and Evolution* (New York: McGraw Hill, 1969), 23.

102. Abraham Gesner, *New Brunswick; with Notes for Emigrants* (London: Simmonds and Ward, 1847), 168.

103. Nova Scotia was divided into Nova Scotia and New Brunswick in 1784.

104. Charles Morris, "The Saint John River," *Acadiensis* (1903): 120–28.

105. Ibid., 124–125.

106. Hemp was an important product used by the Royal Navy for rope-making and for linseed oil. North America was

a valuable source of supply for many naval supplies—masts, tar, pitch, etc.

107. Morris, "Saint John River," 122. He was obviously referring to the Butternut tree (*Juglans cinerea* L.), which occurs in the St. John River valley.

108. Charles Morris, "A General Description of Nova Scotia, its Natural Produce, Soil, Air, Winds etc. With a Particular Description of the Bay of Fundy," NSARM, MG 100, vol. 200, #9 (1749–1750), 66. Selected pages copied from a transcript of the manuscript held in the Library of the Royal Artillery, Woolwich, England.

109. L. J. F. Brimble, *Trees in Britain* (London: MacMillan & Co., 1946), 256. Napoleon's ship *The Orient* was made from 4,000 towering oak trees. It was sunk at the battle of Aboukir Bay off Egypt.

110. John F. W. Herschel, ed., *A Manual of Scientific Enquiry, Prepared for Her Majesty's Navy: and Adapted for Travellers in General* (London: John Murray, 1849), appendix, 436. A "Hoppus Measure" was a unit of volume obtained from the width of the tree trunk.

111. Ibid., 500.

112. Stearns, *Science in the British Colonies*, 124–25.

113. Graeme Wynn, *Timber Colony* (Toronto: University of Toronto Press, 1981), 20.

114. W. Stewart MacNutt, *New Brunswick, A History: 1784—1867* (Toronto: MacMillan, 1963), 47.

115. Patrick Campbell, *Travels in North America, 1791* 23 (Toronto: The Champlain Society, 1937), 57.

116. Campbell Hardy, *Forest Life in Acadie: Sketches of Sport and Natural History in the Lower Provinces of the Canadian Dominion* (London: Chapman Hall, 1869), 27.

117. Wynn, *Timber Colony*, 20.

118. Howard Temperley, ed., *Gubbins' New Brunswick Journals 1811 and 1813*, no. 1 (Fredericon, NB: New Brunswick Heritage Publications, 1980), 48.

119. Wynn, *Timber Colony*, 24.

120. Ibid., 35.

121. MacNutt, *New Brunswick*, 142.

122. Judith Fingard, "Wentworth, Sir John," *DCB* V, 849.

123. For an account of the problems of the surveyors

of woods in New England, see J. J. Malone, *Pine Trees and Politics: the Naval Stores and Forest Policy in Colonial New England* (Seattle: University of Washington Press, 1965).

124. D. M. Young, "Smyth, George Stracey," *DCB* VI, 429.

125. Wynn, *Timber Colony*, 29–30. A. R. M. Lower, *Great Britain's Woodyard: 1691–1775.* (Montreal: McGill-Queen's University Press, 1973), 22–23.

126. See MacNutt, *New Brunswick*, 151.

127. Bonnycastle, *Canadas in 1841*, 145.

128. The English author Thomas Hardy, familiar with building materials, wrote just after the mid-nineteenth century that "the White Pine … the Pinus Strobus … indigenous … especially to Canada & New Brunswick … is the largest of the pines and firs of commerce, & par excellence the house carpenter's wood. The deals from it are the largest import of woodstuffs. The finest growth is from the entrance of the Gulf of St. Lawrence to Quebec." *The Architectural Notebook of Thomas Hardy* (Dorchester: Dorset Natural History & Archaeological Society 1966), 1. I am indebted to Carolyn Young for directing me to this reference.

129. Peter Fisher, *History of New Brunswick, the First History of New Brunswick 1782–1848* (Government of New Brunswick and William Fisher, 1980, reprint of 1921 ed.), 73.

130. Ibid., 73.

131. R. Chalmers, "Surface Geology: Northern New Brunswick and South Eastern Quebec," *Geological Survey of Canada Report*, Section M (1886): 148–49.

132. Wynn, *Timber Colony*, 139.

133. Ibid.

134. M. A. MacDonald, *Rebels and Royalists: The Lives and Material Culture of New Brunswick's Early English-Speaking Settlers 1758–1783* (Fredericton, NB: New Ireland Press, 1990), 107.

135. The export of hemlock bark was still increasing between 1881and 1883. See H. B. Small, *Canadian Forests, Forest Trees, Timber* (Montreal: Dawson Bros., 1884), 55.

136. Kalm, introduction to *Peter Kalm's Travels*, vii.

137. Savage, *Lost Heritage*. See also D. P. Penhallow, "A Review of Canadian Botany from the First Settlement of

New France to the Nineteenth Century," RSC Transactions 1st ser., pt. 1, vol. 5, sect. IV (1887): 45–61.

138. Savage, *Lost Heritage*, 221.

139. Ibid., 231.

140. Stetson, "Traffic in Seeds and Plants," 47. Patrick O'Brien, *Joseph Banks, A Life* (Chicago: University of Chicago Press, 1987), 57–58.

141. Levere and Jarrell, *Curious Field Book*, 8.

142. Richard A. Jarrell, "Masson, Francis," *DCB* V, 580–81.

143. Harold R. Fletcher, *The Story of the Royal Horticultural Society 1804–1968* (Oxford: Oxford University Press for the Royal Horticultural Society, 1969), 100. See also "Douglas, David," *DCB* in collaboration with M. C. Tyrrwhitt-Drake, "Douglas, David," *DCB* VI, 218.

144. A. M. Lysaght, J*oseph Banks in Labrador and Newfoundland 1766. His Diary Manuscripts and Collections* (Berkeley: University California Press, 1971), 142. See also Charles Lyte, *Sir Joseph Banks: 18th century Explorer, Botanist, and Entrepreneur* (Newton Abbott, Devon: David and Charles, 1980), 24.

145. Lyte, *Joseph Banks*, 33. Among the plants that Joseph Banks introduced into Britain are two that are common in the Maritime region. They are Rhodora (*Rhodendron canadense*) and the Swamp Laurel (*Kalmia polifolia*). See Frederick Brendel, "Historical Sketch of the Science of Botany, 759.

146. G. M. Story, "Eppes Cormack, William," *DCB* IX, 158–62. See also George Lawson, "Notes on Some Nova Scotian Plants," Nova Scotia Institute of Natural Science *Transactions* 4, no. 2 (1875–1876): 167–79.

147. Fletcher and Brown, *Royal Botanic Garden Edinburgh*, 66.

148. Patrick Campbell, *Travels in North America 1791* (Toronto: Champlain Society, 1937), 59.

149. G. U. Hay, "John Goldie, Botanist," RSC *Transactions* 2nd series, pt. II, vol. 3, sect. IV (1897): 125–30. A list and descriptions of plants collected by Goldie in Canada in 1819 was presented to the Edinburgh Philosophical Society by Dr. Hooker. Among the plants listed is *Swertia deflexa*

known today as *Halenia deflexa*, the Spurred Gentian, with the habitat given as the "shores of the St. Lawrence, near its mouth," but the precise location is not tabulated. This plant occurs in Nova Scotia, New Brunswick, and Quebec.

150. John Goldie, *Diary of a Journey through Upper Canada and some of the New England States, 1819* (Toronto: [privately published, 1967), ix.

151. W. J. Hooker, *Flora Boreali-Americana* (London: Henry G. Bohm, 1840), microform.

152. W. J. Hooker spelled Kendall's name with a single l. Variation in the spelling of names was frequent at that time.

153. See Alfred G. Bailey, ed., *The Letters of James and Ellen Robb* (Fredericton, NB: Acadiensis Press, 1983), 8. See also Judith F. M. Hoeniger, "Drummond, Thomas," *DCB* VI, 222, and also "Douglas, David," *DCB* IV, 218, *DCB* in collaboration with M. L. Tyrrwhitt-Drake. There is a description of a harrowing experience Kendall shared with three famous Scottish botanists and naturalists—David Douglas, Thomas Drummond, and John Richardson—when their boat was caught in a storm in Hudson's Bay off York Factory and driven seventy miles out into the bay.

154. John Franklin, *Narrative of a Second Expedition to the Shores of the Polar Sea in the Years 1825, 1826, 1827* (New York: Greenwood Press, 1969), x.

155. Ibid., Appendix IV, cxxiii–cxxviii. Members of this expedition carried with them two floras, De Candolle's *Philosophy of Plants* and Wahlenberg's *Flora Upsaliensis*, as well as a "considerable quantity of cartridge paper, to be used in preserving specimens of plants." See John Warkentin, *Geological Lectures by Dr. John Richardson, 1825–26* (Ottawa: National Museums, 1979), 5.

156. In 1838, Kendall returned to Britain hoping to get his captaincy and an appointment to the survey of the Bay of Fundy, but he became superintendent of the West Indian Mail Steamship Line and later of the Peninsular and Oriental Steam Packet Company. See letter from James Robb to W. J. Hooker, 6 February 1838, in North American Letters, LXII ff, 243–44, Royal Botanic Gardens Archives, Kew. See also Clive Holland, "Kendall, Edward Nicholas," *DCB* VII, 464.

157. H. J. Scoggan in *The Flora of Canada* notes that

this Trillium was in Fowler's 1885 list of New Brunswick plants. It appears to have been extirpated from the province since that time. Kendall also found the Indian Cucumber-root (*Medeola virginiana*), the Bellwort (*Uvularia sessilifolia*), the Clubmoss (*Lycopodium dendroidium*), and the Hay-scented fern (*Dicksonia piliuscula* Willd., synonymous with *Dennstaedtia punctilobula* Michx.).

158. "Letter from the Secretary of State for the Colonies written on behalf of the British Museum," *The Royal Gazette* (23 May 1838).

159. In 1929, the surgeon Nathaniel Bagshaw Ward discovered that plants would grow well in an enclosed glass case provided that the soil was reasonably moist. This terrarium revolutionized the transport of plants from one part of the world to another at a time when long sea voyages and poor conditions on board ship led to large losses. The preservation of seeds and plants had long plagued plant collectors. In the mid-eighteenth century, the Royal Society in cooperation with the Governor of Georgia experimented with different methods of preservation. They sent seven packages, all differently wrapped and in only one was the fecundity of the seeds unaltered—that in which the seeds had been coated in beeswax and then in brewers loam moistened in a solution of gum-arabic. See Stearns, *Science in the British Colonies*, 334.

160. Herschel, *Manual of Scientific Enquiry*, XII, 420–36.

161. Ibid., 416–37.

162. A. G. Bailey, *Letters of James and Ellen Robb*, 90.

163. Alexander, *L'Acadie*, 27.

164. Ibid., 126.

165. Ibid., 115, 126.

166. Ibid., 257.

167. Plants living in nutrient poor, boggy conditions are often short of nitrogen. Charles Darwin carried out a series of experiments on insectivorous plants, including the Pitcher Plant. He discovered that the watery fluid in the pitchers contained enzymes that broke down the bodies of the flies and thus made the nitrogen rich nutrients available to the plants. James Alexander's observation was correct in that a certain kind of mosquito and also certain midge larvae inhabit the

cup of the pitcher plant. They appear to have evolved in such a way that the enzymes present in the fluid do not break down their tissues.

168. George Lawson, "Botanical Science—Record of Progress," *Canadian Naturalist* I, no. 1 (1864): 1.

169. See Chapter 1 of this study.

170. See Fletcher, *Story of the Royal Horticultural Society*, 78. See also D. Murray Young, *The Colonial Office in the Early Nineteenth Century* (London: Longmans, 1961), 87. At one point Sir Joseph Banks wrote to the Secretary of Treasury asking for help in sending botanical collectors to different places. See *British Parliamentary Sessional Papers 1821*, vol. 374, 21, 37. Top ranking civil servants with an interest in botany, such as Joseph Sabine, William Hay, and John Barrow, were able to work from within the administration to provide support for botanists in later years.

171. Fletcher, *Story of the Royal Horticultural Society*, 78; also Stearns, *Science in the British Colonies*, 102–103; and Lucille Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (New York: Academic Press, 1979), 83–4.l.

172. Hooker suggested that it was only necessary to address the specimens to "Hooker, Kew." See director of Kew's *Annual Report to Parliament 1851*, quoted in Brockway, *Science and Colonial Expansion*, 77.

173. Raymond, "Bourgeau, Eugène," *DCB* X, 81–82. Bourgeau had previously been the curator for the well known botanical collector Phillip Webb, in Paris.

174. Joseph A. Kastner, *Species of Eternity* (New York: Alfred A. Knopf, 1977), 284.

175. This was of particular significance since the type specimens of many species, necessary for comparative purposes, were housed in various European herbaria. This was true not only of plants obtained by the early collectors, but also the collections of Lewis and Clark, Menzies, Douglas, and the various Arctic expeditions sent out from Britain. See American Academy of Arts and Sciences, *Memorial of Asa Gray* (Cambridge, MA: Boston University Press, 1888), 16.

176. Hunter Dupree, "Thomas Nuttall's Controversy with Asa Gray," *Rhodora* 54 (1952): 196.

177. William Cobbett, *Advice to Young Men and (Incidentally) to Young Women, in the Middle and Higher Ranks of Life* (London: W. Cobbett, 1829), para. 142–47.

178. Letter from James Robb to Sir William Hooker, 24 June 1839, *North American Letters*, LXIII, 399.

179. At Toronto, agriculture and botany were divided into two academic chairs. See Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University Toronto Press, 1987), 206. A chair of botany was established at McGill University in 1857, but by 1859, it had reverted to natural history and under G. W. Dawson encompassed a broad sweep of disciplines—botany, palaeobotany, geology, zoology. See Zeller, *Inventing Canada*, 222–23. In 1858, George Lawson was appointed to Queen's University as chemistry professor. See Zeller, *Inventing Canada*, 228. James Fowler was appointed Queen's University's first professor of botany in 1892. At Acadia University, the first professor of biology was appointed in 1903, while the horticultural school opened in 1894. Economic botany and horticulture were taught there. This school was the forerunner of the provincial Agriculture College at Truro. See Ronald Stewart Longley, *Acadia University 1838–1938* (Wolfville, NS: 1939), 102.

180. This was an estimate made by Prof. W. G. Farlow of Harvard. See Eugene Cittadino, "Ecology and the Professionalization of Botany in America, 1890–1905," in *Studies in History of Biology*, vol. 4, ed. William Coleman and Camille Limoges (Baltimore: Johns Hopkins University Press, 1980), 195, fn. 11.

181. Letter from Robb to Hooker, 24 June, 1839, *North American Letters*, 399. See also letter from Robb to Hooker, 6 February 1838, North American Letters, LXII (no. 124 old index), ff. 243-44.

182. *Synopsis of the System of Education Established by the University of King's College, Fredericton, New Brunswick* (Fredericton, NB: John Simpson, Queen's Printer, 1838).

183. Letter from James Robb to his mother [Elizabeth Paterson], 6 May 1839. Box 1, File 1, Robb Letters, Letter #7, James Robb Papers, UA RG 62, Harriet Irving Library, University of New Brunswick Archives (hereafter UNBA).

184. A. G. Bailey, *Letters of James and Ellen Robb*, 16.

185. James Hannay, *History of New Brunswick*, I (Saint John, NB: John A. Bower, 1909), 402-05.

186. Bailey, Alfred, "Robb, James," *DCB* IX, 666.

187. James Robb, *Agricultural Progress Considered with Special Reference to New Brunswick* [New Brunswick Provincial Government Report] Fredericton, NB: J. Simpson, 1856), 378.

188. Robb found the Torrey and Gray flora useful as he stated in a letter to Hooker, having found all the plants of the Fredericton area in it. He could not obtain copies of it for students' use because it was out of print. See letter from Robb to Hooker, 14 June 1839, North American Letters, LXIII, 399. Robb ordered Herschel's *Manual* in 1850. See A. G. Bailey, *Letters of James and Ellen Robb*, 102.

189. These sentiments were expressed in a letter home. See note in Ganong Manuscript Collection, Box 27, Pkt. R., New Brunswick Museum Archives (hereafter NBMA). See also L. W. Bailey, "Dr. James Robb. A Sketch of His Life and Labours," (Saint John, NB: Barnes & Co.), reprint of NHSNB *Bulletin* 16 (1898).

190. Hyams, *Great Botanical Gardens of the World*, 83-84.

191. [James Robb's Scientific Notes taken at the University of Paris], 1836. James Robb Papers, UA RG 62, UNBA.

192. Letter from James Robb to Sir William Hooker, 26 June 1836, North American Letters, XLV, 184.

193. See note in Ganong Manuscript Collection, Box 37, Pkt. R, NBMA.

194. A. G. Bailey, *Letters of James and Ellen Robb*, 32.

195. F. J. Toole, "The Scientific Tradition," in *University of New Brunswick Memorial Volume* (Fredericton, NB: University of New Brunswick, 1950), 70.

196. A. G. Bailey, *Letters of James and Ellen Robb*, 38.

197. "Proceedings of the British Association for the Advancement of Science—report." *American Journal of Science and the Arts* 41(1841): 55–56.

198. Ibid. See also A. G. Bailey, *Letters of James and Ellen Robb*, 106, 118, 128.

199. See Ernest Boesiger, "Evolutionary Biology in France at the Time of the Evolutionary Synthesis," in *The Evolutionary Synthesis*, ed. Ernst Mayr and William B. Provine (Cambridge, MA.: Harvard University Press, 1980), 309–21. Boesiger suggests that vitalistic ideas permeated much of French thought of the period and became so embedded that they were still prevalent in the first half of the twentieth century. The "vitalists" expressed a reaction to the mechanistic approach adopted by the Cartesians and other French philosophers and scientists of a slightly earlier time.

200. The Wernerian Society members originally supported "Neptunism" in which the rocks were formed by deposition out of aqueous solution under a vast ocean. They gradually changed their ideas to Catastrophism.

201. The ideas of the Uniformitarians had first been proposed by the Scottish agriculturalist, philosopher, and doctor Robert Hutton, who maintained that the earth was very old and was undergoing a continual renewal and decay process. He further maintained that the evidence was all around us.

202. Darwin took part in the voyage of the *Beagle* 1831–1836. Darwin's and Wallace's papers proposing the theory of evolution were read before the Linnean Society, London, 1 July 1858. Darwin's *On the Origin of Species* was published in 1859.

203. In Britain, the ideas of natural theology had been given a thrust by the publication of *Natural Theology* (1802) and other writings by the Cambridge professor and theologian William Paley, and by *The Bridgewater Treatises*, a series of papers by different authors, financed through the 1829 will of the eccentric Earl of Bridgewater and specifically written to demonstrate the profound hand of God in design.

204. A. G. Bailey, *Letters of James and Ellen Robb*, 32.

205. Letter from Robb to Hooker, 24 June 1839, North American Letters, LXIII, 399.

206. A. G. Bailey, *Letters of James and Ellen Robb*, 32.

207. Julian Horatia Ewing was an English writer who resided in Fredericton with her husband Capt. Alexander Ewing 1867–1869. Keenly interested in natural history, she was the daughter of Rev. and Mrs. Alfred Gatty. Mrs. Gatty was well known in England for her nature stories and had written a definitive work on British seaweeds.

208. M. H. Blom and T. Blom, *Canada Home, Juliana Horatia Ewing's Letters 1867–9* (Vancouver: University of British Columbia Press, 1983), 43.

209. Joseph Whitman Bailey, *Loring Woart Bailey: The Story of a Man of Science* (Saint John: J. & A. McMillan, 1925), 9.

210. Ibid., 10, 12.

211. Ibid., 40.

212. Ibid., 72.

213. Ibid., 78.

214. Ibid., 89.

215. Ibid.

216. W. F. Ganong pointed out that the mountain Bailey referred to was Mount Sagamook, which was named by Governor Gordon in 1863, the year of Bailey's visit. See W. F. Ganong, "Notes on the Natural History and Physiography of New Brunswick," NHSNB *Bulletin* 17 (1899): 130.

217. L. W. Bailey, "Notes on the Geology and Botany of New Brunswick," *Canadian Naturalist* (1864): 87. *Ledum latifolium* is now known as *Rhododendron groenlandicum*.

218. J. W. Bailey, *Loring Woart Bailey*, 103.

219. Ibid., 104.

220. Letter from George Parkin to Loring Woart Bailey, 29 March 1920, Little Malvern, Worcestershire, England, MS.2.3.683, Bailey Family Collection, MG H 1, UNBA George Parkin was an eminent educator and supporter of the Imperial federation movement of the British Empire and first secretary of the Cecil Rhodes Trust.

221. See C. Mary Young, *The Connell Memorial Herbarium, University of New Brunswick 1838–1985* (Fredericton, NB: University of New Brunswick, 1986), 4, 7.

222. J. W. Bailey, *Loring Woart Bailey*, 115. See also Obituary Notice, RSC *Proceedings and Transactions* (1925): xiv–xvii.

223. Asa Gray, *Darwiniana, Essays and Reviews pertaining to Darwinism*, ed. A. Hunter Dupree (Cambridge, MA: Belknap Press, 1963), 157. Curiously, it was Agassiz's careful studies on glaciation which provided the Darwinists with a satisfactory explanation of the distribution of some plants.

224. Cynthia Eagle Russett, *Darwin in America:*

The Intellectual Response 1865–1912 (San Francisco: W. H. Freeman, 1976), 9. See also Wayne Hanley, *Natural History in America: From Mark Catesby to Rachel Carson* (New York: Quadrangle, 1977), chap. XIII. See also *American Journal of Science 1860*.

225. "An Address on the Duties and Requirements of a College Course Delivered in the Hall of the University of New Brunswick," MS.5.5.3, 1862, Scrap Book [Loring Woart Bailey], Clippings, 1–4. Bailey Family Collection, MG H 1, UNBA.

226. J. W. Bailey, *Loring Woart Bailey*, 65–66.

227. Morris Zaslow, *Reading the Rocks: The Story of the Geological Survey of Canada 1842–1972* (Toronto: MacMillan & Co., with the Department of Energy Mines and Resources and Information Canada, 1975), 124.

228. D'Urban was an English botanist who worked temporarily for the Geological Survey in 1858. See Zaslow, *Reading the Rocks*, 557.

229. W. F. Ganong, "The Nascent Forest of the Miscou Beach Plain," *Botanical Gazette* 2, no. XLII (1906): 82.

230. Zaslow, *Reading the Rocks*, 54.

231. J. W. Bailey, *Loring Woart Bailey*, 81.

232. R. Chalmers, "Report on Surface Geology of Western New Brunswick with Special Reference to the Area Included in York and Carleton Counties," Geological Survey of Canada *Report*, Section GG (1882–1883–1884): 44–45.

233. Ibid.

234. R. Chalmers, "Report on Surface Geology of Eastern New Brunswick, North Western Nova Scotia and a Portion of Prince Edward Island," Geological Survey of Canada *Report* (1894): 139–41.

235. These plant specimens are known as voucher specimens because they provide proof of the existence of these plants in one particular place at one particular time.

236. L. Kellner, *Alexander von Humboldt* (London: Oxford University Press, 1963), 12–15, 54, 93–95.

237. Joseph D. Hooker, "Outlines of the Distribution of Arctic Plants," *Canadian Naturalist and Geologist* 3 (1868): 325–62.

238. See Obituary of George F. Matthew by L. W. Bailey, RSC *Proceedings* (1923): viii.

239. G. F. Matthew, "The Occurrence of Arctic and Western Plants in Continental Acadia," *Canadian Naturalist and Quarterly Journal of Science* New Ser., 4, no. 2 (1869): 139–66. Matthew had relied on information supplied by James Fowler and Rev. J. P. Sheraton for Kent County, Bailey for York County, and Matthew for St. John and Kings Counties. On his journey through the northern highlands, he used notes by Bailey and by Fowler of Dalhousie and the report of G. L. Goodale of Maine Scientific Survey.

240. Charles Darwin, *The Origin of Species and the Descent of Man* (New York: Modern Library; reprinted from 1859), 285.

241. Matthew, "The Occurrence of Arctic and Western Plants," 139.

242. "Report of the Royal Society of Canada on Matthew's Paper," *Canadian Record of Science* Section 2 (1886–1887): 427.

243. J. Fowler, "Arctic Plants Growing in New Brunswick, with Notes on their Distribution," RSC *Transactions* 1st ser., vol. 5, sect. IV (1887): 189–205. The observations of both Matthew and Fowler were similar to those made by Joseph Banks in Newfoundland when, in 1766, he discovered alpine plants growing close to the sea rather than on the hilltops as he would have expected. Banks suggested that since the snow melted later close to the sea because of the offshore cold currents, the climate there was conducive to alpines. See Lysaght, *Joseph Banks in Newfoundland and Labrador*, 142.

244. Gail MacMillan, "Faith of Our Fathers," *Atlantic Advocate* (October 1980): 64–65.

245. Ibid.

246. Letter from Fowler to Bailey, 8 June 1865, Ganong Collection, Box 23, Pkt. 7, NBMA. Fowler requested plants of the Tobique region from Bailey.

247. Letter from Fowler to Bailey, 23 February 1867, Ganong Collection, Box 23, Pkt. 7, NBMA.

248. Ibid.

249. G. U. Hay, "The Flora of New Brunswick," RSC *Transactions* 1st ser., vol. 11, sect. IV (1893): 47.

250. Ibid.

251. Letter from Fowler to Bailey, 23 February 1867.

252. J. Fowler, "List of the Plants of New Brunswick," *Report of the Secretary for Agriculture (1878)* (Fredericton, NB: 1879), Appendix B.

253. For instance, Fowler wrote to the Buffalo Society of Natural Sciences, communicating frequently with George William Clinton, president of that society, who also helped him with identification. I am indebted to Stephen Clayden for this information. Stephen Clayden wrote an excellent article on Rev. James Fowler, *DCB* XV, 376–77. Fowler also communicated with Asa Gray, who later recommended him for a post at Queen's University.

254. Ibid.

255. MacMillan, "Faith of Our Fathers," 64. At Queen's, Fowler carried on his collecting and endowed their herbarium with many specimens. See Hilda Neatby, *Queen's University*, vol. I, 1841–1917 (Montreal: McGill Queen's University Press, 1978), 164.

256. NHSNB *Bulletin* 1 (1882): 17.

257. James Fowler, "Preliminary List of Plants of N.B.," NHSNB *Bulletin* 4 (1885): 8–84.

258. John M. Macoun was employed by the Geological and Natural History Survey for this purpose from 1882–1913.

259. John M. Macoun, *Autobiography of a Canadian Explorer and Naturalist 1831–1920*, 2nd ed. (Ottawa: Ottawa Field-Naturalists' Club, 1979).

260. Report of the Committee on Botany, NHSNB *Bulletin* 19 (1901): 350.

261. John M. Macoun, *Catalogue of Canadian Plants: Part I, Polypetaleae*, Geological and Natural History Survey of Canada (Montreal: Dawson Bros., 1883), Preface vi.

262. "Report from the New Brunswick Natural History Society," RSC *Transactions* LXV, 2nd ser. (1896): 65.

263. W. Austin Squires, *The History and Development of the New Brunswick Museum (1842–1945)*, (Saint John, NB: New Brunswick Museum, 1945), 13.

264. James Fowler, "A Visit to St. Andrews, N.B. with a Catalogue of Plants Collected in its Vicinity," *Miramichi Natural History Association Proceedings* II (1901): 21–28.

265. Ibid.

266. Squires, *History and Development of the New Brunswick Museum*, 11.

267. Ibid., 13.

268. G. U. Hay, "Botany on the Upper St. John River," NHSNB *Bulletin* 2 (1883): 23.

269. "Report on the Committee for Botany," NHSNB *Bulletin* 1 (1882): 18.

270. "Report on the Committee for Botany," NHSNB *Bulletin* 27 (1909): 154.

271. "Report on the Committee for Botany," NHSNB *Bulletin* 1 (1882): 74.

272. Hay, "Flora of New Brunswick," 48.

273. See Mary Sanger, "William Francis Ganong, Regional Historian," MA Thesis, University of Maine, 1980, 84.

274. C. A. Weatherby and John Adams, "A List of the Vascular plants of Grand Manan, Charlotte County, New Brunswick," *Contributions to the Gray Herbarium of Harvard University* 157 (1945): 13.

275. Letter from James Vroom to L. W. Bailey, 15 August 1881, Ganong Collection, Box 13, Pkt. 8, NBMA.

276. Hay, "Botany of the Upper St. John River," 119.

277. Ibid.

278. W. Austin Squires, *A Naturalist in New Brunswick* (Saint John: New Brunswick Museum, 1972), 17.

279. G. F. Matthew, "Dr. George U. Hay," Obituary, 1913, RSC *Proceedings and Transactions* 3rd ser., 7 (1914), xix–xxi. See also Stephen R. Clayden, "Hay, George Upham," DCB XIV: 459–61.

280. His degrees are listed in "Acadia University Blue Books," Acadia University Archives.

281. C. H. McLean, comp., *Prominent People of New Brunswick* (Saint John, NB: Biographical Society of Canada, 1937), xxxiii.

282. Hay, "Botany of the Upper St. John River," 21–30.

283. On many journeys, he was accompanied by Robert Chalmers and/or William Francis Ganong.

284. Ganong, "Notes on the Natural History and Physiography of New Brunswick," 39. "On the Physiography of the Basin of the Negoot, or South Tobique Lakes," NHSNB *Bulletin* 19, no. 4 (1901): 326.

285. G. U. Hay, "The Restigouche with Notes especially on its Flora," NHSNB *Bulletin* 14 (1896): 12–35.

286. Ibid., 21.

287. G. U. Hay, "Some Features of the Flora of Northern New Brunswick," RSC *Transactions* 2nd series, vol. 8, sect. IV (1902): 125–34.

288. Thomas Baillie, Surveyor General, "Map of the Province of New Brunswick in Illustration of a Report of the Commissioner of Crown Lands and Forests dated Aug. 1st 1829," Map Division, Public Archives of Canada. I am indebted to D. Murray Young for this information.

289. Hay, "Some Features of the Flora of Northern New Brunswick," 132.

290. G. U. Hay, "The South Tobique Lakes," NHSNB *Bulletin* 22 (1902): 474.

291. Ibid., 481.

292. George Benjamin Woods, *English Poetry and Prose of the Romantic Movement* (Chicago: Scott, Foresman, 1929).

293. Alfred Tennyson, *In Memoriam* (London: MacMillan, 1905), 56, st. 4.

294. Hay, "South Tobique Lakes," 474.

295. Ibid., 423.

296. A collection of pressed dried plants.

297. A. E. Roland and E. C. Smith, *The Flora of Nova Scotia* (Halifax, NS: The Nova Scotia Museum, 1969), 286, states that the personal herbarium of G. U. Hay is found at Acadia University; however, there are only fifty to sixty plants collected by Hay housed at Acadia. "The History of Acadia Herbarium," 1946, by Harlan P. Banks, states that the herbarium was begun in 1910 with an initial gift of a small collection made by G. U. Hay of Saint John, New Brunswick. These were mostly collected in 1877, and a few plants collected by J. Fowler were included. I am indebted to Ruth E. Newell, Assistant Curator of the E. C. Smith Herbarium at Acadia University, for this information, personal communication, 2 November 1987. Most of the plants collected by Hay appear to be at the New Brunswick Museum.

298. Clayden, "Hay, George Upham," 459–61. Hay contacted L. H. Bailey of Cornell University and W. Deane of

Harvard on vascular plants and others on algae and fungi.

299. "Report of the Committee on Botany," NHSNB *Bulletin* 10 (1890): 61.

300. "Report of the Botanical Committee," NHSNB *Bulletin* 6 (1887): 79.

301. W. F. Ganong, "An Outline of Phytobiology with Special Reference to the Study of its Problems by Local Botanists and Suggestions for a Biological Survey of Acadian Plants," NHSNB *Bulletin* 12 (1894): 1–15.

302. Ibid., 13.

303. E. Gorham, "Titus Smith: A Pioneer of Plant Ecology in North America," *Ecology* 36 (1955): 116–23.

304. G. U. Hay, "Memorial Sketch of John Moser," NHSNB *Bulletin* 26 (1908): 46. A. C. Chute, rev., *Records of the Graduates of Acadia University, 1843–1926* (Wolfville, NS: [Associated Alumni of Acadia University], 1926). John Moser and G. U. Hay, comps., "List of Mosses in New Brunswick," NHSNB *Bulletin* 16 (1898): 23.

305. Weatherby and Adams, "A List of the Vascular Plants of Grand Manan," 13. H. F. Perkins, "The Flora of Blissville," *Saint John Gazette* (8 March 1894). H. F. Perkins, "Preliminary List of Plants Found Growing on Grand Manan," NHSNB *Bulletin* 13 (1895): 105.

306. "Report on the Committee for Botany," NHSNB *Bulletin* 13 (1895): 105. James Vroom, "Trees and Forests," *Saint John Daily Sun* (2 August 1897).

307. G. U. Hay and A. H. MacKay, "List of the Marine Algae of the Maritime Provinces, with Notes," RSC *Transactions* sect. IV, no. 5 (1887): 170–74.

308. G. U. Hay, "Report on the Botany of the Summer Camp 1898," NHSNB *Bulletin* 16 (1898): appendix, 70–71.

309. In 1829, a London doctor, Nathaniel Bagshaw Ward, was observing moth pupae in an enclosed glass jar. He noted a grass and a fern growing successfully in the same container. He then devised a mini-greenhouse in which he sent plants to Australia. These Wardian cases revolutionised the transport of living plants from one part of the world to another.

310. Hay, "Botany of the Upper St. John River," 30. See also C. Mary Young, "Pteridomania," *New Brunswick Naturalist* 19, no. 3 (1992): 34–35. See also Harold R. Hinds,

"Rare New Brunswick Plants, The Hart's Tongue Fern in New Brunswick—Is it a Hoax?" *New Brunswick Naturalist* 12, no. 1 (1983): 14–16.

311. "Report on the Committee for Botany," NHSNB *Bulletin* 25 (1907): 563.

312. "Report, Fredericton Natural History Society," NHSNB *Bulletin* 16 (1898): 84.

313. George Inch's specimens are located at the New Brunswick Museum and at the University of New Brunswick.

314. This information is from the Connell Memorial Herbarium, University of New Brunswick.

315. "Report King's County Natural History Society," NHSNB *Bulletin* 16 (1898): 85.

316. "Annual Report Miramichi Natural History Association," RSC *Transactions* (1899): xcv.

317. "Annual Report Miramichi Natural History Association," RSC *Transactions* (1901): Appendix B, iv. Richard A. Jarrell, "Science Education at U.N.B. in the Nineteenth Century," Acadiensis II, no. 2 (1973): 66.

318. Philip Cox, a science teacher at Newcastle, was the first student at the University of New Brunswick to obtain a Ph.D. at that institution. See Katherine F. C. MacNaughton, *The Development of the Theory and Practice of Education in New Brunswick, 1784–1900; A Study in Historical Background* (Fredericton, NB: University of New Brunswick Historical Studies, 1947), 248.

319. B. Boivin, "Survey of Canadian Herbaria," *Provancheria* 10 (1980): 3. *Proceedings of the Miramichi Natural History Association* 4 (1905): 56.

320. *Proceedings of the Miramichi Natural History Association*, donations for 1903–1904. An aye-aye is a small lemur-like nocturnal mammal.

321. *Proceedings of the Miramichi Natural History Association*, 6 (1911): 29. L. J. Tweedie, "Opening Address," *Proceedings of the Miramichi Natural History Association*, 7 (1913): 62.

322. See G. U. Hay, ed., *Educational Review* (1888), 1, 8, 159.

323. A. G. Bailey, *Letters of James and Ellen Robb*,

110, 118.

324. See "The Meetings of the British Association for the Advancement of Science," *Canadian Record of Science* 7, (1896–1897): 397. See also J. W. Bailey, *Loring Woart Bailey*, 117.

325. Matthew, "Dr. George U. Hay," Obituary, xix-xxi. See also Stephen R. Clayden, "Fowler, James," *DCB* XV: 376 77.

326. NHSNB *Bulletin* 23 (1905): 382.

327. D. E. Allen, "The Natural History Society in Britain through the Years," *Archives of Natural History* 14, no. 3 (1987): 245.

328. Charles G. D. Roberts, "Tantramar Revisited" in *The Book of Canadian Poetry*, ed. A. J. M. Smith (Chicago: University of Chicago Press, 1943), 179.

329. Hay, "South Tobique Lakes," 474-75.

330. See "The Tantramar Revisited," in Squires, *A Naturalist in New Brunswick*, 65.

331. For information on William Francis Ganong, see Stephen R. Clayden, "William Francis Ganong," *New Brunswick Museum News*, Special Supplement (Fall 1991): 1-4 and Sanger, "William Francis Ganong, Regional Historian." See also Alison Mitcham, *Three Remarkable Maritimers* (Hantsport, NS: Lancelot Press, 1985).

332. Squires, *History and Development of the New Brunswick Museum*, 13.

333. Cittadino, "Ecology and the Professionalization of Botany in America, 1890–1905," 189.

334. Hay, "Botany of the Upper St. John River," 22.

335. Cittadino, "Ecology and the Professionalization of Botany in America, 1890–1905," 189.

336. Ibid. Cittadino suggests that there was a gradual move away from classical taxonomy at the end of the 1800s and that ecological analyses were a logical outcome of laboratory physiological studies.

337. Henry C. Cowles had himself written a classic paper in 1899 on the ecology of the sand dunes of Lake Michigan. See William S. Cooper, "Henry Chandler Cowles," *Ecology* XVI, no. 3 (1899): 282. Cittadino, "Ecology and the Professionalization of Botany in America, 1890–1905," 189.

338. W. F. Ganong, "The Vegetation of the Bay of Fundy

Salt and Dyked Marshes. An Ecological Study," *Botanical Gazette* (September 1903): 161–85.

339. Ibid.

340. W. F. Ganong, "Upon Raised Peat Bogs in the Province of New Brunswick," RSC *Transactions* 2nd ser., vol. III, sect. IV (1897): 131–63.

341. Ericaceous plants are those that belong to the family Ericaceae, which includes the heathers and Labrador Tea.

342. W. F. Ganong, "Notes on the Natural History and Physiography of New Brunswick. 7. On Halophytic Colonies in the Interior of New Brunswick," NHSNB *Bulletin* 16 (1898): 50–51.

343. "Report of the King's County Natural History Society," NHSNB *Bulletin* 17 (1899): 179.

344. W. F. Ganong, "The Nascent Forest of the Miscou Beach Plain," *Botanical Gazette* XLII, no. 2 (August 1906): 81–106.

345. Ibid., 99.

346. Ibid., 105.

347. W. F. Ganong, "Notes on the Natural History and Physiography of New Brunswick. 23. Forestry Problems, 227.

348. Kellner, *Alexander von Humboldt*, 36.

349. W. F. Ganong "Notes on the Natural History and Physiography of New Brunswick. 69. The Forestry Situation in New Brunswick," NHSNB *Bulletin* 21 (1903): 88–92.

350. A forest reserve of approximately 1,881 square miles had been suggested by Edward Jack, surveyor and Crown Lands official, in 1883. It would have incorporated the headwaters of the Tobique, Nepisiguit, and S.W. Miramichi Rivers. In 1901, the House of Assembly passed a bill authorizing the Governor in Council to set aside land of not over ninety-nine square miles as a reserve. Approximately seventy-two square miles were finally set aside as Mount Carleton Provincial Park in 1973. See Edward Jack, "An Expedition to the Headwaters of the Little South-west Miramichi," *Acadiensis* 5 (1905): 116–51. See also W. F. Ganong, "Notes on the Natural History and Physiography of New Brunswick. 69. The Forestry Situation," 88–92.

351. A. G. Bailey, ed., *The University of New Brunswick Memorial Volume* (Fredericton, NB, 1950), 48.

352. Squires, *History and Development of the New Brunswick Museum*, 15.

353. "Historical Note," *The Acadian Naturalist*, Bulletin on the Natural History Society of New Brunswick, New Series 1 (1943): 3.

354. Squires, *History and Development of the New Brunswick Museum*, 19. This project had been strongly supported by W. F. Ganong and by the inveterate collector of art and of New Brunswick objects, Dr. John Clarence Webster.

355. "Remarks by W. G. Farlow," *Memorial of Asa Gray*, 27. "Remarks by Sereno Watson," Memorial of Asa Gray, 17.

356. See Darwin, *Origin of Species*, 290.

357. "Remarks by W. G. Farlow," *Memorial of Asa Gray*, 43.

358. Asa Gray, "The Origin of Species by Means of Natural Selection," in *Darwiniana*, ed. Dupree, 10.

359. Asa Gray, "Species as to Variation, Geographical Distribution and Succession," in *Darwiniana*, ed. Dupree, 146–68. See also Darwin, *Origin of Species*, 44.

360. Asa Gray, "Species as to Variation, Geographical Distribution and Succession," in *Darwiniana*, ed. Dupree, 146–68, 148.

361. Asa Gray, 156.

362. Ibid., 156.

363. Asa Gray, "Sequoia and its History. The Relation of North America to Northeast Asia and to Tertiary vegetation," in *Darwiniana*, ed. Dupree, V, 169–94.

364. Darwin, *Origin of Species*, 290.

365. Ibid., 290.

366. Asa Gray, in *Darwiniana*, ed. Dupree, 185.

367. A. Hunter Dupree, *Memoirs* VI (American Academy of Arts and Sciences, 1859), 250, 442.

368. Arthur Stanley Pease, "Merritt Lyndon Fernald 1873–1950," *Rhodora* 53, no. 26 (1951): 33–38.

369. "Report on Botany," NHSNB *Bulletin* 12 (1894): 69.

370. "Report of Council on Botany," NHSNB *Bulletin* 22 (1904): 289–90.

371. See the series of papers on Fernald, *Rhodora* 53,

no. 26 (1951), 33–8, 39–43, 44–55, 56–61, 61–65.

372. Arthur Stanley Pease, "The New England Botanical Club, a Half Century Ago and Later," *Rhodora* 53, no. 26 (1951): 100.

373. M. L. Fernald, "Botanizing on the Gaspé Peninsula 1902-1904," *Rhodora* 53, no. 26 (1951): 1–2.

374. Ibid., 2.

375. S. F. Blake, "Notes on the Flora of New Brunswick," *Rhodora* 20, no. 234 (1918): 101–107.

376. Bernice G. Schubert, "Sidney Fay Blake," *Rhodora* 62 (1960): 325–38.

377. Ibid.

378. Fernald, "Botanizing on the Gaspé Peninsula," 3.

379. Blake, "Notes on the Flora of New Brunswick," 101–107. Stephen Clayden suggests that the Laurentian Aster may have arisen as a variety of the more wide-ranging *A. brachyactis*, which along with other plants may have migrated into the St. Lawrence region at the end of the Wisconsin Ice Age. See Stephen R. Clayden, "Annual Coastal Asters in New Brunswick," *Chickadee Notes* 17 (1994): 1-4. [Saint John: New Brunswick Museum].

380. M. L. Fernald and K. M. Weigand, "A Summer's Botanizing in Eastern Maine and Western New Brunswick," *Rhodora* 12 (1910): 101–21.

381. Hay recorded the flowering dates in a series of papers in the NHSNB *Bulletin*. See "Report on Botany," NHSNB *Bulletin* (1894): 70; "Notes on Wild Garden," NHSNB *Bulletin* (1899): 108-113; NHSNB *Bulletin* (1905): 23; NHSNB *Bulletin* (1907): 25; NHSNB *Bulletin* (1909): 27.

382. *Scirpus fluviatilis*, *Scirpus pedicillaris*, and *Scirpus cypericus* var. *pelius*.

383. Fernald and Weigand, "A Summer's Botanizing," 101–21.

384. Ibid., 110.

385. Fernald, "Geographic Affinities of the Vascular Flora," 228. These observations of similarity between Asian and Eastern Canadian plants were not new. M. Sarrazin, the French Medecin du Roi at Quebec, had suggested a similarity in the 1700s. Jesuit priests of the eighteenth century were convinced similar plants, e.g. ginseng, would be found in the two regions. See. C. LaFlamme, "Michel Sarrazin," 20. See also Donovan, "A Letter

from Louisburg, 1756," *Acadiensis* (Autumn 1980): 113–30.

386. Fernald, "Persistence of Plants in Unglaciated Areas of Boreal America," 241–342.

387. Fernald, "Geographic Affinities of the Vascular Flora," 219–47.

388. Frère Marie Victorin, *Flore Laurentienne*, rev. E. Rouleau, 2nd ed. (Montreal: Les Presses de l'Université de Montreal, 1935; 1964), 74–75.

389. A. E. Roland and E. C. Smith, *The Flora of Nova Scotia* (Halifax, NS: The Nova Scotia Museum, 1969), 287.

390. Donald Culross Peattie, "Norman Carter Fassett 1900–1945," *Rhodora* 56 (1945): 233–42.

391. Norman C. Fassett, "The Vegetation of the Estuaries of Northeastern North America," Boston Society of Natural History *Proceedings* 39 (1928): 75–130.

392. Mayr and Provine, *Evolutionary Synthesis*, 138. See also Mayr, *Growth of Biological Thought*, 278.

393. Verne Grant, *Plant Speciation* (New York: Columbia University Press, 1971), 55, 150.

394. Cinchona was used to make an anti-malarial drug.

395. Gray, in *Darwiniana*, ed. Dupree, 156.

396. Patrick O'Brien, *The Nutmeg of Consolation* (London: Harper Collins, 1993), 199–200.

397. Weatherby and Adams, "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick," 12.

398. Ibid.

399. Clarence Hinckley Knowlton, "Joseph Richmond Churchill," *Rhodora* 36 (1934): 1–7.

400. M. L. Fernald, "Alfred Charles Weatherby: Botanist and Helper of Botanists," *Rhodora* 51, no. 609 (1949): 169–79.

401. Weatherby and Adams, "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick," 14.

402. Ibid., 5.

403. Abraham Gesner, "First Report on the Geology of Grand Manan," Charles Buchanan, ed. (Grand Manan Historical Society, 1936), reprinted in "Back to the Beginning, Island Geology re-examined," *The Grand Manan Historian* XXIII (1981): 13.

404. Weatherby and Adams, "A List of the Vascular

Plants of Grand Manan, Charlotte County, New Brunswick," 7.

405. Ibid., 84.

406. See Hinds, *Flora of New Brunswick*, 665.

407. See Weatherby and Adams, "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick," 11, 12.

408. Albion R. Hodgon and Radcliffe B. Pike, "Flora of the Wolf Islands, New Brunswick," *Rhodora* 66 (1964): 154. South Wolf Island is the only site in New Brunswick where the Marsh Felwort is known to occur.

409. These islands were investigated by John McCain, Albion R. Hodgdon, and Radcliffe B. Pike. "The Vascular Flora of Kent Island," *Rhodora* 75 (1973): 311–22.

410. Weatherby and Adams, "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick."

411. "Note on Canadian Natural History," *Canadian Journal of Industry, Science, & Art* 3, no. 17 (1858): 461.

412. In New Brunswick, plants had been collected for the Geological Survey by Robert Chalmers and George Upham Hay. See Chapters 5 and 7 of this study.

413. W. H. Collins, "The National Museum of Canada," Department of Mines, Annual Report for 1926, *National Museums of Canada Bulletin* 50 (1928): 39.

414. Robert Campbell, "The Progress of Botany in the Nineteenth Century," *Canadian Record of Science* 9 (1903–16): 42.

415. For botanists this was 1911. See Macoun, *Autobiography of a Canadian Explorer and Naturalist*, 298.

416. Quoted in Zaslow, *Reading the Rocks*, 257.

417. Macoun, *Autobiography of a Canadian Explorer and Naturalist*, 41–43. Dr. Dewey was a specialist on sedges, Dr. Robbins on Potamogetons, and Dr. Englemann on rushes.

418. Ibid., 218. Lawson's own collections were housed at Mount Allison University and in 1951 were presented to the National Museums to add to the National Collection. See Annual Report for 1954–1955, National Museums *Bulletin* 142 (1956): 13.

419. Macoun, *Autobiography of a Canadian Explorer and Naturalist*, 42.

420. George M. Grant, *Ocean to Ocean: Sanford*

Fleming's Expedition through Canada in 1872 (Toronto: James Campbell & Son, 1873), 21.

421. Macoun, *Catalogue of Canadian Plants Part I, Polypetaleae*, 2. Macoun states in the preface, "New Brunswick notices are principally from a catalogue of New Brunswick plants, published in the years 1878–9, by the Rev. James Fowler, M. A., Professor of Natural History, Queen's College, Kingston, Ont., but late Science Master in the Normal School at Fredericton, N. B. The Bulletin of the Natural History Society of New Brunswick for the years 1882–3 contains additional notices both of species and localities."

422. McInnes was a graduate of the University of New Brunswick. While working for the Geological Survey in New Brunswick, he was an assistant to L. W. Bailey. He became director of the Geological Survey of Canada in 1919 and Director of the Victoria Museum, Ottawa, in 1920. See Obituary notice, RSC *Proceedings and Transactions* (1925), xi–xiv. See also Zaslow, *Reading the Rocks*, 132.

423. Zaslow, *Reading the Rocks*, 354. See also Don W. Thomson, Men and Meridians: The History of Surveying and Mapping in Canada. 3 vols. (Ottawa: R. Duhamel, Queen's Printer, 1966–1969), 3, 243–48. It should be noted that Collins carried out yeoman service in the Geological Survey in mapping the geology of the Sudbury nickel-copper belts and in ensuring the expansion of the National Air Photography Library.

424. Collins, "National Museum of Canada," 32–37, 38.

425. J. A. Macoun, "Summary Report," Sessional Paper 26, Geological Survey of Canada (1914): 151.

426. Ibid., 151.

427. See Malte's specimens in the Connell Memorial Herbarium, University of New Brunswick.

428. Duplicate specimens of M. O. Malte's collection from these areas are preserved at the Mount Allison University herbarium. I am indebted to Harold R. Hinds for this information.

429. "Annual Report for 1926," National Museums *Bulletin* (1928): 25.

430. *Annual Report National Herbarium* II, 37 Department of Mines (1927–1928). See also *Annual Report National Herbarium* (1929–1930), III, 37. Malte and Watson

collected 550 plants in 1927 and 600 plants in 1929.

431. Ibid., (1924–1925) National Herbarium 5, 51.

432. Zaslow, *Reading the Rocks*, 356.

433. *National Museums Annual Report* (1949–1950), 20.

434. This was the herbarium at the University of New Brunswick.

435. Stephen Ward, "Historical Collections Ruined by Lack of Cash," *The Independent* (5 August 1988).

436. Zaslow, *Reading the Rocks*, 400.

437. *National Museums Annual Report* 142, (1954–1955, dated 1956), 13.

438. "Annual Report of National Museums Canada for the Fiscal Year 1955–56," *National Museums of Canada Bulletin* 147 (1955–1956): 18.

439. H. J. Scoggan *The Flora of Canada*, 4 vols. (Ottawa: National Museum of Natural Sciences, 1978-1979).

440. The collections are now housed in a new building at Aylmer. I am indebted to Stephen R. Clayden for this information.

441. Archie F. Key, *Beyond Four Walls* (Toronto: McClelland and Stewart, 1973), 224.

442. The museum had been split from the Geological Survey in 1927. The museum was then involved in the display of specimens.

443. Verbal communication from Harold R. Hinds.

444. An examination of duplicate specimens in the University of New Brunswick herbarium revealed the extent of their collections.

445. National Museums' members M. J. Shchepanek and A. W. Dugal carried out an extensive survey of Charlotte County and around the St. Croix River in 1986. In 1989, E. Haber and V. Bristow explored the plant life of north central New Brunswick around the Bald Mountain area.

446. The rift between experimental biologists and field biologists and taxonomists, which is accepted by many historians of science, has occasionally been challenged. Joel B. Hagen cites the work of F. E. Clements, H. M. Hall, and G. Turesson as evidence. Their fieldwork was backed up with experimental transplantation of plants under different

conditions. This, however, was a different kind of laboratory work from the true experimental biologists. See Joel B. Hagen, "Experimentalists and Naturalists in Twentieth Century Botany 1920–1950," *Scientia Canadensis—Journal of the History of Canadian Science, Technology and Medicine* 17, no. 1 (1984): 249–70.

447. Mayr and Provine, *Evolutionary Synthesis*, 177. See also Mayr, *Growth of Biological Thought*, 70, 119, 248.

448. Chartrand, et al., *Histoires des Sciences au Quebec*, 334, quoted from "La Tradition Botanique à Montreal," *Contradictions et Biculture: Communications 1955–1961* (Ottawa: Les Éditions du Jour, [1964]), 78. [Translation: "The recent rise of molecular biology has had the effect of monopolizing the talents and energies (and the financial resources) to the point of threatening progress on other fronts."]

449. The Department of Agriculture was established after a resolution was passed in the House of Commons to "inquire into the best means of encouraging and developing the Agricultural Industries of Canada." See D. P. Penhallow, "The Experimental Farms of Canada," *Canadian Record of Science* 5 (1892–1893): 149.

450. *Canada Agriculture, the First Hundred Years*, History Series, no. 1 (Ottawa: Canada Department of Agriculture, Queen's Printer, 1967), 10.

451. Obituary notice, James Fletcher, RSC *Proceedings and Transactions* 3rd ser., vol. 2 (1909): xlv–xlvii. See also T. H. Anstey, *One Hundred Harvests* (Ottawa: Agriculture Canada, 1987), 20.

452. Anstey, *One Hundred Harvests*, 21.

453. Parliament of Canada, *Sessional Papers* XLI, no. 16 (1906–1907), 65. See also Anstey, *One Hundred Harvests*, 20.

454. Anstey, *One Hundred Harvests*, 20.

455. A. Forster, "The Identity of *Iris Hookeri* and the Asian *I. Setosa*," *Rhodora* 5, no. 54 (1903): 158–59.

456. *Canadian Who's Who* (1937). T. H. Anstey states that Hans Gussow was educated at Breslau, Leipzig and Berlin. See Anstey, *One Hundred Harvests*, 21.

457. Robert E. Radford, *Fundamentals of Plant Systematics* (New York: Harper Row, 1986), 47. This system was widely adopted by many herbaria. It was already in use in

Berlin, the Gray Herbarium at Harvard University, the Arnold Arboretum in Boston, and in Leningrad.

458. Parliament of Canada, *Sessional Papers* LLI, 16–18, no. 9 (1917): 1127.

459. *Report of the Minister of Agriculture* for the year ended 31 March 1945 (Ottawa: Dominion of Canada, 1945), 26.

460. *Report of the Minister of Agriculture* for the year ended 31 March 1939 (Ottawa: Dominion of Canada, 1939), 21.

461. J. M. Swaine, "Scientific Research, the Key to Progress in Agriculture," RSC *Transactions* 3rd ser., 33 (1939): 5.

462. In 1876, the Englishman, coffee grower, and general wanderer in Brazil Henry Wickham offered his services. He was successful in obtaining seeds and in taking them to the Royal Botanic Gardens at Kew. The story has it that he spirited the seeds out of Brazil under the noses of customs officials. In actual fact there were no regulations against exporting seeds at that time. See Desmond, *Kew: The History of the Royal Botanic Gardens*, 253–58.

463. See Wade Davis, *One River, Explorations and Discoveries in the Amazon Rain Forest* (New York: Simon and Schuster, 1996), 300.

464. *Report of the Director of Science Service* for the year 1945 (Ottawa: Canada, Department of Agriculture, 1945), 26.

465. See Davis, *One River*, 300.

466. *Free Press Prairie Farmer*, Winnipeg (21 April 1943).

467. *Report of the Minister of Agriculture* for the year ended 31 March 31 1940, 26.

468. This was a publication of the Natural History Society of New Brunswick under the editorship of R. P. Gorham. He was followed by Herbert Habeeb, a physicist at the University of New Brunswick, who made a special study of mosses. For information on Herbert Habeeb, see Stephen R. Clayden, "Herbert Habeeb," New Brunswick Museum (hereafter NBM) *News* (M/J, J/A, 1989), 3–6.

469. R. P. Gorham, "The Distribution of *Prunus nigra* Ait. in New Brunswick," *Acadian Naturalist* 1 (1943–1944): 43–46.

470. *Report of the Director of Science Service* for year ended 31 March 1950 (Ottawa: Canada, Department of Agriculture, 1950).

471. *Annual Report* for year ended 31 March 1962 (Ottawa: Canada, Department of Agriculture, 1962), 8.

472. *Plant Research Institute* (Ottawa: Canada Agriculture, Queen's Printer, 1969), 1.

473. *Annual Report* for the year ended 31 March 1950 (Ottawa: Canada, Department of Agriculture, 1950), 37, (1954), 40. See also *Annual Report* for the year ended 31 March 1975 (Ottawa: Canada, Department of Agriculture, 1975), 15.

474. *Annual Report* for the year ended 31 March 1962 (Ottawa: Canada, Department of Agriculture, 1962), 8.

475. R. E. Whiting and R. S. W. Bobbette, "The orchid *Listera australis*, rediscovered in Ontario," *Canadian Field Naturalist* 88 (1974): 346–47.

476. William J. Cody and Derek Munro, "The Genus *Listera* (Twayblades) in New Brunswick," *Canadian Field Naturalist* 94 (1980): 443–46.

477. Davis, *One River*, 346–47.

478. *Research Report* (Ottawa: Canada, Department of Agriculture, Plant Research Institute, 1963–1966), 33. This approach is sometimes known as neo-Adanson after the French botanist who first introduced this idea.

479. Ibid.

480. Old methods of determining species are also used. The palaeontologist Richard Fortey, working on fossil trilobites, maintains that the human eye is particularly sensitive for discerning differences and similarities between species. See Richard Fortey, *Trilobites, Witness to Evolution* (London: Harper Collins, 2000), 146.

481. Government of Canada, "Federal Biodiversity Information Partnership Established," http://www.nature.ca/research/system_e.cfm.

482. Archibald Lampman, "The Song Sparrow" in *The Book of Canadian Poetry*, ed. Smith, 187.

483. Squires, *A Naturalist in New Brunswick*, 20, 69.

484. *Nature News*, NBM 33, no. 6 (May–June 1955).

485. W. Austin Squires, "*Impatiens Royalii* in New Brunswick," *Canadian Field Naturalist* 59 (1945): 69.

486. Ibid.

487. Peter A. Pearce, "A Tribute to William Austin Squires 1905–1978," *Canadian Field Naturalist* 94 (1980):

199–201.

488. At the end of the nineteenth century, L. W. Bailey's request for a suitable museum for storage of specimens received an unsympathetic response. See L. W. Bailey, *The Study of Natural History and the Use of Natural Science Museums* (Fredericton, NB: H. Chubb, 1872). By 1931, the "museum" occupied two rooms in the Old Arts Building and was only opened on application to the janitor, with $200 allocated for maintenance of all biological and geological specimens. See Sir Henry Miers and S. F. Markham, *Directory of Museums and Galleries* (London: Museums Association, 1931).

489. Verbal communication with Dr. A. G. Bailey.

490. Verbal communication with Dr. A. R. A. Taylor.

491. C. Mary Young, "A Pioneer of Conservation," *Refuge* 2 (June 1991): 4.

492. Rachel Carson, *Silent Spring* (Cambridge, MA: Riverside Press, 1962), 129–35.

493. R. W. Wein, ed., and D. M. Jones, comp., *Ecological Reserves in New Brunswick* (Fredericton, NB: University of New Brunswick, 1975). See also R. W. Wein, ed., and R. J. Speer, comp., *Ecological Reserves in New Brunswick: 1975 Field Work* (Fredericton, NB: University of New Brunswick, 1975); and P. M. Taschereau, ed., "Ecological Reserves in the Maritimes," *Terminal Report Scientific Advisory Panel*. Region 7. Nova Scotia, New Brunswick, Prince Edward Island (Halifax, NS: Canadian Committee for the International Biological Programme, Conservation of Terrestrial Communities Subcommittee, 1974).

494. Verbal communication with Harold R. Hinds.

495. See *Chickadee Notes, a Series on the Natural History of New Brunswick*, NBM (1993).

496. Stephen R. Clayden and A. D. B. Heward, "Furbish's Lousewort in New Brunswick," *Chickadee Notes, a Series on the Natural History of New Brunswick*, no. 6 ([1993]), 1.

497. Ibid.

498. Patricia Roberts-Pichette, "Annotated Checklist of the Vascular Plants, Collected from the Fredericton Region," Record 6 (Fredericton: New Brunswick Research and Productivity Council, December 1966), 1–76.

499. Patricia Roberts-Pichette, "New Records of Arctic

Species in South-Eastern New Brunswick," *Rhodora* 769 (January–March 1967): 92–93. R. P. Gorham's find had been reported earlier in the *Acadian Naturalist*.

500. Harold R. Hinds, "Rare Plants of New Brunswick: Search for the Alpine Bilberry," *New Brunswick Naturalist* 16, no. 1 (December 1987): 6–7. See also C. Mary Young, "A Case for History," *New Brunswick Naturalist* 16, no. 1 (December 1987): 5–6.

501. Harold R. Hinds, "Importance of the Lower Eel River," Nature Trust of New Brunswick, *Refuge* 5, no. 4 (December 1995): 3–4.

502. Harold R. Hinds, "Annotated Checklist of the Vascular Plants of Carleton County, N.B.," *Journal of New Brunswick Museum* (1980): 120–44. Harold R. Hinds, "Annotated Checklist of the Woody Plants of New Brunswick," Canada Forest Service *Information Report* M-X-103 (1979). Harold R. Hinds, "The Rare Vascular Plants of New Brunswick," National Museum of Canada, *Syllogeous* 50 (1983).

503. Weatherby and Adams, "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick." Charles A. Weatherby and John Adams, *The Flora of the Grand Manan Archipelago*. Rev. by Harold R. Hinds and George H. Flanders (Grand Harbour, NB: Grand Manan Historical Society, 1995).

504. Hinds, *Flora of New Brunswick*.

505. Newfoundland has no provincial flora, but there is a checklist of plants for that province.

506. Stephen R. Clayden, "Information Age Dawns in NBM Herbarium," NBM *Courier and Annual Report* (Fall 1997): 28–29.

507. Andrew MacDougall, "Appalachian Hardwood Forest Conservation Stewardship Project: Phase I," Nature Trust of New Brunswick, *Summary Report* (1997).

508. Ibid. Among the plants discovered were *Desmodium glutinosum*, *Sanicula trifoliata*, and *Botrychium minganense*. More commonly, wild ginger, yellow lady's slipper, maidenhair fern, blue cohosh, and Goldie's fern were also found.

509. Don Cayo, "Exploring Fundy's Untamed Coast," *Canadian Geographic* 114, no. 4 (July 1994): 28–37.

Stephen R. Clayden has been particularly interested in the regional distribution of New Brunswick plants and how past geological and climatic events affected its flora. He has also studied and published information on the ecological zones of the province. See Stephen R. Clayden, "History, Physical Setting and Regional Variation of the Flora" in Hinds, *Flora of New Brunswick*, 35–73.

510. D. M. Britton and J. P. Goltz, "*Isoetes prototypus*, a New Diploid Species from Eastern Canada," *Canadian Journal of Botany* 69, no. 2 (1991): 277–81.

511. James P. Goltz, "The Discovery of the Curly-grass Fern in New Brunswick," *New Brunswick Naturalist* 3 (18 November 1991): 43. See also James P. Goltz and Harold R. Hinds, "*Schizea pusilla*, Curly-grass Fern, an Addition to the Flora of New Brunswick," *The Canadian Field Naturalist* 106 (1992): 372–75.

512. James P. Goltz, "The Need for Preservation of Old Growth Forests," Nature Trust of New Brunswick, *Refuge* 2 (June 1991): 6.

513. Margo Sheppard, "In Awe of Minister's Face," Nature Trust of New Brunswick, *Refuge* 11, no. 2 (July 2001): 1.

514. John Bartlett, *Familiar Quotations*, revised and enlarged by Emily Morison Beck, 14th ed. (Boston: Little Brown, 1968), 829b.

515. Peter J. Bowler, *Evolution: The History of an Idea*, rev. ed. (Berkeley: University of California Press, 1983; 1989), 64.

516. Darwin's theory of evolution was presented before the Linnean Society in July 1858 and was published in book form in August 1859.

517. Desmond Bowen, *The Idea of the Victorian Church: A Study of the Church of England* 1833–1889 (Montreal: McGill University Press, 1969), 153, see fn. 69 quoting from Kingsley, *Letters* II, 123. I am indebted to D. Murray Young for directing me to this reference.

518. G. Kitson Clark, *An Expanding Society, Britain 1830–1900* (Cambridge: Cambridge University Press, 1967), 102. I am indebted to D. Murray Young for directing me to this book.

519. Gray, *Darwiniana*, ed. Dupree, 214.

520. Mayr, *Growth of Biological Thought*, 263.

521. This was true of Joseph D. Hooker even when he agreed with the Darwinian viewpoint. See Charles Singer, *A History of Biology to About the Year 1900* (London and New York: Abelard Schumann, 1962), 558.

522. The concept of the type specimen is based on the description of the first plant of that type found. It is founded on the idea that each species has recognizable essential features. Any one species can be described, defined, and determined. A species exhibits characteristics shared by all others of the same species.

523. For a discussion of the reception of Darwinism in Quebec, see Chartrand, Duchesne and Gingras, *Histoires des Sciences au Quebec*, 159–88.

524. *Canadian Journal of Industry*, Science and Art (1860): 387.

525. *Canadian Journal of Industry*, Science and Art (April 1876): 357.

526. Minute Book, NHSNB, entries for 30 January 1863 and 6 June 1882, NBMA.

527. See Letter from George Matthew to Loring Woart Bailey, 15 January 1862, MS.2.3.216, Bailey Family Collection, MG H 1, UNBA.

528. Stephen R. Clayden, "Fowler, James," *DCB* XV, 376–77, see fn. referring to account of Fowler's career at Queen's written by MacClement (1928).

529. James Fowler, "Botanical Classification," *Queen's Quarterly* III (1895–1896): 269.

530. J. V. Ellis, "President's Address," NHSNB *Bulletin* 20 (1902): 488.

531. Stearns, *Science in the British Colonies*, 13.

532. See A. M. Winchester, *Genetics: A Survey of the Principles of Heredity*, 4th ed. (Boston: Houghton Mifflin, 1972).

533. Ibid.

534. See J. C. Ritchie, *Postglacial Vegetation of Canada* (Cambridge, Cambridge University Press, 1987), 3.

535. Frances E. Mayle and Les C. Cwynar, "Impact of the Younger Dryas Cooling Event Upon Lowland Vegetation of Maritime Canada," *Ecological Monographs* 64, no. 2 (May 1995): 131–54.

536. The genitive of the name of William of Ockham is perhaps more frequently spelled *Occam's razor*: "The principle that in explaining anything no more assumptions should be made than are necessary." "Occam's razor, n.". OED Online. December 2013. Oxford University Press. http://www.oed.com/view/Entry/234636?redirectedFrom=ockham%27s+razor (accessed March 05, 2014).

537. V. C. Wynne-Edwards, "Isolated Arctic-Alpine Floras in Eastern North America: A Discussion of Their Glacial and Recent History," RSC *Transactions*, 3rd ser., vol. 31, sect. V (1937): 33–58; and ibid., "Some Factors in the Isolation of Rare Alpine Plants," RSC *Transactions*, 3rd ser., vol. 33, sect. V (1939): 35–42.

538. See Fensome and Williams, *The Last Billion Years*, 182.

539. See J. K. Morton and Joan M. Venn, *The Flora of Manitoulin Island* (Waterloo: University of Waterloo Biology Series, 2000), 11.

540. See Clayden and Heward, "Furbish's Lousewort in New Brunswick," 3.

541. Ledyard Stebbins, "Concepts of Species and Genera" in *Flora of North America*, I, ed. Flora of North America Editorial Committee (New York: Oxford University Press, 1993), 230.

542. Plants taken from mountainous regions were grown in lowland gardens and examined for changes in habit and size. There was a considerable amount of work on the effect of environment done in 1940 by Jens Clausen, David D. Keck, and William M. Hiesey. The influence of environment was not altogether an original idea. Even centuries before, John Ray (1674) had found "a very great latitude, ... wholly to be imputed to the soil, the season, the climate or some other external circumstances." He illustrates this by transplanting mountain species. See Raven, *John Ray*, 190.

543. An occasional doubt has been thrown on transplant studies for there is always the possibility that plants having a different genetic structure may react with the same environment to produce similar phenotypes—a process known as canalization. See Warren G. Abrahamson and Otto T. Solbrig, "Soil Preferences and Variation in Flavinoid Pigments

in Species of Aster," *Rhodora* 72 (1970): 255, 261.

544. Harold R. Hinds carried out an experiment in which he grew *Aster subulatus* and the variety *Aster subulatus* var. *obtusifolius* under precisely the same conditions. They both retained their individual characteristics. Personal communication with Harold R. Hinds.

545. See Winchester, *Genetics*, 40-41.

546. Marie Victorin, *Flore Laurentienne*, Ernst Rouleau, ed. and rev. (Montreal: Les Presses de l'Université de Montreal, 1964), 77. Marie Victorin made this statement largely because he noticed the number of foreign plants that had found their way by some means or other into North America. Similarly, Hardy, *Forest Life in Acadie*, 18, states: "To the Englishman unaccustomed to northern fir forests and their accompanying flora, the woods are naturally the strangest feature in the country. ... But in the fields and uplands of a thoroughly cleared district he is scarcely reminded of the difference in scene from that to which he has been accustomed. In the pastures he sees English grasses with the buttercup the ox-eye and the dandelion; ... the wild rose and the blackberry, as in English hedgerows."

Bibliography

FLORAS CONSULTED

Flora of North America. vol. I. Edited by the Flora of North America Editorial Committee. New York: Oxford University Press, 1993.

Haines, Arthur, and Thomas F. Vining. *Flora of Maine: A Manual for Identification of Native and Naturalized Vascular Plants of Maine*. Bar Harbor, ME: V. F. Thomas Co., 1998.

Hinds, Harold R. *The Flora of New Brunswick*, 2nd ed. Fredericton, NB: Biology Department, University of New Brunswick, 2000.

Roland, A. E., and E. C. Smith. *The Flora of Nova Scotia*. Halifax, NS: Nova Scotia Museum, 1969.

Scoggan, H. J. *The Flora of Canada*. 4 vols. Ottawa: National Museum of Natural Sciences, 1978–1979.

Victorin, Frère Marie. *Flore Laurentienne*. Edited and revised by E. Rouleau. 2nd ed. Montreal: Les Presses de l'Université de Montréal, 1935; 1964.

Weatherby, Charles A. and John Adams. *The Flora of the Grand Manan Archipelago*. Revised by Harold R. Hinds and George H. Flanders. Grand Harbour, NB: Grand Manan Historical Society, 1995.

Zinck, Marian, Rev. *Roland's Flora of Nova Scotia*. 2 vols. Halifax, NS: Nimbus Publishing and the Nova Scotia Museum, 1998.

ARCHIVAL AND UNPUBLISHED SOURCES

Natural History Society of New Brunswick (NHSNB)

Natural History Society of New Brunswick Minute Book, entries for 30 January 1863 and 6 June 1882.

New Brunswick Museum Archives (NBMA)

Ganong Manuscript Collection

R 2 Box 37. Handwritten Notes on James Robb.

Box 1, Pkt. 2. Letter, G. W. Bailey to W. F. Ganong, 16 March 1931.

Box 13, Pkt. 8. Letter, James Vroom to L. W. Bailey, 15 August 1881.

Box 23, Pkt. 7. Letter, J. Fowler to L. W. Bailey, 8 June 1865.

Box 23, Pkt. 7. Letter, J. Fowler to L. W. Bailey, Bass River, NB, 23 February 1867.

Public Archives of Canada

Baillie, Thomas. "Map of the Province of New Brunswick." 1829. Map Division.

Biggar, H. P., ed. *Voyages of Jacques Cartier 1491–1527*. no. 11. Ottawa: King's Printer, 1924.

Public Archives of Nova Scotia

MG 100, vol. 200, #9, (1749–1750): 66. Morris, Charles. "A General Description of Nova Scotia, its Natural Produce, Soil, Air, Winds etc. with a Particular Description of the Bay of Fundy." Selected pages from a manuscript held in the Library of the Royal Artillery, Woolwich, England.

Royal Botanic Garden Archives, Kew

North American Letters

North American Letters, XLV: 184. Letter, James Robb to Sir William Hooker, 26 June 1836.
North American Letters, LXII: ff. 243–44. Letter, James Robb to W. J. Hooker, 6 February 1838.
North American Letters, LXIII: 399. Letter, James Robb to Sir William Hooker, 24 June 1839.

University of New Brunswick Archives (UNBA)

Bailey Family Collection (MG H 1)

MS.2.3.216. Letter, George Matthew to Loring Woart Bailey, 15 January 1862.
MS.2.3.683. Letter, George Parkin, Little Malvern, Worcestershire, England, to Loring Woart Bailey, 29 March 1920.
MS.5.5.3, Scrap Book [Loring Woart Bailey]. Clippings: 1–4. "An Address on the Duties and Requirements of a College Course Delivered in the Hall of the University of New Brunswick," 1862.

James Robb Papers (UA RG 62)

[James Robb's Scientific Notes Taken at the University of Paris], 1836.
Box 1, File 1, Robb Letters, Letter #7. James Robb to his mother [Elizabeth Paterson], 6 May 1839.

Unpublished Thesis

Sanger, Mary E. T. E., "William Francis Ganong, Regional Historian." MA Thesis, University of Maine, 1980.

PUBLISHED SOURCES

Books

Adams, A. Leith. *Field and Forest Rambles with Notes and Observations on the Natural History of Eastern Canada*. London: Henry S. King and Co., 1873.

Alexander, James E. *L'Acadie or Seven Year's Exploration in British America*. Vol. 2. London: Henry Colburn, 1849.

Allen, David Elliston. *The Naturalist in Britain: A Social History*. London: Allen Lane, 1976.

American Academy of Arts and Sciences, *Memorial of Asa Gray*. Cambridge, MA: Boston University Press, 1888.

Arber, Agnes. *Herbals, Their Origin and Evolution: A Chapter in the History of Botany 1470–1670*. Cambridge: Cambridge University Press, 1912; reprinted 1938.

Bailey, Alfred G., ed. *The University of New Brunswick Memorial Volume*. Fredericton, NB: University of New Brunswick, 1950.

———, ed. *The Letters of James and Ellen Robb*. Fredericton, NB: Acadiensis Press, 1983.

Bailey, Joseph Whitman. *Loring Woart Bailey: The Story of a Man of Science*. Saint John: J. & A. McMillan, 1925.

Bailey, L. W. *The Study of Natural History and the Use of Natural Science Museums: An Address Delivered at the Encoenia of the University of New Brunswick, June 27th, 1872: Being an Appeal for Assistance towards the Establishment of a University and Provincial Museum*. [Fredericton, NB?]: H. Chubb, 1872.

Barbour, Lynn. *The Heyday of Natural History 1820–1870*. London: Jonathan Cape, 1980.

Bartlett, John. *Familiar Quotations*. Revised and enlarged by Emily Morison Beck. 14th ed. Boston: Little Brown, 1968.

Berkeley, Edmund, and Dorothy Smith Berkeley. *John Clayton*. Chapel Hill: University of North Carolina, 1963.

———. *The Life and Travels of John Bartram from Lake Ontario to the River St. John*. Tallahasee: University of

Florida Press, 1982.
Blake, William. *The Complete Poetry and Prose of William Blake*. Edited by David V. Erdman. Newly revised ed. Berkeley and Los Angeles: University of California Press, 1982.
Blom, M. H., and T. Blom. *Canada Home: Juliana Horatia Ewing's Letters 1867–9*. Vancouver: University of British Columbia Press, 1983.
Blunt, Wilfred. *The Art of Botanical Illustration*. London: Collins, 1950.
———. *The Compleat Naturalist: A Life of Linnaeus*. London: Collins, 1971; 1974.
Bonnycastle, Richard H. *The Canadas in 1841*. 2 vols. London: Henry Colburn, 1841; republished by the Social Science Research Council of Canada, 1968.
———. *Newfoundland 1842: A Sequel to the Canadas in 1841*. 2 vols. London: Henry Colburn, 1842.
Bowen, Desmond, *The Idea of the Victorian Church: A Study of the Church of England 1833–1889*. Montreal: McGill University Press, 1969.
Bowler, Peter J. *Evolution: The History of an Idea*. Rev. ed. Berkeley: University of California Press, 1983; 1989.
Briggs, D., and S. M. Walters. *Plant Variation and Evolution*. New York: McGraw Hill, 1969.
Brimble, L. J. F. *Trees in Britain*. London: MacMillan & Co., 1946.
Brockway, Lucille. *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens*. New York: Academic Press, 1979.
Campbell, Patrick. *Travels in North America 1791*. Toronto: Champlain Society, 1937.
Carson, Rachel. *Silent Spring*. Cambridge, MA: Riverside Press, 1962.
Chartrand, Luc, Raymond Duschesne, and Yves Gingras. *Histoires des Sciences au Quebec*. Montreal: Les Editions Boreal, 1987.
Chute, A. C., rev. *Records of the Graduates of Acadia University, 1843–1926*. Wolfville, NS: [Associated Alumni of Acadia University], 1926.
Clark, Kitson G. *An Expanding Society, Britain 1830–1900*. Cambridge: Cambridge University Press, 1967.
Cobbett, William. *Advice to Young Men and (Incidentally) to*

Young Women, in the Middle and Higher Ranks of Life. London: W. Cobbett, 1829.

Corfield, Richard. *The Silent Landscape: The Scientific Voyage of HMS Challenger*. Washington: Joseph Henry, 2001.

Cornut, Jacques Phillippe. *Canadensium Plantarum Historia*. Paris, 1635; reprinted New York: Johnson, 1966.

Dansereau, Pierre. *Contradictions et Biculture: Communications 1955–1961*. Montreal: Les Éditions du Jour, [1964].

Darwin, Charles. *The Origin of Species and the Descent of Man*. New York: Modern Library, reprinted from 1859.

Davis, Wade. *One River, Explorations and Discoveries in the Amazon Rain Forest*. New York: Simon and Schuster, 1996.

Denys, Nicolas. *Description and Natural History of the Coasts of North America*. Edited by W. F. Ganong. Toronto: Champlain Society, 1908.

Desmond, Ray. *Kew: The History of the Royal Botanic Gardens. London*: Harvill Press with the Royal Botanic Gardens Kew, 1995.

Dièreville, Sieur de. *Relation of the Voyage to Port Royal in Acadia*, New France. Edited by John Clarence Webster. Toronto: Champlain Society, 1933.

Dupree, A. Hunter. *Memoirs*. Vol VI. American Academy of Arts and Sciences, 1859.

Effert, Virginia S. *Tall Trees and Far Horizons*. New York: Dodd Mead & Co., 1965.

Evelyn, John. *Diary of John Evelyn, 1641–1706*. Edited by William Bray. London: Frederick Warne & Co., 1818.

Fensome, Robert A., and Graham L. Williams, eds. *The Last Billion Years*. Halifax, NS: Nimbus, 2001.

Fisher, Peter. *History of New Brunswick, the First History of New Brunswick 1782–1848*. [Reprint of the 1921 edition]. The Government of New Brunswick and William Fisher, 1980.

Fletcher, Harold R. *The Story of the Royal Horticultural Society 1804–1968*. Oxford: Oxford University Press for the Royal Horticultural Society, 1969.

Fletcher, Harold R., and William H. Brown. *The Royal Botanic Garden Edinburgh 1670–1970*. Edinburgh: HMSO, 1970.

Fortey, Richard. *Trilobites, Witness to Evolution*. London:

Harper Collins, 2000.
Frängsmyr, Tore, ed. *Linnaeus, the Man and His Work*. Berkeley: University of California Press, 1983.
Franklin, John. *Narrative of a Second Expedition to the Shores of the Polar Sea in the Years 1825, 1826, 1827*. New York: Greenwood Press, 1969.
Ganong, William F. *Historic Sites in the Province of New Brunswick*. St. Stephen, NB: Print'n Press Ltd., 1983.
Gesner, Abraham. *New Brunswick; with Notes for Emigrants*. London: Simmonds and Ward, 1847.
Goldie, John. *Diary of a Journey through Upper Canada and Some of the New England States, 1819*. Toronto: [privately published], 1967.
Grant, George M. *Ocean to Ocean: Sanford Fleming's Expedition through Canada in 1872*. Toronto: James Campbell & Son, 1873.
Grant, Verne. *Plant Speciation*. New York: Columbia University Press, 1971.
Gray, Asa. *Darwiniana, Essays and Reviews Pertaining to Darwinism*. Edited by A. Hunter Dupree. Cambridge, MA: Belknap Press of Harvard University Press, 1963.
Hamilton, W. D., and S. A. Spray, eds. *Source Materials Relating to the New Brunswick Indian*. [Class Notes]. Fredericton, NB: 1976.
Hannay, James. *History of New Brunswick*. Vol. 1. Saint John, NB: John A. Bower, 1909.
Hanley, Wayne. *Natural History in America: From Marc Catesby to Rachel Carson*. New York: Quadrangle, 1977.
Hardy, Campbell. *Forest Life in Acadie: Sketches of Sport and Natural History in the Lower Provinces of the Canadian Dominion*. London: Chapman Hall, 1869.
Hardy, Thomas. *Architectural Notebook of Thomas Hardy*. Dorchester: Dorset Natural History & Archaeological Society, 1966.
Herriot, George. *Travels Through the Canadas*. London, 1807; reprinted Toronto: M. G. Hurtig, 1971.
Herschel, John F. W., ed. *A Manual of Scientific Enquiry, Prepared for Her Majesty's Navy: and Adapted for Travellers in General*. London: John Murray, 1849.
Hooker, W. J. *Flora Boreali-Americana*. [microfilm] London:

Henry G. Bohm, 1840.
Hyams, Edward. *Great Botanical Gardens of the World*. London: Thomas Nelson & Sons, 1969.
Josselyn, John. *Account of Two Voyages: Collections of the Massachusetts Historical Society*. Cambridge, MA: E. W. Metcalf & Co., 1833.
———. New England Rarities. Edited by Edward Tuckerman. London: 1672; Boston: 1865.
Kalm, Pehr. *Peter Kalm's Travels in North America*. Edited and revised by Adolph B. Benson. 2 vols. New York: Dover Publications, 1966.
Kastner, Joseph A. *A Species of Eternity*. New York: Alfred A. Knopf, 1977.
Kellner, L. *Alexander von Humboldt*. London: Oxford University Press, 1963.
Key, Archie F. *Beyond Four Walls*. Toronto: McClelland and Stewart, 1973.
Lescarbot, Marc. *Nova Francia: A Description of Acadia in 1606*. Translated by P. Erondelle 1609. London: Harper Bros., 1928.
Levere, Trevor H., and Richard A. Jarrell, eds. *A Curious Field Book: Science and Society in Canadian History*. Toronto: Oxford University Press, 1974.
Longley, Ronald Stewart. *Acadia University, 1838–1938*. Wolfville, NS, 1939.
Loudon, John Claudius. *In Search of English Gardens: The Travels of John Claudius Loudon and His Wife, Jane*. London: Century, 1990.
Lower, A. R. M. *Great Britain's Woodyard: 1691–1775*. Montreal: McGill-Queen's University Press, 1973.
Lysaght, A. M. *Joseph Banks in Labrador and Newfoundland 1766: His Diary Manuscripts and Collections*. Berkeley: University of California Press, 1971.
Lyte, Charles. *Sir Joseph Banks: 18th-Century Explorer, Botanist, and Entrepreneur*. Newtown Abbott, Devon: David and Charles, 1980.
MacDonald, M. A. *Rebels and Royalists: The Lives and Material Culture of New Brunswick's Early English-Speaking Settlers 1758–1783*. Fredericton, NB: New Ireland Press, 1990.

MacNaughton, Katherine F. C. *The Development of the Theory and Practice of Education in New Brunswick, 1784–1900: A Study in Historical Background*. Fredericton, NB: University of New Brunswick Historical Studies, 1947.

MacNutt, W. Stewart. *New Brunswick, A History: 1784–1867*. Toronto: MacMillan, 1963.

Macoun, John M. *Autobiography of a Canadian Explorer and Naturalist 1831–1920*. 2nd ed. Ottawa: Ottawa Field Naturalists' Club, 1979.

———. *Catalogue of Canadian Plants: Part I, Polypetaleae*. Geological and Natural History Survey of Canada. Montreal: Dawson Bros., 1883.

Malone, J. J. *Pine Trees and Politics: The Naval Stores and Forest Policy in Colonial New England*. Seattle: University of Washington Press, 1965.

Mayr, Ernst. *The Growth of Biological Thought*. Cambridge, MA: Belknap Press, 1982.

Mayr, Ernst, and William B. Provine. *The Evolutionary Synthesis*. Cambridge, MA: Harvard University Press, 1980.

McLean, C. H., comp. *Prominent People of New Brunswick*. [Saint John, NB]: Biographical Society of Canada, 1937.

Miers, Henry, and S. F. Markham. *Directory of Museums and Galleries*. London: Museums Association, 1931.

Mitcham, Alison. *Three Remarkable Maritimers*. Hantsport, NS: Lancelot Press, 1985.

Morton, J. K., and Joan M. Venn. *The Flora of Manitoulin Island*. Waterloo: University of Waterloo, 2000.

Neatby, Hilda. *Queen's University, I: 1841–1917*. Montreal and Kingston: McGill-Queen's University Press, 1978.

O'Brien, Patrick. *Joseph Banks: A Life*. Chicago: University of Chicago Press. 1987.

———. The *Nutmeg of Consolation*. London: Harper Collins, 1993.

Pitre, Marie Claire, and Denise Pelletier. *Les Pays Bas, Histoire de la Region Jemseg-Woodstock sur la Rivière Saint-John Pendant la Période Française (1604–1759)*. Fredericton, NB: Sociétié d'histoire de la Rivière Saint John, 1985.

Pizzetti, Ippolito, and Henry Crocker. *Flowers for Your Garden*. New York: Abrams, 1975.

Porter, C. L. *Taxonomy of Flowering Plants*. San Francisco: W.

H. Freeman & Co., 1967.
Quinn, David B. *North America from the Earliest Discovery to First Settlements: The Norse Voyages to 1612*. New York: Harper & Row, 1977.
Radford, Robert E. *Fundamentals of Plant Systematics*. New York: Harper & Row, 1986.
Raven, Charles E. *John Ray, Naturalist: His Life and Works*. 2nd ed. Cambridge: Cambridge University Press, 1950.
Ritchie, J. C. *Postglacial Vegetation of Canada*. Cambridge: Cambridge University Press, 1987.
Ruse, Michael. *The Darwinian Revolution*. Chicago: University of Chicago Press, 1979.
Russett, Cynthia Eagle. *Darwin in America: The Intellectual Response 1865–1912*. San Francisco: W. H. Freeman, 1976.
Savage, Henry. *Lost Heritage*. New York: William Morrow and Co., 1970.
Singer, Charles. *A History of Biology to About the Year 1900*. London and New York: Abelard Schumann, 1962.
Small, H. B. *Canadian Forests, Forest Trees, Timber*. Montreal: Dawson Bros., 1884.
Smith, Alan G. R. *Science and Society in the Seventeenth Century*. London: Thames and Hudson, 1972.
Smith, A. J. M., ed. *The Book of Canadian Poetry*. Chicago: University of Chicago Press, 1943.
Snyder, Laura J. *The Philosophical Breakfast Club*. New York: Broadway Books, 2011.
Squires, W. Austin. *The History and Development of the New Brunswick Museum (1842–1945)*. Administrative Series, no. 2. Saint John, NB: New Brunswick Museum, 1945.
———. *A Naturalist in New Brunswick*. Saint John, NB: New Brunswick Museum, 1972.
Stearns, Raymond Phineas. *Science in the British Colonies of America*. Urbana, IL: University of Illinois Press, 1970.
Taschereau, P. M., ed. "Ecological Reserves in the Maritimes," *Terminal Report Scientific Advisory Panel*. Region 7. Nova Scotia, New Brunswick, Prince Edward Island. Halifax, NS: Canadian Committee for the International Biological Programme, Conservation of Terrestrial Communities Subcommittee, 1974.

Temperley, Howard, ed. *Gubbins' New Brunswick Journals 1811 and 1813*. No. 1. Fredericton, NB: New Brunswick Heritage Publications, 1980.

Tennyson, Alfred. *In Memoriam*. London: Macmillan, 1905.

Thomas, Keith. *Man and the Natural World*. New York: Pantheon Books, 1983.

Thwaites, Reuben Gold, ed. *Jesuit Relations and Allied Documents: IV Acadia and Quebec 1612–1614*. Cleveland, IL: The Burrows Company, 1896.

———, ed. *Jesuit Relations and Allied Documents: III Travels and Explorations of the Jesuit Missionaries in New France 1610–1791, Acadia, 1610–1613*. Cleveland, IL: The Burrows Company, 1899.

Virville, Adrien Davy de. *Histoire de la Botanique en France*. Paris-Nice: La Comité Français du VIIIe Congrès International de la Botanique, 1954.

Warkentin, John. *Geological Lectures by Dr. John Richardson, 1825–26*. Ottawa: National Museums, 1979.

Webster, John Clarence, ed. *Acadia at the End of the Seventeenth Century: Letters, Journals and Memoirs of Joseph Robineau du Villebon 1690–1700*. Monographic Series, no. 1. Saint John, NB: New Brunswick Museum, 1934; reprinted 1979.

Wein, R. W., ed., and D. M. Jones, comp. *Ecological Reserves in New Brunswick*. Fredericton, NB: University of New Brunswick, 1975.

Wein, R. W., ed., and R. J. Speer, comp. *Ecological Reserves in New Brunswick: 1975 Field Work*. Fredericton, NB: University of New Brunswick, 1975.

Wilson, David Scofield. *In the Presence of Nature*. Amherst, MA: University of Massachusetts Press, 1978.

Winchester, A. M. *Genetics: A Survey of the Principles of Heredity*. 4th ed. Boston: Houghton Mifflin, 1972.

Winchester, Simon. *Krakatoa*. New York: Harper Collins, 2003.

Woods, George Benjamin. *English Poetry and Prose of the Romantic Movement*. Chicago: Scott, Foresman, 1929.

Wynn, Graeme. *Timber Colony*. Toronto: University of Toronto Press, 1981.

Young, C. Mary. *The Connell Memorial Herbarium, University* *of New Brunswick 1838–1985*. Fredericton, NB: University of New Brunswick, 1986.

Young, D. Murray. *The Colonial Office in the Early Nineteenth Century*. London: Longmans, 1961.

Zaslow, Morris. *Reading the Rocks: The Story of the Geological Survey of Canada 1842–1972*. Toronto: MacMillan & Co., 1975.

Zeller, Suzanne. *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation*. Toronto: University of Toronto Press, 1987.

Articles

Abrahamson, Warren G. and Otto T. Solbrig, "Soil Preferences and Variation in Flavinoid Pigments in Species of Aster." *Rhodora* 72 (1970): 255, 261.

Allen, D. E. "The Natural History Society in Britain through the Years." *Archives of Natural History* 14, no. 3 (1987): 245.

"Annual Reports Miramichi Natural History Association." *The Royal Society of Canada Transactions* (1899): xcv; Appendix B (1901): lv.

Bailey, Alfred. "Robb, James" *Dictionary of Canadian Biography* IX: 666.

Bailey, L. W. "Dr. James Robb. A Sketch of His Life and Labours." *Bulletin of the Natural History Society of New Brunswick* 16 (1898): 2.

———. "Notes on the Geology and Botany of New Brunswick." *Canadian Naturalist* (1864): 87.

"Bailey, Loring Woart." Obituary. *Royal Society of Canada Proceedings and Transactions* (1925): xiv–xvii.

Bennett, Ethel M. G. "Hébert, Louis." *Dictionary of Canadian Biography* I: 367–68.

Blake, S. F. "Notes on the Flora of New Brunswick." *Rhodora* 20, no. 234 (1918): 101–107.

Boesiger, Ernest. "Evolutionary Biology in France at the Time of the Evolutionary Synthesis." In *The Evolutionary Synthesis*, edited by Ernst Mayr and William B. Provine, 309–21. Cambridge, MA: Harvard University Press, 1980.

Boivin, B. "Botany History." *Canadian Encyclopedia*. Vol. I.

Edmonton: Hurtig Publishers, (1985): 206–207.
———. “La Flore du Canada in 1708.” *Provancheria* 9 (1978): 225–26.
———. “Survey of Canadian Herbaria.” *Provancheria* 10 (1980): 3.
Brendel, Frederick. “Historical Sketch of the Science of Botany in North America from 1635–1840.” *American Naturalist* 12 (1879): 751–61.
Britton, D. M., and J. P. Goltz. “*Isoetes Prototypus*, a New Diploid Species from Eastern Canada.” *Canadian Journal of Botany* 60, no. 2 (1991): 277–81.
Campbell, Robert. “The Progress of Botany in the Nineteenth Century.” *Canadian Record of Science* 9 (1903–1916): 42.
Cayo, Don. “Exploring Fundy’s Untamed Coast.” *Canadian Geographic* 114, no. 4 (July 1994): 28–37.
Chalmers, R. “Report on Surface Geology of Eastern New Brunswick, North Western Nova Scotia and a Portion of Prince Edward Island.” *Geological Survey of Canada Report* (1894): 139–41.
———. “Report on Surface Geology of Western New Brunswick with Special Reference to the Area Included in York and Carleton Counties.” *Geological Survey of Canada Report* Section GG (1882–1883–1884): 44–45.
———. “Surface Geology: Northern New Brunswick and South Eastern Quebec.” *Geological Survey of Canada Report*, Section M (1886): 148–49.
Cittadino, Eugene. “Ecology and the Professionalization of Botany in America, 1890–1905.” In *Studies in the History of Biology*, vol. 4, edited by William Coleman and Camille Limoges. Baltimore: Johns Hopkins University Press, 1980.
Clayden, Stephen R. “Annual Coastal Asters in New Brunswick.” *New Brunswick Museum Chickadee Notes* 17 (1994): 1–4.
———. “Fowler, James.” *Dictionary of Canadian Biography* XV: 376–77.
———. “Hay, George Upham.” *Dictionary of Canadian Biography* XIV: 459–61.
———. “Herbert Habeeb.” *New Brunswick Museum News*, M/J, J/A (1989): 3–6.
———. “History, Physical Setting and Regional Variation of the Flora.” In *The Flora of New Brunswick*, 2nd ed., edited

by Harold R. Hinds, 35–73. Fredericton, NB: Biology Department, University of New Brunswick, 2000.

———. "Information Age Dawns in NBM Herbarium." *New Brunswick Museum Courier and Annual Report* (Fall 1997): 28–29.

———. "William Francis Ganong." *New Brunswick Museum News*, Special Supplement (Fall 1991): 1–4.

Clayden, Stephen R., and A. D. B. Heward. "Furbish's Lousewort in New Brunswick." *New Brunswick Museum Chickadee Notes*, no. 6 (1993): 1–4.

Cody, William J., and Derek Munro. "The Genus *Listera* (Twayblades) in New Brunswick." *Canadian Field Naturalist* 94 (1980): 443–46.

Collins, W. H. "The National Museum of Canada." Department of Mines, Annual Report for 1926, *National Museums of Canada Bulletin* 50 (1928): 39.

Cooper, William S. "Henry Chandler Cowles." *Ecology* XVI, no. 3 (1899): 282.

Donovan, Ken. "A Letter from Louisbourg 1756." *Acadiensis* (Autumn 1980): 113–30.

Dupree, Hunter. "Thomas Nuttall's Controversy with Asa Gray." *Rhodora* 54 (1952): 196.

Ellis, J. V. "President's Address." *Bulletin of the Natural History Society of New Brunswick* 20 (1902): 488.

Eriksson, Gunnar. "Linnaeus the Botanist." In *Linnaeus, the Man and His Work*, edited by Tore Frängsmyr, 64–70. Berkeley: University of California Press, 1983.

Fassett, Norman C. "The Vegetation of the Estuaries of North-Eastern North America." *Boston Society of Natural History Proceedings* 39 (1928): 75–130.

Fernald, Merritt Lyndon. "Alfred Charles Weatherby: Botanist and Helper of Botanists." *Rhodora* 51, no. 609 (1949): 169–79.

———. "Botanizing on the Gaspé Peninsula 1902–1904." *Rhodora* 53 (1951): 1–2.

———. "The Geographic Affinities of the Vascular Flora of New England, the Maritime Provinces and Newfoundland." *American Journal of Botany* 5, no. 5 (1918): 219–47.

———. "Persistence of Plants in Unglaciated Areas of Boreal America." *Memoirs of American Academy of Arts and Science* 15, no. 3 (1925): 241–342.

Fernald, Merritt Lyndon, and K. M. Weigand. "A Summer's Botanizing in Eastern Maine and Western New Brunswick." *Rhodora* 12 (1910): 101–21.

Fingard, Judith. "Wentworth, Sir John." *Dictionary of Canadian Biography* V: 849.

"Fletcher, James." Obituary. *Royal Society of Canada Proceedings and Transactions*, 3rd ser., 2 (1909): xlv–xlvii.

Forster, A. "The Identity of *Iris Hookeri* and the Asian *I. Setosa*." *Rhodora* 5, no. 54 (1903): 158–59.

Fowler, James. "Arctic Plants Growing in New Brunswick, with Notes on their Distribution." *Royal Society of Canada Transactions*, 1st ser., vol. 5, sect. IV (1887): 189–205.

———. "A Visit to St. Andrews, N.B. with a Catalogue of Plants Collected in its Vicinity." *Miramichi Natural History Association Proceedings* II (1901): 21–28.

———. "Botanical Classification." *Queen's Quarterly* 3 (1895–1896): 269.

———. "List of Plants of New Brunswick." Report of the Secretary for Agriculture (1878). Fredericton, NB,1879.

———. "Preliminary List of Plants of N.B." *Bulletin of the Natural History Society of New Brunswick* 4 (1885): 8–84.

Free Press Prairie Farmer, Winnipeg (21 April 1943).

Ganong, William Francis. "The Identity of the Animals and Plants Mentioned in the Early Voyages to Eastern Canada and Newfoundland." *Royal Society of Canada Proceedings and Transactions*, 3rd ser., vol. III, sect. II, no. 5 (1910): 227.

———. "The Nascent Forest of the Miscou Beach Plain." *Botanical Gazette* XLII, no. 2 (1906): 81–106.

———. "Notes on the Natural History and Physiography of New Brunswick." *Bulletin of the Natural History Society of New Brunswick* 17 (1899): 130.

———. "Notes on the Natural History and Physiography of New Brunswick. 7. On Halophytic Colonies in the Interior of New Brunswick." *Bulletin of the Natural History Society of New Brunswick* 16 (1898): 50–51.

———. "Notes on the Natural History and Physiography of New Brunswick. 23. Forestry Problems in New Brunswick." *Bulletin of the Natural History Society of New Brunswick* 18 (1900): 227 and 239.

———. "Notes on the Natural History and Physiography of

New Brunswick. 39. On the Physiography of the Basin of the Negoot, or South Tobique Lakes." *Bulletin of the Natural History Society of New Brunswick* 19, no. 4 (1901): 326.

———. "Notes on the Natural History and Physiography of New Brunswick. 69. The Forestry Situation in New Brunswick." *Bulletin of the Natural History Society of New Brunswick* 21 (1903): 88–92.

———. "An Outline of Phytobiology with Special Reference to the Study of Its Problems by Local Botanists and Suggestions for a Biological Survey of Acadian Plants." *Bulletin of the Natural History Society of New Brunswick* 12 (1894): 1–15.

———. "Upon Raised Peat Bogs in the Province of New Brunswick." *Royal Society of Canada Transactions*, 2nd ser., vol. III, sect. IV (1897): 131–63.

———. "The Vegetation of the Bay of Fundy Salt and Dyked Marshes. An Ecological Study." *Botanical Gazette* (September 1903): 161–85.

Gesner, Abraham. "First Report on the Geology of Grand Manan." Edited by Charles Buchanan. Grand Manan Historical Society 1936. Reprinted in "Back to the Beginning, Island Geology re-examined." *The Grand Manan Historian* XXIII (1981): 13.

Goltz, James P. "The Discovery of the Curly-Grass Fern in New Brunswick." *New Brunswick Naturalist* 3 (November 1991): 43.

———. "The Need for Preservation of Old Growth Forests." [Nature Trust of New Brunswick] *Refuge* 2 (June 1991): 6.

Goltz, James P., and Harold R. Hinds. "*Schizea pusilla*, Curly-Grass Fern, an Addition to the Flora of New Brunswick." *The Canadian Field Naturalist* 106 (1992): 372–75.

Gorham, E. "Titus Smith: A Pioneer of Plant Ecology in North America." *Ecology* 36 (1955):116–23.

Gorham, R. P. "The Distribution of *Prunus nigra* Ait. in New Brunswick." *Acadian Naturalist* 1 (1943–1944): 43–46.

Hagen, Joel B. "Experimentalists and Naturalists in Twentieth Century Botany 1920–1950." *Scientia Canadensis—Journal of the History of Canadian Science, Technology and Medicine* 17, no. 1 (1984): 249–70.

Hay, G. U. "Botany on the Upper St. John River." *Bulletin of the Natural History Society of New Brunswick* 2 (1883): 23.
———, ed. *Educational Review* (1888).
———. "The Flora of New Brunswick." *Royal Society of Canada Transactions*, 1st ser., vol. 11, sect. IV (1893): 47.
———. "John Goldie, Botanist." *Royal Society of Canada Transactions*, 2nd ser., vol. 3, sect. IV (1897): 125–30.
———. "Memorial Sketch of John Moser." *Bulletin of the Natural History Society of New Brunswick* 26 (1908): 46.
———. "Report on the Botany of the Summer Camp 1898." *Bulletin of the Natural History Society of New Brunswick* 16 (1898): appendix, 70–71.
———. "The Restigouche with Notes Especially on its Flora." *Bulletin of the Natural History Society of New Brunswick* 14 (1896): 25–35.
———. "Some Features of the Flora of Northern New Brunswick." *Royal Society of Canada Transactions*, 2nd ser., vol. 8, sect. IV (1902): 125–34.
———. "The South Tobique Lakes." *Bulletin of the Natural History Society of New Brunswick* 22 (1902): 474.
Hay, G. U., and A. H. MacKay. "List of the Marine Algae of the Maritime Provinces, with Notes." *Royal Society of Canada Transactions*, sect. IV, no. 5 (1887): 170–74.
Hincks, William. "President's Address [to the Canadian Institute]." *Canadian Journal of Industry, Science and Art* (April 1876): 357.
Hinds, Harold R. "Annotated Checklist of the Vascular Plants of Carleton County, N.B." *Journal of the New Brunswick Museum* (1980): 120–44.
———. "Annotated Checklist of the Woody Plants of New Brunswick." *Canada Forest Service Information Report* M-X-103 (1979).
———. "Importance of the Lower Eel River." [Nature Trust of New Brunswick] *Refuge* 5, no. 4 (December 1995): 3–4.
———. "Rare New Brunswick Plants, The Hart's Tongue Fern in New Brunswick—Is it a Hoax?" *New Brunswick Naturalist* 12, no. 1 (1983): 14–16.
———. "Rare Plants of New Brunswick: Search for the Alpine Bilberry." *New Brunswick Naturalist* 16, no. 1 (December 1987): 6–7.

———. "The Rare Vascular Plants of New Brunswick." [National Museum of Canada] *Syllogeous* 50 (1983).

"Historical Note." *The Acadian Naturalist, Bulletin of the Natural History Society of New Brunswick*, New Series 1 (1943): 3.

Hodgdon, Albion R., and Radcliffe B. Pike. "Flora of the Wolf Islands, New Brunswick." *Rhodora* 66 (1964): 154.

Hoeniger, Judith F. M. "Drummond, Thomas." *Dictionary of Canadian Biography*, VI: 222.

Holland, Clive. "Kendall, Edward Nicholas." *Dictionary of Canadian Biography*, VII: 464.

Hooker, Joseph D. "Outlines of the Distribution of Arctic Plants." *Canadian Naturalist and Geologist* 3 (1868): 325–62.

Jack, Edward. "An Expedition to the Headwaters of the Little South-West Miramichi." *Acadiensis* 5 (1905): 116–51.

Jarrell, Richard A. "Masson, Francis" *Dictionary of Canadian Biography*, V: 580–81.

———. "Science Education at U.N.B. in the Nineteenth Century." *Acadiensis* II, no. 2 (1973): 66.

Knowlton, Clarence Hinckley. "Joseph Richmond Churchill." *Rhodora* 36 (1934): 1–7.

LaFlamme, C. "Jacques Phillippe Cornut – Note Pour Server à l'Histoire des Sciences au Canada." *Royal Society of Canada Transactions*, 2nd ser., vol. 2, sect. 4 (1901): 57.

———. "Michel Sarrazin: Materiaux Pour Server à l'Histoire de la Science en Canada." *Royal Society of Canada Transactions*, 1st ser., vol. 5, sect. 4 (1887): 2.

Lawson, George. "Botanical Science—Record of Progress." *Canadian Naturalist* I, no. 1 (1864): 1.

———. "Notes on Some Nova Scotian Plants." *Transactions of Nova Scotia Institute of Natural Science* 4, no. 2 (1875–1876): 167–79.

MacDougall, Andrew. "Appalachian Hardwood Forest Conservation Stewardship Project: Phase 1." Nature Trust of New Brunswick, *Summary Report*, 1997.

MacMillan, Gail. "Faith of Our Fathers." *Atlantic Advocate* (October 1980): 64–65.

Matthew, G. F. "Dr. George U. Hay." Obituary, 1913, *Royal Society of Canada Proceedings and Transactions*, 3rd ser.,

7 (1914), xix–xxi.
———. “The Occurrence of Arctic and Western Plants in Continental Acadia.” *Canadian Naturalist and Quarterly Journal of Science*. New series, 4, no. 2 (1869): 139–66.
“Matthew, George F.” Obituary. *Royal Society of Canada Proceedings and Transactions*, 3rd ser. (1923): viii.
Mayle, Frances E., and Les C. Cwynar. “Impact of the Younger Dryas Cooling Event Upon Lowland Vegetation of Maritime Canada.” *Ecological Monographs* 64, no. 2 (May 1995): 131–54.
McCain, John, Radcliffe B. Pike, and Albion R. Hodgon. “The Vascular Flora of Kent Island.” *Rhodora* 75 (1973): 311–22.
“McInnes, William.” Obituary. *Royal Society of Canada Proceedings and Transactions*, 3rd ser. (1925): xi–xiv.
“The Meetings of the British Association for the Advancement of Science.” *Canadian Record of Science* 7 (1896–1897): 397.
“Michel François Gaultier et l’Etude Prelinéene de la Flora Canadienne.” *Colloques Internationeaux du Centre National de la Recherche Scientifique*. Paris, 1956.
Morris, Charles. “The Saint John River.” *Acadiensis* (1903): 120–28.
Moser, John, and G. U. Hay, comps. “List of Mosses in New Brunswick.” *Bulletin of the Natural History Society of New Brunswick* 16 (1898): 23.
“New Brunswick Museum, Saint John, NB.” *Nature News* (May–June 1955; September–October 1958).
“Note on Canadian Natural History.” *Canadian Journal of Industry, Science and Art* 3, no. 17 (1858): 461.
“Occam's razor, n.” OED Online. December 2013. Oxford University Press. http://www.oed.com/view/Entry/234636?redirectedFrom=ockham%27s+razor (accessed March 05, 2014).
Pearce, Peter A. “A Tribute to William Austin Squires 1905–1978.” *Canadian Field Naturalist* 94 (1980): 199–201.
Pease, Arthur Stanley. “Merritt Lyndon Fernald 1873–1950.” *Rhodora* 53, no. 26 (1951): 33–38.
———. “The New England Botany Club, a Half Century Ago and Later.” *Rhodora* 53, no. 26 (1951): 92–105.
Peattie, Donald Culross. “Norman Carter Fassett 1900–1945.”

Rhodora 56 (1945): 232–42.
Penhallow, D. P. "The Experimental Farms of Canada," *Canadian Record of Science* 5 (1892–1893): 149.
———. "A Review of Canadian Botany from the First Settlement of New France to the Nineteenth Century." Pt.1. *Royal Society of Canada Transactions*, 1st ser., pt. 1, vol. 5, sect. IV (1887): 45–61.
Perkins, H. F. "The Flora of Blissville." *Saint John Gazette* (8 March 1894).
———. "Preliminary List of Plants Found Growing on Grand Manan." *Bulletin of the Natural History Society of New Brunswick* 13 (1895): 105.
"Proceedings of the British Association for the Advancement of Science." *American Journal of Science and the Arts* 41 (1841): 55–56.
Proceedings of the Miramichi Natural History Association 4 (1905): 56; 6 (1911): 29; 7 (1913): 62.
Raymond, Marcel. "Borgeau, Eugène" *Dictionary of Canadian Biography* X: 81–82.
"Report, Fredericton Natural History Society." *Bulletin of the Natural History Society of New Brunswick* 16 (1898): 84.
"Report from the New Brunswick Natural History Society." *Royal Society of Canada Transactions* LXV, 2nd ser., vol. 2 (1896): 65.
"Report of the King's County Natural History Society." *Bulletin of the Natural History Society of New Brunswick* 16 (1898): 85; 17 (1899): 179.
"Report of the Royal Society of Canada on Matthew's Paper." *Canadian Record of Science* Section 2 (1886–1887): 427.
"Reports on the Committee for Botany." *Bulletins of the Natural History Society of New Brunswick* 1 (1882); 6 (1887); 10 (1890); 12 (1894); 13 (1895); 22 (1904); 25 (1907); 27 (1909).
Rhodora 53, no. 26 (1951), 33–8, 39–43, 44–55, 56–61, 61–65 [series of papers on Fernald].
Roberts-Pichette, Patricia R. "Annotated Checklist of the Vascular Plants, Collected from the Fredericton Region." Record 6 (Fredericton: New Brunswick Research and Productivity Council, December 1966), 1–76.
———. "New Records of Arctic Species in South-Eastern

New Brunswick." *Rhodora* 769 (January–March 1967): 92–93.

Rousseau, Jacques. "Dièrville." *Dictionary of Canadian Biography*, II: 188.

Schubert, Bernice G. "Sidney Fay Blake." *Rhodora* 62 (1960): 325–38.

Sheppard, Margo. "In Awe of Minister's Face." Nature Trust of New Brunswick, *Refuge* 11, no. 2 (July 2001): 1.

Squires, W. Austin. "*Impatiens Royalii* in New Brunswick." *Canadian Field Naturalist* 59 (1945): 69.

Stebbins, Ledyard. "Concepts of Species and Genera." In *Flora of North America*, edited by the Flora of North America Editorial Committee. New York: Oxford University Press, 1993.

Stetson, Sarah P. "The Traffic in Seeds and Plants from England's Colonies in North America." *Agricultural History* XXIII (1949): 50–56.

Story, G. M. "Eppes Cormack, William." *Dictionary of Canadian Biography* IX: 158–62.

Swaine, J. M. "Scientific Research, the Key to Progress in Agriculture." *Royal Society of Canada Transactions*, 3rd ser., 33 (1939): 300.

Taillemite, Étienne. "Barrin de la Galissonière, Roland Michel Marquis de la Galissonière." *Dictionary of Canadian Biography*, III: 26–32.

"Trust Study Charts St. John River Rare Plants" *Refuge* 12, no. 1 (April 2002): 3.

Toole, F. J. "The Scientific Tradition." In *University of New Brunswick Memorial Volume*. Fredericton, NB: University of New Brunswick, 1950.

Vroom, James. "Trees and Forests," *Saint John Daily Sun* (2 August 1897).

Tyrrwhitt-Drake, M. C. "Douglas, David." *Dictionary of Canadian Biography* VI: 218.

Ward, Stephen. "Historical Collections Ruined by Lack of Cash." *The Independent* (5 August 1988).

Weatherby, Charles A., and John Adams. "A List of the Vascular Plants of Grand Manan, Charlotte County, New Brunswick." *Contributions to the Gray Herbarium* 157 (1945): 13.

———. "Annotated Checklist of the Vascular Plants of

Grand Manan, Charlotte County, New Brunswick." Revised by Harold R. Hinds and George H. Flanders. [Saint John, NB]: Grand Manan Historical Society, 1995.

Whiting, R. E., and R. S. W. Bobbette. "The orchid *Listera australis*, Rediscovered in Ontario." *Canadian Field Naturalist* 88 (1974): 346–47.

Wynne-Edwards, V. C. "Isolated Arctic-Alpine Floras in Eastern North America: A Discussion of their Glacial and Recent History." *Royal Society of Canada Transactions*, 3rd ser., vol. 31, sect. V (1937): 33–58.

———. "Some Factors in the Isolation of Rare Alpine Plants." *Royal Society of Canada Transactions*, 3rd ser., vol. 33, sect. V (1939): 35–42.

Young, D. M. "Smyth, George Stracey." *Dictionary of Canadian Biography* VI: 429.

Young, C. Mary. "A Case for History." *New Brunswick Naturalist* 16, no. 1 (December 1987): 5–6.

———. "A Pioneer of Conservation." *Refuge* 2 (June 1991): 4.

———. "Pteridomania." *New Brunswick Naturalist* 19, no. 3 (October 1992): 34–35.

Government Publications

Canada

Anstey, T. H. *One Hundred Harvests*. Ottawa: Agriculture Canada, 1987.

"Annual Report of National Museums Canada for the Fiscal Year 1955–56." *National Museums of Canada Bulletin* 147 (1955–1956): 18.

Canadian Permanent Committee on Geographical Names. *Gazetteer of Canada. New Brunswick*. 2nd ed. Ottawa: Surveys and Mapping Branch, Department of Energy, Mines, and Resources, 1972.

Department of Agriculture. *Canada Agriculture, the First Hundred Years*. History Series, no. 1. Ottawa: Canada Department of Agriculture, Queen's Printer, 1967.

———. *Plant Research Institute*. Ottawa: Canada Department of Agriculture, Queen's Printer, 1969.

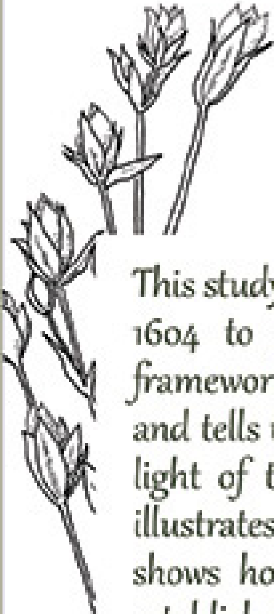
———. *Report of Minister of Agriculture for Years Ended March 31st*. 1940; 1945; 1950; 1962; 1974/5.
———. *Research Report 1963–1966*. Ottawa: Canada Department of Agriculture, Plant Research Institute, 1963—1966.
Dominion of Canada. *Reports of the Minister of Agriculture for the Years Ended March 31st*. 1939; 1945.
———. Department of Mines, *National Herbarium Annual Report* II, no. 37 (1927–1928); no. 51 (1914–1925); (1919–1930).
———. *National Museums Annual Reports*, (1949–1950); (1954–1955 [dated 1956]).
Government of Canada. "Federal Biodiversity Information Partnership Established." http://www.nature.ca/research/system_e.cfm.
Macoun, J. A. "Summary Report." Sessional Paper 26, Geological Survey of Canada (1914): 151.
Parliament of Canada, House of Commons. *Sessional Papers* XLI, no. 16 (1906–1907): 65.
———. *Sessional Papers* LLI, 16–18, no. 9 (1917): 1127.
Thomson, Don. W. *Men and Meridians: The History of Surveying and Mapping in Canada*. 3 vols. Ottawa: R. Duhamel, Queen's Printer, 1966–1969.

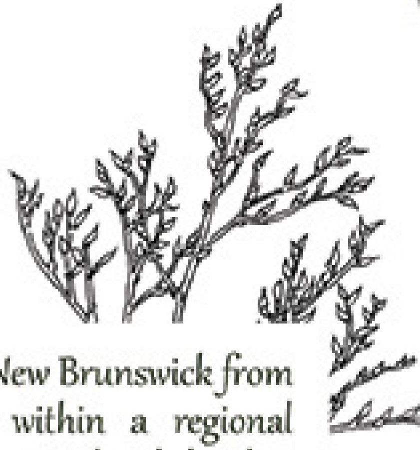
Province of New Brunswick

Robb, James. *Agricultural Progress Considered with Special Reference to New Brunswick*. [New Brunswick Provincial Government Report] Fredericton, NB: J. Simpson, 1856.
Synopsis of the System of Education Established by the University of King's College, Fredericton, New Brunswick. Fredericton, NB: John Simpson, Queen's Printer, 1838.

United Kingdom

House of Commons. *British Parliamentary Sessional Papers* 374, no. 21 (1821): 37.
Letter, from the Secretary of State for the Colonies written on behalf of the British Museum. *The Royal Gazette* (23 May 1838).





This study of plant exploration in New Brunswick from 1604 to 2000 is placed firmly within a regional framework. It encompasses short biographical sketches and tells the stories of naturalists and botanists in the light of the times in which they lived. The account illustrates the development of the science of botany and shows how, as museums and learning centres were established in the new land, North Americans became masters in their own house, taking over the botanical enquiry that had previously been the prerogative of Europeans. It examines early ecological studies and curious anomalies of plant distribution, as well as the modern-day emphasis on plant diversity and the need for conservation. Furthermore, it embodies implicit lessons that speak to our present-day concerns with climate change and the environment.