

# FEDS, FORESTS, AND FIRE

A Century of Canadian Forestry Innovation

Richard A. Rajala



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# **Feds, Forests, and Fire**

**A Century of Canadian Forestry Innovation**

**Richard A. Rajala**

**Canada Science and Technology Museum  
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# Abstract

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Over the past century, foresters have endeavoured to exploit, protect, and renew the Canadian forest. They have taken their inspiration from a philosophy of natural resource management that sought efficient use, and that recognized forests primarily for their commodity value. This conservation ethic has come under attack in recent decades from the environmental movement. However, even as the profession engages in the sometimes painful process of adjusting to new imperatives, it is worthwhile to pause and consider forestry in its historical perspective: to explore its dynamic tradition of innovation in protection and management, and the changing government policies that shaped these practices. This study integrates an account of the federal government's role in Canadian forestry, emphasizing its contribution to the science and technology of fire protection, inventory, and silviculture, with a broader analysis of forest management in Canada. By linking the evolution of federal policy to a history of the organization now known as the Canadian Forest Service, and relating this political-institutional focus to the process of innovation in the above fields, this study seeks to contribute to the understanding of forest exploitation and conservation.

The narrative devotes particular attention to the development of forest fire prevention, detection, and suppression procedures: the dominant concern of federal and provincial resource agencies throughout much of the twentieth century. Federal research and development in reforestation and forest survey techniques are also documented in a manner that captures the main currents of change.

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# Résumé

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Au XX<sup>e</sup> siècle, les experts-forestiers se sont employés à exploiter, protéger et renouveler la forêt canadienne. Ils s'inspiraient d'une philosophie de gestion des ressources naturelles qui visait l'efficacité d'utilisation et voyait les forêts comme autant de produits à exploiter. Ces principes de conservation ont été remis en question par le mouvement écologiste au cours des dernières décennies. Mais, alors même que les forestiers s'engagent dans un processus parfois ardu d'adaptation de leurs pratiques aux nouveaux impératifs, il convient de considérer la foresterie dans une perspective historique : se pencher sur sa dynamique tradition d'innovation en matière de protection et de gestion ainsi que sur les politiques gouvernementales changeantes qui en ont déterminé les pratiques. Cette étude décrit le rôle joué par le gouvernement fédéral dans l'évolution de la foresterie au Canada, mettant l'accent sur sa contribution à la science et à la technologie appliquées à la protection contre les incendies, l'inventaire et la sylviculture, et présente une analyse plus large de la gestion des forêts au pays. En faisant le lien entre l'évolution des politiques fédérales et l'histoire de l'organisme qui porte aujourd'hui le nom de Service canadien des forêts, puis en établissant un parallèle entre cette orientation politico-institutionnelle et le processus d'innovation qui a cours dans les domaines mentionnés, cette étude vise à favoriser la compréhension de l'exploitation et de la conservation des forêts.

L'exposé s'intéresse particulièrement à l'évolution des pratiques en matière de prévention, détection et combat des incendies de forêt, principales préoccupations des organismes de gestion des ressources naturelles provinciaux et fédéraux au XX<sup>e</sup> siècle. Ce document traite aussi des activités fédérales de recherche et développement en reforestation et inventaire forestier, de manière à faire ressortir les principales tendances de changement.





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# Foreword

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With this excellent and detailed review of the history of federal forestry research in Canada, Richard A. Rajala has produced a volume that will serve Canadian forest historians well, while also providing current federal forestry scientists with a sense of their own place within this research continuum. I believe that this volume connects readers directly to the philosophy of scientific research in this country, helping them not only to understand what drives researchers, but also illustrating the value of this research to Canadians in general. Rajala also leaves the reader with two major impressions. The first is that a continued federal forestry research program has produced world-class research results that have greatly benefitted both forest management agencies and the people of Canada. The second is that this has been accomplished by a stream of incredibly resilient researchers and managers, despite the lack of political foresight and will which has threatened the Canadian federal forest research program almost continually since its inception.

Established in 1899, the federal agency now known as the Canadian Forest Service (within the Department of Natural Resources) has resided in more than a dozen departments over the past century, with a resource strength that has changed frequently in response to government policy and economic constraint. Prior to the 1930s, this agency managed federal forest reserves in the West and conducted a limited research program. During this same period, however, this changed, with the transfer of natural resources ownership to the western provinces, leaving the agency with a somewhat restricted federal forestry research mandate, dealing primarily with forest protection. Over the ensuing seven decades, this mandate has expanded when governments recognized the value of forest science and created short-term federal-provincial development programs, and has contracted during times of fiscal restraint and restructuring.

Since its inception in 1925, the history and development of the federal forest fire research program in Canada has mirrored the ebb and flow of the larger forest research program. Although various provincial-territorial fire management organizations, and some universities, have fire research programs, the federal government program has represented by far the strongest, broadest, and most continuous commitment to forest fire research across Canada. Prior to the mid-1960s, a modest fire research program (primarily in Ottawa and at the Petawawa Forest Experiment Station in Ontario) focussed

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# Avant-propos

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Avec cette analyse rigoureuse et détaillée de l'histoire de la recherche fédérale en foresterie au Canada, Richard A. Rajala a réalisé un ouvrage qui devrait être fort utile aux historiens de la forêt canadienne et donner aux scientifiques à l'emploi du gouvernement fédéral une idée de leur place au sein du continuum de la recherche. Je crois que cet exposé relie directement les lecteurs à la philosophie de recherche scientifique au pays, non seulement en les aidant à comprendre ce qui anime les chercheurs, mais aussi en démontrant la valeur de cette recherche pour l'ensemble des Canadiens. Rajala laisse les lecteurs sur deux impressions : d'abord, que le programme fédéral permanent de recherche en foresterie a produit des résultats de niveau international qui ont été très avantageux pour les organismes de gestion forestière et la population, et ensuite, que ces travaux ont été menés par une succession de chercheurs et de gestionnaires extraordinairement résolus, malgré le manque flagrant de volonté et de perspective politiques qui mine le programme fédéral de recherche en foresterie pratiquement depuis sa création.

Instituée en 1899, l'agence fédérale aujourd'hui appelée Service canadien des forêts (au sein du ministère des Ressources naturelles) a relevé de plus d'une dizaine de ministères au XX<sup>e</sup> siècle et ses ressources financières ont varié en fonction des politiques gouvernementales et des contraintes économiques changeantes. Avant les années 1930, l'organisme gère les réserves forestières fédérales de l'Ouest et dirigeait un petit nombre de programmes de recherche. Mais les choses ont changé à l'époque, quand la gouverne de ces ressources naturelles est passée aux provinces de l'Ouest, ce qui laissait à l'agence un mandat de recherche en foresterie réduit essentiellement à la protection des forêts. Au cours des sept décennies suivantes, ce mandat s'est élargi quand les gouvernements reconnaissaient la valeur de la science forestière et mettaient en œuvre des programmes de développement provinciaux et fédéraux à court terme, et a subi des compressions en périodes de restrictions ou de restructuration budgétaires.

Depuis sa création en 1925, le programme de recherche fédéral sur les feux de forêt a connu une évolution qui rappelle les fluctuations du programme plus vaste de recherche en foresterie. Divers organismes provinciaux et territoriaux de gestion des incendies ainsi que des universités ont lancé leurs propres programmes, mais celui du gouvernement fédéral représente l'engagement le plus ambitieux, le plus vaste et le plus constant en recherche sur les feux de forêt au Canada. Jusqu'au

on fire behaviour and fire danger rating. In the mid-1960s, federal regional laboratories were established across Canada (in New Brunswick, Newfoundland, Quebec, Ontario, Alberta, and British Columbia) to provide continuous contact with provincial forest management agencies, and an expanded capability to address their concerns and requirements. Fire research programs were developed at these centres to augment ongoing research activities at Petawawa, and the Forest Fire Research Institute was established in Ottawa. This was the zenith of the federal fire research program in Canada, with substantial fire research activity in the areas of fire danger rating, prediction of fire occurrence and behaviour, fire ecology, and computerized fire management systems. From this peak period, the level of Canadian fire research has seen a steady decline, as has federal forestry research in general, consistent with declining funding support. Closure of the Forest Fire Research Institute in 1979 was followed by the closing of the Petawawa National Forestry Institute in 1995, with the reassignment of a diminishing number of fire researchers to regional establishments. Through all of this, the fire research program continued to adjust, forming strong collaborative alliances with management agencies, universities, and international partners to address emerging fire research issues, particularly in the areas of fire behaviour prediction, climate change impacts, and carbon budgets.

Throughout this narrative, Rajala has emphasized federal fire research in Canada, including the development of new fire suppression technology that has been of direct benefit to Canadian fire management agencies. He has focussed primarily, however, on the evolution of fire danger research in this country. This particular research activity, perhaps better than any other, demonstrates the philosophy and approach of Canadian fire researchers, producing systems that have often been referred to as the “crown jewels” of Canadian fire research. Indeed, a separate volume could be written on the evolution and immediate relevance of fire danger rating systems in this country over the past several decades. Since the initiation of fire danger research in 1925, five different fire danger rating systems have been developed, with increasing sophistication and applicability across the country. The approach has been to build upon previous danger rating systems in an evolutionary fashion, and to use field experiments (including test fires at various scales) and empirical analysis extensively. This research has also benefitted greatly from a sense of continuity, with retiring fire researchers mentoring younger colleagues entering the organization.

The current system, the **Canadian Forest Fire Danger Rating System (CFFDRS)**, incorporates both the Canadian Forest Fire Weather Index (FWI) System

milieu des années 1960, un modeste programme (basé à Ottawa et à la Station d'expériences forestières de Petawawa, en Ontario) s'intéressait surtout au comportement du feu et à l'évaluation du danger d'incendie. Vers 1965, le gouvernement fédéral a ouvert des laboratoires régionaux d'un bout à l'autre du pays (au Nouveau-Brunswick, à Terre-Neuve, au Québec, en Ontario, en Alberta et en Colombie-Britannique) afin d'assurer un lien permanent avec les agences de gestion forestière provinciales et de pouvoir mieux répondre à leurs préoccupations et besoins. Ces centres ont développé des programmes de recherche sur les incendies qui complétaient les travaux menés à Petawawa et l'Institut de recherches sur les feux de forêt a été établi à Ottawa. Le programme fédéral de recherche sur les incendies était alors à son zénith au Canada : il menait des recherches d'envergure sur des volets aussi variés que l'évaluation du danger d'incendie, la prévision de la fréquence et du comportement des feux, l'écologie du feu et les systèmes informatisés de gestion des incendies. Depuis, le secteur de la recherche sur les incendies connaît un déclin constant au pays et il en va de même pour les activités fédérales de recherche en foresterie dans l'ensemble, ce qui est conséquent avec la diminution du soutien financier. La fermeture de l'Institut de recherches sur les feux de forêt, en 1979, et de l'Institut forestier national de Petawawa, en 1995, a entraîné la réaffectation des chercheurs en incendie, de moins en moins nombreux, vers des établissements régionaux. Malgré tout, le programme de recherche sur les incendies n'a cessé de s'adapter, formant de solides partenariats avec des agences de gestion, des universités et d'autres intervenants sur la scène mondiale, afin de s'attaquer aux problèmes de l'heure en recherche sur les incendies, particulièrement la prévision du comportement des incendies, les effets des changements climatiques et les bilans du carbone.

Dans cet ouvrage, Rajala fait valoir les activités de recherche fédérales en matière de feux de forêt au Canada, incluant l'élaboration de nouvelles technologies d'extinction des incendies dont ont directement bénéficié diverses agences canadiennes de gestion des incendies. Mais il s'intéresse principalement à l'évolution de la recherche sur les dangers d'incendie au pays. Ce domaine de recherche, peut-être plus que tout autre secteur, illustre bien la philosophie et la démarche des chercheurs canadiens en incendie, qui ont permis la mise en œuvre de méthodes souvent désignées comme des « joyaux de la couronne » du programme canadien de recherche sur les feux de forêt. En fait, le sujet de l'évolution et de la pertinence immédiate des méthodes d'évaluation du danger d'incendie utilisés au pays ces dernières décennies mériterait à lui seul tout un ouvrage. Depuis les débuts de la recherche sur le danger d'incendie, en 1925, cinq méthodes distinctes

and the Canadian Forest Fire Behaviour Prediction (FBP) System. The FWI System, which provides qualitative numerical ratings of relative fire potential, based solely upon weather observations, has been in use throughout Canada since 1970. The FBP System, which was developed using data gathered through major experimental burning programs and wildfire documentation in major fuel types across Canada, gives quantitative predictions of fire behaviour characteristics such as rate of spread, fuel consumption, and frontal fire intensity. Introduced in 1989, the FBP System was the culmination of many years of effort, and extensive field programs that involved many researchers and numerous Canadian fire management agencies. These agencies use the CFFDRS in both planning and operational fire suppression activities, predicting the number and location of fires, planning detection, and pre-positioning resources in anticipation of fire activity. The CFFDRS is used universally across Canada, and has recently been introduced in parts of the United States, in the United Kingdom, and in New Zealand. While it is difficult to place an actual value of the cost-effectiveness of a fire danger rating system, a 1987–1988 Government of Canada review determined that at least \$750,000,000 CDN in benefits could be attributed to the use of the CFFDRS during the 1971–1982 period. This is a fitting tribute to the early pioneers of fire danger rating research in this country, as well as those who have followed in their footsteps.

Research is already underway on the development of the next generation of fire behaviour and occurrence prediction models for Canada. This work involves extensive international and cross-disciplinary collaboration, particularly with fire researchers from the United States and Russia. The International Crown Fire Modelling Experiment, carried out in the late 1990s in Canada's Northwest Territories, is a prime example of the future collaborative nature of forest fire research. Fire scientists are also being asked to address major national and international science/policy issues, reflecting a growing awareness of fire as a part of many larger global issues. Major new initiatives are underway addressing the impacts of climate change on forest fire activity in Canada, as well as growing fuel management problems in the expanding wildland-urban interface in this country. Given its resilience over the past many decades, it is likely the Canadian fire research program will continue to evolve in order to address major relevant issues as they emerge.

One might sense, in reading the above, that forest fire research in this country has followed a winding and somewhat uncertain path. The fact that these research efforts and the products evolving from this program are not only critical in Canada today, but are also increasingly relevant internationally, is a tribute

d'évaluation du danger ont été élaborées, chacune présentant un raffinement et des possibilités d'application supérieurs à la précédente. L'idée maîtresse était de perfectionner la méthode d'évaluation la plus récente et de la faire évoluer en multipliant les expériences sur le terrain (telles les incendies d'essai d'envergures variées) et les analyses empiriques. Ce domaine de recherche a aussi largement bénéficié d'un souci de la continuité, les chercheurs en incendie servant de mentors à la nouvelle génération de scientifiques avant de prendre leur retraite.

La méthode actuelle, dite **Méthode canadienne d'évaluation des dangers d'incendie de forêt (MCEDIF)**, fait le lien entre la Méthode canadienne de l'indice forêt-météo (IFM) et la Méthode canadienne de prévision du comportement des incendies de forêt (PCI). La méthode IFM, qui donne une évaluation numérique qualitative du potentiel relatif d'incendie en se fondant uniquement sur des observations météorologiques, est utilisée partout au Canada depuis 1970. La méthode PCI, elle, a été élaborée à partir de données recueillies lors de programmes de brûlages expérimentaux ou provenant de documents sur les feux irréguliers (principaux types de combustibles) au Canada. Elle fournit des estimations quantitatives de certains comportements du feu, comme la vitesse de propagation, la consommation de combustible et l'intensité frontale des incendies. Lancée en 1989, la méthode PCI était la culmination de nombreuses années de travail et de plusieurs programmes d'envergure sur le terrain, ayant mobilisé quantité de chercheurs et d'agences canadiennes de gestion des incendies. Ces agences utilisent aujourd'hui la MCEDIF dans leurs activités de suppression des incendies, tant lors de la planification que des opérations, afin de prévoir le nombre et l'emplacement de feux de forêt, d'en planifier la détection et de déployer les ressources en prévision d'incendies soupçonnés. La MCEDIF est la méthode universelle au Canada et elle a récemment été mise à l'essai dans certaines régions des États-Unis, du Royaume-Uni et de la Nouvelle-Zélande. Il est difficile de déterminer le rapport coût-efficacité d'une méthode d'évaluation du danger, mais une étude du gouvernement du Canada menée en 1987-1988 a révélé que des bénéfices d'au moins 750 000 000 \$ CAN étaient attribuables à l'utilisation de la MCEDIF durant la période 1971-1982. Ceci est tout à l'honneur des pionniers canadiens de la recherche en évaluation du danger d'incendie et des chercheurs qui ont continué leur œuvre.

Des recherches ayant trait à la prochaine génération de modèles de prévision du comportement et de la fréquence des incendies de forêt ont été amorcées au Canada. Ces travaux exigent une collaboration internationale et interdisciplinaire étroite, en particulier avec les chercheurs américains et russes. L'Expérience

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to all of Canada's forest fire scientists, past and present. This narrative by Rajala serves these efforts both accurately and well.

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2004

internationale de modélisation des feux de cimes, menée vers la fin des années 1990 dans les Territoires du Nord-Ouest, est un bel exemple de coopération dans la recherche sur les feux de forêt. Les scientifiques en études des incendies sont aussi appelés à se prononcer sur d'importantes questions touchant la science ou les politiques nationales et internationales, ce qui révèle une sensibilisation accrue au facteur incendie dans plusieurs grands dossiers mondiaux. On a initié des projets de recherche d'envergure afin de mieux cerner les répercussions des changements climatiques sur l'activité des feux de forêt au Canada. Le pays fait face à des problèmes de gestion des combustibles de plus en plus sérieux en raison de l'empiètement grandissant des régions urbaines sur les milieux sauvages. Ceci dit, étant donné la souplesse qu'il a démontré au fil des décennies, le programme canadien de recherche sur les feux de forêt devrait continuer d'évoluer et d'apporter des solutions aux grands problèmes de l'heure.

À la lecture de ce qui précède, on pourrait croire que la recherche sur les feux de forêt a suivi une voie sinueuse et plutôt incertaine au Canada. Le fait que les travaux de recherche et les produits qui en résultent sont non seulement essentiels au pays mais aussi de plus en plus utiles dans le monde témoigne de la valeur de tous les scientifiques canadiens du secteur des incendies de forêt, d'hier et d'aujourd'hui. Cet exposé de Richard Rajala rend justice à leurs efforts à la fois avec élégance et justesse.

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2004

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# Acknowledgments

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Over the past decade or so, I have had the good fortune to carry out three studies on aspects of Canadian forest history under contract to the Canada Science and Technology Museum. Canadians in general, and scholars such as myself in particular, are fortunate to have an institution devoted to serious inquiry into our material history. This study, completed in the summer of 2000, took me down paths I had not previously explored, and I am grateful to Garth Wilson for the opportunity to further develop my understanding of the place of forests in Canadian life.

Historians depend heavily upon librarians and archivists to help us find our way through source materials. In conducting the research for this book, I benefitted greatly from the expertise of Alice Solyma and Barbara Hendel at the Pacific Forestry Centre. Roxanne Smith and other staff at the B.C. Ministry of Forests Library proved enormously helpful as well, on this and many other occasions. I received a good deal of cheerful assistance from Library and Archives Canada staff during image research in Ottawa. My thanks go out to the helpful and knowledgeable people at the above institutions.

I would also like to take this opportunity to acknowledge historian Ken Drushka, who passed away recently. His contributions to our awareness of forestry issues in Canada have been tremendous.

Finally, as always, many thanks to my wife Jean, who played a major role in all phases of the project. This book is dedicated to her, and to the memory of my sister-in-law, Vi Rajala.

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# Remerciements

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Ces dix dernières années, j'ai eu le privilège d'être mandaté par le Musée des sciences et de la technologie du Canada pour mener trois études sur certains aspects de l'histoire du secteur forestier au pays. Nous, les Canadiens, en particulier les chercheurs comme moi, avons la chance de disposer d'une institution vouée à l'examen de l'histoire de notre culture matérielle. Cette étude terminée à l'été 2000 m'a permis d'emprunter des sentiers que je n'avais encore jamais explorés et je suis reconnaissant envers Garth Wilson de m'avoir fourni l'occasion exceptionnelle d'approfondir ma compréhension du rôle que joue la forêt dans la vie au Canada.

Les historiens comptent énormément sur les bibliothécaires et les archivistes pour mettre la main sur des sources et de la documentation pertinentes. Au cours de mes recherches, j'ai eu le bonheur de bénéficier des compétences d'Alice Solyma et de Barbara Hendel, du Centre forestier du Pacifique. Roxanne Smith et le personnel de la bibliothèque du ministère des Forêts de la Colombie-Britannique se sont aussi montrés des plus serviables. À Ottawa, j'ai été chaleureusement soutenu dans ma recherche d'images par des employés de Bibliothèque et Archives Canada. Je tiens donc à remercier les gens si serviables et si bien renseignés de tous ces établissements.

Je profite également de cette occasion pour rendre hommage à l'historien Ken Drushka, décédé récemment. L'ensemble de sa contribution à notre prise de conscience des grands enjeux en matière de forêts au Canada est considérable.

Enfin, comme toujours, je remercie ma femme, Jean, pour le rôle important qu'elle a tenu à chacune des phases de ce grand projet. C'est à elle qu'est dédié cet ouvrage, de même qu'à la mémoire de ma belle-sœur Vi Rajala.



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# Introduction

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Canada is one of the world's most abundantly forested countries: its 453 million hectares (1.2 billion acres) of forest accounting for almost 42 per cent of the land base. Directly or indirectly, about 840,000 Canadians draw their livelihood from the forest, and over 300 communities depend upon the industry for the largest portion of their economic base. Canada leads the world in exporting wood products: its lumber, newsprint, and pulp contributing 46 per cent, 53 per cent, and 34 per cent of international trade, respectively.<sup>1</sup>

Canada is exceptional for the magnitude of its forests, their economic importance, and the degree of public ownership. Over 90 per cent of the nation's forestland belongs to the provincial, territorial, and federal governments. Federal control extended to western Canada prior to 1930, when the prairie provinces secured control over their natural resources, and thereafter was restricted largely to the North. Cutting rights to the 71 per cent of forestland under provincial jurisdiction, comprising the bulk of the commercially important timber, are awarded to companies through a variety of tenure agreements which provide a source of Crown revenue through stumpage fees and taxes. Although the Atlantic provinces disposed of much of their forestland, Crown ownership is the rule in central and western Canada.

Provincial control of forest resources, which originates in constitutional arrangements set down by the Fathers of Confederation, had consequences both for the federal government's role in Canadian forestry and the quest for a national forest policy. Over time, federal power has expanded to include new jurisdictions such as social security, welfare, and environmental regulation, although the provinces have sometimes been wary of centralization. Historically, forest policies at both levels of government have been oriented towards maximizing the flow of forestry revenues through the promotion of industrial growth and regional development. Cooperation between the two levels of government has been inconsistent, however: while the provinces have traditionally been critical of the lack of federal participation in forestry programs, many have also resisted encroachment on their jurisdictions. Ottawa has responded with national programs in times of perceived forest-sector crisis, although its commitment to conservation has wavered in accordance with changing economic circumstances and public trends.<sup>2</sup>

Since its inception in 1899, the agency now known as the Canadian Forest Service has had many names,

has resided in over 14 different departments, and has endured numerous changes in fortune. From the turn of the century to 1930, its management responsibilities on Dominion lands in the West, complemented by a growing involvement in research after the First World War, enabled the organization to become the nation's most prominent forest agency. Decimated by the transfer of natural resources to the prairie provinces and British Columbia at that time, the Service survived through the Great Depression and the Second World War under a restricted research mandate, then blossomed again during the immediate postwar decades as forest science and federal-provincial cooperation in resource development found temporary favour among the political elites. The agency's dynamic growth came to an end in the early 1970s, when government restraints sapped its scientific vigour and morale for a decade. A second round of cooperative forest development agreements lifted the organization out of the doldrums early the next decade, before the axe fell again in the mid-1990s.

Despite the importance of forests to Canada's economic and social history, they have attracted surprisingly little scholarly attention. Moreover, much of the best recent work has had a provincial focus — not surprising, given their jurisdiction over forest management. During the 1980s, the study of forest history flourished in Canada, prompted by widespread concern over the state of the nation's woodlands. Gillis and Roach's *Lost Initiatives*, Swift's *Cut and Run*, and *Heritage Lost* by Donald MacKay — their titles reflecting the prevailing sense of alarm — raised awareness of the processes which had contributed to a looming wood-supply crisis. Gillis and Roach made a particularly impressive scholarly contribution by integrating an account of federal forestry with an analysis of provincial policy development, and theirs remains the first reference for students interested in the political history of the Canadian forest. Kenneth Johnstone deepened our understanding of the federal forest service's institutional history with his 1991 *Timber and Trauma*.<sup>3</sup>

This study aspires to contribute to the historiography of Canadian forestry by placing the federal role within a broader context of technological change, scientific inquiry, and policy formation. Neither a complete institutional history — in that it makes no reference to the biological component of federal forest science — nor a total treatment of science and technology, it documents the agency's management of western lands, goes on to discuss its research in the fields of fire protection,

forest inventory, and silviculture, and considers the history of federal-provincial cooperation. Finally, it relates the history of the Canadian Forest Service to the evolution of provincial and industrial forest protection practices, with primary emphasis on the technology of fire detection and suppression. This book covers roughly a century of our forest history, leaving consideration of the last decade of the twentieth century for future scholars who will be better able to assess the most recent policy developments.

Chief Inspector of Timber and Forestry Elihu Stewart headed the Dominion's small Forestry Branch from its inception until 1907, with responsibility for firefighting on federal lands and managing the western forest reserves, which had been created to husband essential water resources and provide lumber for farm and community development. Stewart, and his successor Robert Campbell, succeeded in imposing a rudimentary management system on the reserves: rangers patrolled for fire and trespass, built roads and trails, and cleared fireguards around their boundaries.

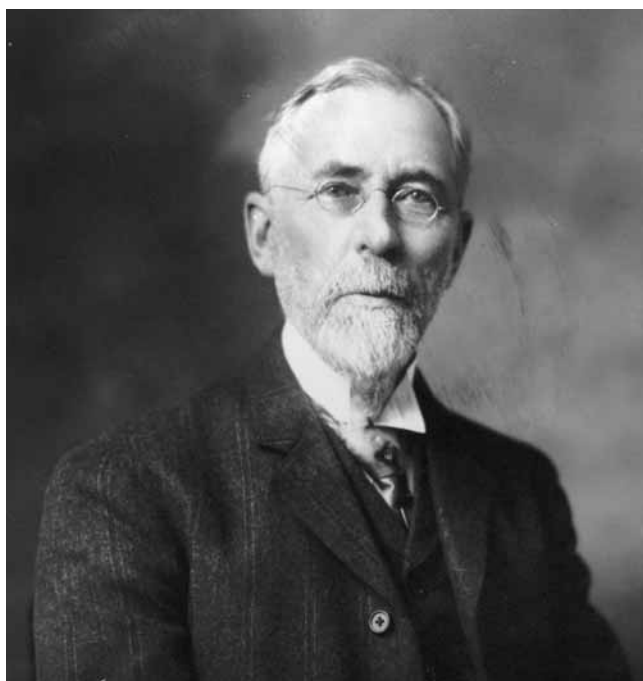
The Commission of Conservation represented the Dominion Government's most ambitious early foray into the conservation field — albeit one that stopped short of government intervention. Created in 1909 as a scientific and advisory body, the Commission conducted the first

serious inquiries into Canadian forest conditions, in cooperation with provincial governments and corporations. Pioneering ventures included surveys of British Columbia's forests and the Trent Watershed in Ontario; establishment of an experimental station at Lake Edward, Quebec; and, studies of cutover eastern Canadian pulpwood lands.

The Forestry Branch also entered the research field in 1913 with the founding of a forest products laboratory at McGill University, devoted to investigating ways to increase industrial uses of Canadian woods. Convinced of the need for scientific knowledge upon which to base his agency's management practices, in 1915 Campbell organized an advisory committee to set an agenda for future inquiry. The First World War prevented this body from making an immediate impact, and enlistments cost the Forestry Branch much of its professional staff. But the war years also contributed to an increase in the Branch's stature as a national research organization. A recommendation by the Scientific and Industrial Research Council for a small appropriation coincided with a request for help in managing the Petawawa Military Reserve from the Department of Militia and Defence, leading to the establishment of a forest experiment station there in 1918. A year later, a second forest products laboratory came into existence at the University of British Columbia to study the use of Sitka spruce in airplane construction. The real advance in Forestry Branch fortunes, however, came in 1921 when, having lost favour in government circles, the Commission of Conservation was abolished. With the field to itself, the agency absorbed the Commission's most prominent foresters, took over its research projects, and prepared to expand its influence as Canada's national forestry body.

The all-purpose ranger assumed all phases of the protection burden at the turn of the century; however, over the next two decades, mechanization and specialization introduced new efficiencies to forest firefighting. Canadians pioneered the development of portable gasoline-powered fire pumps: technology that gave organizations the ability to bring water short distances through linen hoses to fire sites. The first generation of pumps proved a valuable supplement to the hand tools traditionally used by suppression crews, even though their bulk and performance left something to be desired. Detection techniques became more systematic with the construction of lookout towers — some linked by telephone or radio to ranger stations.

The availability of surplus aircraft following the First World War brought forestry into the aerial age. The existence of vast forests, often uninterrupted by settlement, made Canadian foresters enthusiastic about the technology's potential in forest protection and inventory. Federal, provincial, and industry organizations initiated



**Figure 1** Elihu Stewart, Superintendent of Forestry for the Dominion of Canada, Ottawa, Ont. (1899–1907) — October 1907.

(Source: Topley, William James/Library and Archives Canada/PA-91095)



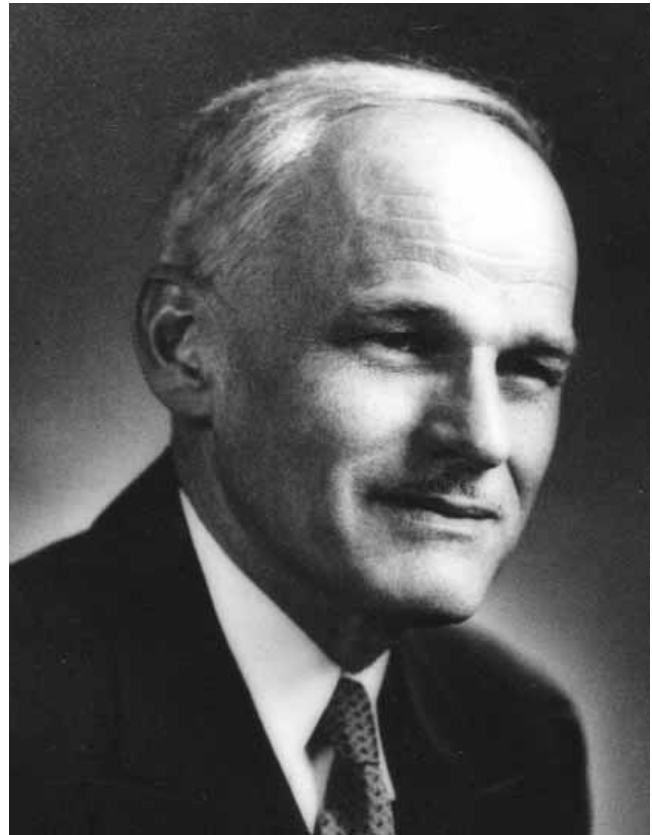


**Figure 2** E.H. Finlayson, Director of the Dominion Forest Service (1924–1936).

(Source: Natural Resources Canada — Canadian Forest Service)

airborne fire patrols in Western Canada, Ontario, and Quebec in the 1920s, as an alternative to continuous observation from lookouts. The concurrent development of forest sketching and photographic survey techniques provided public- and private-sector foresters with fast, inexpensive estimates of the extent and composition of tracts of forest land.

Political developments during the early 1920s also seemed to favour the Dominion Forest Service. Under Director E.H. Finlayson, Mackenzie King's Liberal government hosted a national forest protection conference in 1924, and hinted at its willingness to extend federal aid to the provinces in the area of fire control. The movement toward the development of a truly national forestry policy floundered, however, on Mackenzie King's reluctance to challenge the existing basis of federal-provincial relations, and he embarked upon a course that would result in the transfer of natural resources to the prairie provinces and British Columbia. Left with only the forest products laboratories and the Petawawa experiment station, federal forestry faced an uncertain future, made even more bleak when the Great Depression forced deep cuts in its appropriations and curtailed work on the national forest survey. Defeated in his bid



**Figure 3** James G. Wright, forest fire researcher.

(Source: Natural Resources Canada — Canadian Forest Service)

to retain the reserves, Finlayson set his sights on an expanded research role to compensate for his organization's lost forest protection and management duties. Federal relief projects provided labour for the establishment of experimental research stations at Valcartier, Quebec; the Duck Mountain forest reserve in Manitoba; Acadia; New Brunswick; and, Kananaskis, Alberta in the early 1930s. The Petawawa facility also benefitted from developments undertaken by the relief workers themselves.

At Petawawa, James G. Wright and Herbert W. Beall initiated studies into the relationship between weather and forest flammability, laying a foundation that would make Canada a world leader in forest-fire science. Their research on how weather conditioned the moisture content of the fuels that provided the source of ignition and early spread of fires contributed to the production of the first set of fire danger tables in 1933. These tables in turn became the basis for a danger rating system which gave protection organizations a systematic way of planning activities and allocating resources. The methods developed by Wright and Beall continue to influence the conduct of forest fire research today: a legacy found in the modern Canadian Forest Fire Danger Rating System.



**Figure 4** Herbert W. Beall, forest fire researcher.

(Source: Reproduced by permission of the Canadian Forest Service, Natural Resources Canada — 2004)

Still reluctant to tinker with constitutional arrangements, Mackenzie King returned to power in 1935, after an interlude of Conservative rule in Canada with no vision of a new national forest policy. Pushed to the breaking point by the overwhelming challenges of the early 1930s, the idealistic Finlayson committed suicide in early 1936. His death came only three years before the National Forestry Program created, in 1939, the sort of dynamic action he had envisaged. Designed to provide employment and training in forest conservation for young men across the country, the scheme involved federal and provincial sections devoted to the development of experimental stations and nurseries — as well as to protection, reforestation, and forest recreation work — and attracted over 5,000 enrollees. A Canadian equivalent of Roosevelt's Civilian Conservation Corps, the program embodied the principle of federal-provincial cooperation essential to any national forest policy. Unfortunately, the Canadian scheme arrived just as the Second World War was turning the attention of policy-makers to the problem of economic and military mobilization. The National Forestry Program, which might have accomplished so much in both environmental and social rehabilitation if adopted when the Depression was at its worst, existed for only a single season.

The war years dealt a temporary blow to Dominion Forest Service hopes for new initiatives. Enlistments and transfers cost the agency much of its personnel, and Director D. Roy Cameron was loaned first to the Wartime

Prices and Trade Board, and then the Department of Munitions and Supply. By 1943, however, industry, forestry organizations, and the provinces themselves were anxious for federal assistance to remedy the combined consequences of reduced Depression-era forest protection investments and wartime over-cutting. Forestry achieved a measure of some prominence in the reconstruction planning process and, had the anticipated postwar slump materialized, the National Forestry Program might have been resurrected.

The economic boom that followed the Second World War scuttled the most ambitious proposals, although the agency did secure increased funding in 1946 for its forest economics, air survey, silvicultural research, and protection divisions, along with its laboratories. Returning veterans and the recruitment of additional foresters injected new life into an organization anticipating postwar opportunities. Silvicultural research focussed on forest mensuration, preparation of working plans, cutting methods, tree-breeding, and reforestation. In the forest protection field, Wright's system of fire danger rating had come into use in most provinces. In addition to continuing research on the fire-weather relationship, the protection division sought to develop means for determining the severity of fire seasons for large areas, classifying fuel types, and methods for testing fire suppression devices and chemicals. Perhaps the most dynamic field was that of forest inventory, where wartime advances in aerial photography and interpretation techniques enabled more accurate estimation of timber types and volumes.

The 1949 *Canada Forestry Act* ushered in a new era of federal forestry. A response to postwar forest-sector pressure for support in harvest expansion and management planning, the legislation made federal assistance available to provinces for inventories, reforestation, fire protection, and the construction of access roads. Inventory agreements with the provinces resulted in aerial photographic coverage for most of Canada, providing a basis for estimates compiled with photo interpretation and forest sampling techniques developed by the agency. In addition to administering these programs, federal foresters strengthened their research efforts. Larger appropriations permitted the construction of new laboratory facilities and staff increases, making the 1950s a decade of real optimism for the agency.

The postwar years also witnessed important changes in fire suppression techniques. The availability of surplus military airplanes and experienced pilots led to a transition in the role of aircraft from patrol and support work to their use as "water-bombers". The Ontario Department of Lands and Forests began experiments as early as 1944, and by the end of the decade had developed the practice of dropping latex-lined paper bags

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filled with water from Beaver aircraft. Mounting water tanks on the floats of these planes, and on the larger Otter, proved more successful, setting the stage for the widespread adoption of water-bombing airplanes and helicopters by forest protection agencies.

Elsewhere, Stearmans, Avengers, Cansos, and the giant Martin Mars, which was used by a group of British Columbia forest companies, provided a means of dropping water and flame-retardant chemicals. Saskatchewan opted to utilize Norsemen aircraft in transporting smoke-jumpers to fires from a base at Prince Albert. When the fleet of Second World War-era tankers began showing its age, the conversion of newer passenger and cargo planes provided forestry organizations with faster, high-capacity initial response equipment. Canadair's CL-215, the first plane designed solely for aerial fire suppression, consolidated Canada's reputation as an international leader in forest protection technology. The efficiency of ground crews also increased with the development of portable pumps capable of delivering three times as much water, at half the weight of earlier models. Federal foresters tested new technologies and fire retardants, published reports on their characteristics, and collaborated with provincial agencies and manufacturers in developing innovations in the field of fire suppression.

While Canadian forestry organizations made progress in protecting mature timber — evident in reduced average acreages burned per fire — the mechanization of harvesting methods accelerated the rate of cut for the pulp-and-paper mills that sprang up across the boreal forest after the war. Natural reforestation suffered under the impact of these technologies, and provincial planting programs lagged far behind the accumulation of land which had not been satisfactorily restocked. Industry pressure for greater recognition of its economic importance, and concern for future wood supplies, prompted the Diefenbaker government to raise Forestry to Department status in 1960, and the agency grew over the next five years. Centres at St. John's, Fredericton, Sainte-Foy, Sault Ste. Marie, Winnipeg, Calgary, and Victoria coordinated regional research, operating in conjunction

with institutes at Ottawa and Sault Ste. Marie, the Petawawa Forest Experiment Station, and the forest products laboratories, to give federal forestry a vigorous, national identity.

The postwar national forest policy in science and federal-provincial cooperation began to lose its focus in the mid-1960s, however. The 1966 absorption of the agency into a new Department of Forestry and Rural Development diminished its status, and termination of federal-provincial agreements in 1968 undermined provincial reforestation efforts. Merged with Fisheries that year, and then shifted into Environment Canada, the Canadian Forestry Service suffered from staff cuts, loss of research facilities and low morale. Only public pressure saved the Petawawa installation from closure in 1978, as budget restraints forced tough choices on officials. Federal forestry enjoyed a revival in the 1980s under the forest resource development agreements which Ottawa had negotiated with the provinces. Planting programs flourished, but this national forest policy proved temporary as well: a fleeting response to a timber supply crisis that threatened the long-term viability of the forest sector.

The story of the federal government's role in Canadian forestry is one of shifting tides — of scientific accomplishment in a context of political expediency; of intermittent coherence against a backdrop of constitutional wrangling. The Petawawa facility has now been mothballed and, while the Canadian Forest Service maintains its scientific profile, the organization has perhaps never fully recovered from the loss of the western forest reserves in 1930. Without a significant role in the management of commercial forest land — such as the U.S. Forest Service enjoys by virtue of its jurisdiction over the national forest system — federal forestry in Canada has been vulnerable to indifference born of a faith in the inexhaustibility of our forests. Canada remains without a viable national forest policy, and industry has accelerated its development of alternate fibre sources in the North in recent decades, as traditional wood-producing regions and their dependent communities fall into decline.

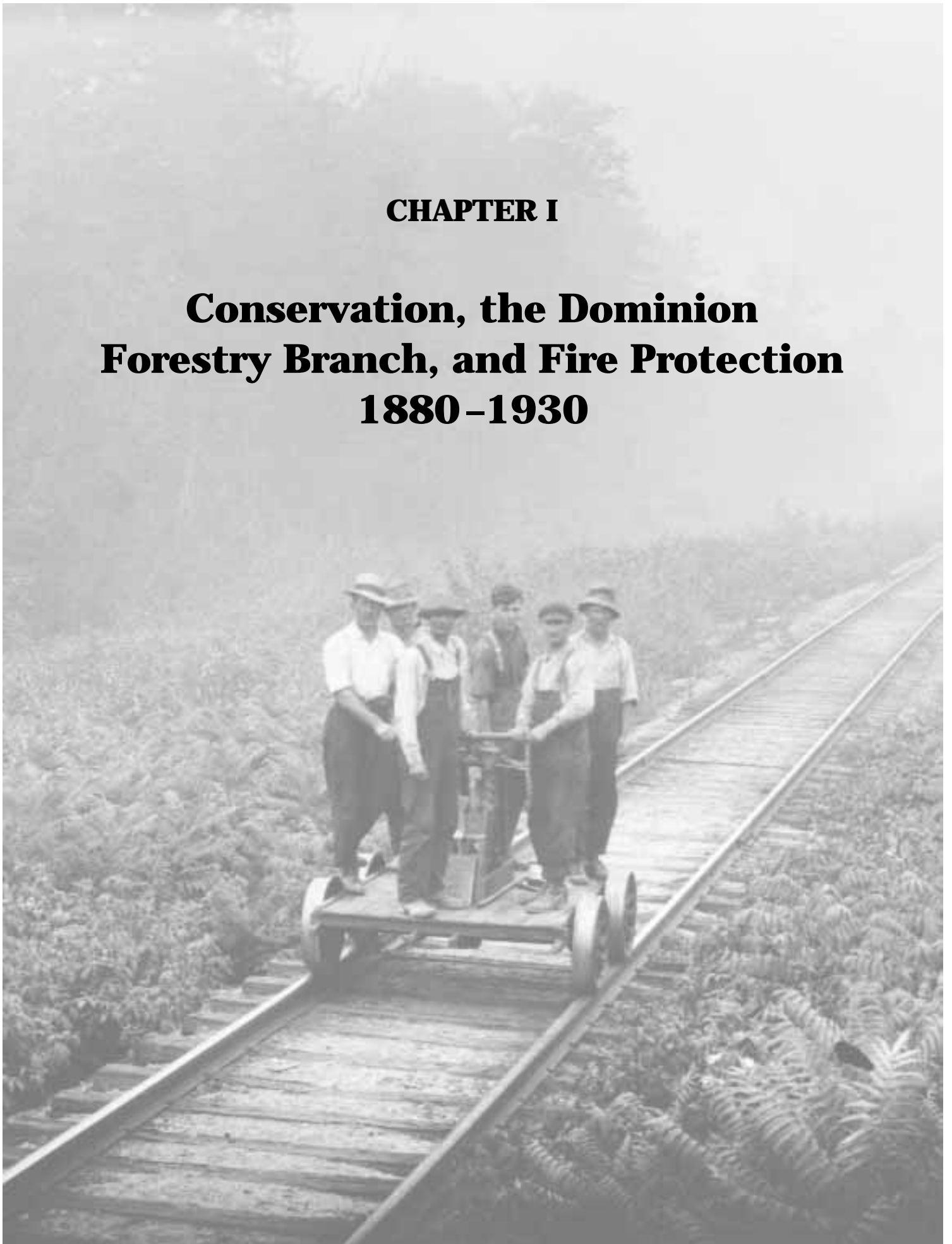
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## **CHAPTER I**

# **Conservation, the Dominion Forestry Branch, and Fire Protection 1880–1930**





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# Conservation, the Dominion Forestry Branch, and Fire Protection, 1880–1930

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During the first three decades of its existence, the Dominion Forestry Branch — along with the provincial organizations that came into being during the early twentieth century — took its first steps in managing Canadian forest lands. Originally treated as obstacles to settlement — a persistent sentiment where agriculture and lumbering competed for dominance — forests came to be viewed by governments as engines of economic development. Forestry in Canada, as one of its pioneers put it, would be born “independent of sentimental considerations,” and develop along “practical and businesslike” lines in both the federal and provincial spheres.<sup>1</sup>

This utilitarian concept of trees as potential sources of public revenue and private profit gave rise to a cooperative relationship between governments and timber interests, placing clear limits on the functions performed by early forestry organizations. Aside from their primary duty — that of collecting the government’s share of wealth generated from Crown lands — they devoted themselves largely to protecting forests from fire. Some resources were devoted to tree-planting where this served to support agriculture, and foresters conducted surveys as a basis for the creation of reserves on lands that would not support farms. In the main, however, forest management was equated with fire protection.

With limited resources at their disposal, and drawing freely from precedents set by the more generously funded U.S. Forest Service, the Dominion Forestry Branch and its provincial counterparts engaged in a dynamic process of technological and organizational innovation. The early fire ranger who travelled by horseback and canoe lost some ground to the stationary lookout. Telephones and radios permitted instant communication between lookouts and headquarters. Although gaining access to fires in remote, mountainous country remained difficult or even impossible, in settled areas automobiles hastened the arrival of fire crews. Aviation, a topic discussed in the following chapter, began to play an important role in fire patrols and in the transportation of fire suppression forces and equipment. Finally, the development of motorized portable pumping equipment provided a breakthrough in firefighting technology.

However, if foresters were unanimous in seeing forest fires as an enemy that must be fought during this period, their capacity to do so remained quite limited. Conflagrations destroyed settlements, killed hundreds, and burned thousands of acres of forest land across Canada. Conservationists, foresters, public officials, and

lumbermen bemoaned the loss, and made some progress in guarding marketable timber; however, the apparently limitless supply made it all too easy for stingy governments to restrain expenditures on forest protection. Those in the profession who wished to extend protection to the immature forests, and regulate logging practices to reduce the amount of slash in order to encourage natural reproduction, would have to be patient.

The federal role in Canadian forestry originated with the Dominion’s creation in 1867. The Prairie West, and most of the North, had been granted to the Hudson’s Bay Company by the British Crown in 1670. The sparsely settled area known as Rupert’s Land, which included all the lands draining into Hudson Bay, figured prominently in Sir John A. Macdonald’s vision of Confederation. Possession of the West would provide a hinterland of natural resources, a market for the products of central Canadian factories, and a defence against the American sense of “Manifest Destiny” which tended to encourage calls for annexation of the region.

Although the *British North America Act* awarded control over natural resources to the original provinces of Ontario, Quebec, New Brunswick and Nova Scotia, Canada succeeded in gaining the approval of the Hudson’s Bay Company and the British Parliament to purchase the Northwest in 1868. Macdonald also retained federal authority over Manitoba’s lands and resources when the Riel Rebellion forced the creation of the “postage stamp” province in 1870. A year later, British Columbia entered Confederation as a full partner, with control over its resources intact, aside from a forty-mile-wide strip of land along the route of the Canadian Pacific Railway, and a block of forested land in the Peace River region, which had been awarded to the federal government as part of the agreement for a transcontinental railroad.<sup>2</sup>

Ottawa moved quickly to establish control over its possessions stretching from Ontario to the Rocky Mountains. The *Land Act* of 1872 provided for free homestead grants to promote settlement; a new Department of the Interior took responsibility for administering Dominion lands; and the North West Mounted Police came into existence to enforce law and order. In 1875, Parliament passed the *North West Territories Act* and established a Governing Council to administer the region, which was later divided into the Districts of Assiniboia, Saskatchewan, Alberta and Athabasca for administrative purposes. The Council’s 1877 Ordinance Respecting the Prevention of Prairie and Forest Fires provided for prosecution of those whose

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lack of caution allowed fires to spread. The Department of the Interior appointed Crown Timber Agents to collect dues from cutting on leased timber berths in the region, and revenue collection remained the central preoccupation of the Department's Timber, Mines, and Grazing Branch, following its creation in 1882. The Branch's first forest rangers appeared in 1883, working under the supervision of the Timber Agents.<sup>3</sup>

By the time Confederation had been forged from British North America's disparate parts, the timber industries of Ontario, Quebec, and New Brunswick had already developed close relations with governments that had adopted lease systems of forest tenure, confirming public ownership of the resource while providing an important source of revenue for provincial treasuries in the form of ground rents and royalties. On the West Coast, British Columbia's embryonic timber industry set down roots at Burrard Inlet, and developed export markets around the Pacific Rim. The real boom on the West Coast would not begin until the 1886 completion of the CPR linked the province's immense timber resources to the prairie market. By this time, however, operations in the Ottawa Valley and the Atlantic region were already experiencing shortages of the easily accessible white pine which was essential to the square timber trade that had dominated eastern lumbering throughout the nineteenth century.<sup>4</sup>

Concern about dwindling supplies on Crown Land in Quebec fostered cooperation in conservation among lumbermen and government officials, as a means of promoting stability and expansion. By the mid-1870s, the province had adopted a cutting regulation which imposed a minimum diameter limit in order to preserve small timber, and appointed inspectors to ensure that the Crown received its royalties. The province passed a forest fire prevention act in 1870, but did not provide a means for its enforcement. The province's early ranger staff had statutory authority to regulate cutting practices and dispense fire-prevention advice, although loose administration and corruption diminished the effectiveness of Quebec's otherwise progressive legislation.<sup>5</sup>

A similar halting pattern of progress was evident in Ontario, where officials made no effort to compel adherence to an 1871 diameter limit rule. The province's 1878 *Act to Preserve Forests By Fire*, which introduced burning restrictions during the April-November closed season, met a similar fate. In forest-dependent New Brunswick, depletion of pine by the 1850s had forced lumbermen to make an early transition to spruce, which was sufficiently abundant to forestall any interest in forest conservation until the 1890s. On the Pacific Coast, British Columbia adopted the Ontario model of issuing annual renewable leases in 1865 to ensure the government's right to royalties. Legislation on forest protection followed in 1874 with passage of the *Bush Fires Act*, which provided for

penalties against those whose carelessness with fire damaged the property of others or Crown land. It is not clear when the province's government appointed its first Fire Wardens — later described as wandering patrolmen who were "hard to find when wanted in an emergency" — but an 1896 amendment refers to the existence of forest rangers empowered to enforce the *Act*.<sup>6</sup>

By 1880, then, most provincial governments had developed some appreciation of the timber industry's financial value, and had taken a few rudimentary steps in forest protection, but showed little inclination to make significant investments in administration or regulation. During the second half of the nineteenth century, however, concern over depletion of the North American forest gradually gained headway. George Perkins Marsh's seminal *Man and Nature* appeared in 1864, warning that civilizations must use natural resources wisely or perish. Eleven years later, the American Forestry Association came into existence, numbering a few Canadians among its members. Massive fires in the Ottawa Valley in the early 1870s, in tandem with diminishing reserves of white pine, prompted veteran lumberman James Little to call for governments to take action on fires, enforce diameter limits to ensure regeneration, and protect non-agricultural forestland from the encroachment of settlers.<sup>7</sup>

Although the common assumption of unlimited timber abundance would remain a barrier to legislative initiative, Little and the few lumbermen who shared his views found allies among progressive farmers, fruit-growers, scientists, and urban middle-class elites in central Canada who shared an interest in forest conservation. As this diverse group coalesced, the operators would direct its reformist enthusiasm along practical lines, in keeping with the industry's goals of economic stability and expansion. Conservation began to take on a particular meaning, emphasizing efficient resource exploitation by large-scale private enterprise, in partnership with a more activist state.<sup>8</sup>

The Canadians' first opportunity to share ideas with like-minded Americans came in the form of an invitation to attend the 1882 inaugural meeting of the American Forestry Congress in Cincinnati, Ohio. There, a delegation of Ontarians met a group from Montreal which included James Little and his son, William. The Canadians' proposal that the organization's second meeting be held in Montreal that August won acceptance, setting the stage for the official birth of the Canadian conservation movement.

The Littles managed to secure the participation of Quebec lumbermen, who shared a growing concern about tenure issues, the encroachment of settlers on the remaining northern pine limits, and improved fire protection. Seeing an opportunity to make the meeting a



forum for their views, the operators succeeded in securing unanimous endorsement of recommendations which urged governments to adopt forest fire regulations, create protection organizations, establish forest reserves on non-agricultural timberlands, and take action against brush-burning by settlers during periods of high fire hazard. These proposals, Gillis and Roach observe, exerted a great influence on early Canadian forestry legislation, and succeeded in cementing the industry's place within the nation's conservation movement.<sup>9</sup>

Quebec took the first legislative action in the aftermath of the meeting, adopting an 1883 measure that provided for the appointment of forest rangers, at limit-holders' expense, to undertake fire patrols on their holdings. Quebec's lumbermen were equally satisfied with the establishment of a forest reserve east of the Ottawa River that barred settlers from the territory. This victory was short-lived, however, as the new Parti National government heeded the demands of the province's colonization movement and opened the area to settlement in 1886.<sup>10</sup>

Ontario responded more slowly, but with more lasting results. In 1883, the province established the position of Clerk of Forestry within the Department of Agriculture to educate farmers on woodlot management. In 1895, Thomas Southworth accepted the position, and two years later Ontario's *Forest Reserves Act* authorized the setting aside of timber areas to ensure future production. Southworth simultaneously became Director of a new Bureau of Forestry. Industrial tenure and revenue matters remained in the hands of the Commissioner of Crown Lands, but fire protection received attention in 1885 when limitholders and the federal government agreed to share the expense of hiring 37 rangers to patrol forested districts during the May-October period.

Although New Brunswick appears to have been relatively isolated from the influence exerted by the Congress meeting on Central Canadian legislators, the province did introduce a diameter limit regulation in 1883 which prohibited the cutting of pine or spruce timber that would not produce a log 5.5 metres (18 feet) in length with a 25-centimetre (10-inch) diameter. Severe fires the following year prompted the Surveyor General to recommend the creation of a ranger staff to guard the forest during the dry season. The legislature responded in 1885 with a forest fire law that introduced restrictions on burning during the May-December period, providing for the prosecution of violators. Not until 1897 did New Brunswick follow up by funding the hiring of rangers, allotting \$2,000 for this purpose and appointing a Chief Fire Warden.<sup>11</sup>

With its jurisdiction confined to the Prairie West and British Columbia's Railway Belt, the federal government edged more cautiously toward accepting a role in forest

management after the Congress. Sir John A. Macdonald, concerned that the lack of trees on the Prairies was contributing to a disappointingly slow rate of settlement, appointed Joseph Morgan to inquire into the subjects of tree-planting and forest conservation in February 1883. Morgan reported back a year later, recommending that the Dominion begin a program of tree-planting on the Prairies, but government apathy and preoccupation with the Riel Rebellion in 1885 caused officials to ignore the document.<sup>12</sup>

Completion of the CPR in 1886 revived Macdonald's concern over the rate of western settlement, and in 1887 Morgan was appointed Commissioner of Forestry, with instructions to report on methods of tree-planting on the Prairies and to consider the broader issue of "preserving and protecting the forests in the Dominion." His 1889 report restated the need for reforestation in the West, called for the protection of forests at the headwaters of rivers in the Rocky Mountains, proposed the establishment of forest experiment stations, and urged Dominion and provincial governments to take action against forest destruction. The Department of the Interior, devoted to maximizing revenue from the development of western lands, rejected Morgan's ambitious scheme and abolished his position in 1890.<sup>13</sup>

Morgan did not depart without one accomplishment, however: an 1884 amendment to the *Dominion Lands Act* which provided for the creation of a forest reserve in the Rockies to ensure the water supplies essential to agriculture and ranching in semi-arid southern Alberta and Saskatchewan. Responsibility for the administration of the Rocky Mountains Forest Reserve went to the Department of the Interior's Timber, Minerals and Grazing Branch, which made no effort to protect or manage the area. Moreover, the Branch had already leased out extensive tracts of the most valuable timber. These existing allocations would significantly limit the federal government's management of the reserve system as it evolved. Indeed, Ottawa showed little interest in managing its western forests. Although members of the North West Mounted Police were appointed as fire guardians in the late 1880s, the Department of the Interior refused requests for funds to control fires in the region. The Dominion Government thus made few strides, during the 1880s, in fulfilling the vision of the early conservation movement.<sup>14</sup>

The election of Wilfrid Laurier's Liberal Party in 1896 coincided with the onset of a period of sustained economic growth keyed by the closing of the American frontier and rising world wheat prices, which in turn stimulated massive settlement of the Prairie region. New federal initiatives in forestry flowed from Laurier's ambitions for western development, supported by his desire to remain in step with public support for conservation, as long as this did not imply burdening private

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enterprise with undue regulation. The 1898 establishment of the Forestry Branch in the Department of the Interior, passage of the 1906 and 1911 *Forest Reserve Acts*, and the creation of the Commission of Conservation in 1909, marked the real beginning of the federal government's involvement in forestry.

Laurier's Minister of the Interior, Clifford Sifton, motivated by a desire to tighten Ottawa's control over the Dominion's agricultural and timber resources in the West, wasted little time in launching management initiatives. Shortly after taking office, he increased the number of Crown Timber Agents, had homestead inspectors appointed as fire rangers, and announced the government's intention to withdraw the richest belts of timber in Manitoba and the Northwest Territories from settlement. Work began on cutting fire guards through the recently established Moose Mountain and Turtle Mountain Reserves.<sup>15</sup>

Winnipeg-based Inspector of Crown Timber Agents, E.F. Stephenson, proposed a more thorough program of land-classification and reserve-creation which would ensure forest protection while making timber available for settlement and commercial exploitation. Sifton accepted his recommendation that a commissioner be appointed to study the forest management problem in the West, and a July 1899 Order-in-Council created the new position of Chief Inspector of Timber and Forestry under the Chief Clerk of Timber and Grazing. Elihu Stewart, a Dominion Land Surveyor with a wide knowledge of forest conditions from the Ottawa River to the Rockies, came to the post with instructions to inquire into the whole matter of forest protection, forest reserves, and tree-planting as a basis for future government policy. A second section of the Order introduced new regulations for Dominion timber berths. In addition to establishing a minimum diameter limit of 25 centimetres (10 inches), the new policy required operators to pay an equal share of the cost of fire prevention and suppression on their berths.<sup>16</sup>

Stewart presented his first report in 1899, describing the forestry problem of the Northwest as one of conservation and propagation. He urged the government to follow the lead of Ontario and Quebec in establishing a fire-ranging organization to carry out patrols during periods of high hazard. The North West Mounted Police had performed a valuable service in enforcing the *Fire Acts* of Manitoba and the Territories, but their numbers were not adequate to the task. Second, he advised the adoption of a "judicious system of cutting" to ensure a continuous supply of timber from those areas better suited to forestry than agriculture. Finally, Stewart recommended that the federal government encourage tree-planting by prairie settlers.<sup>17</sup>

By 1901, Stewart had begun to make progress on two of these fronts as Superintendent of the new Dominion

Forestry Branch. After touring the forested districts of the Prairies and the B.C. Railway Belt in 1900 to gather information on the fire problem and tree-planting, in 1901 he succeeded in initiating a system of fire patrol on several reserves. Crown Timber Agents hired local men on a temporary basis, paying them three dollars a day to patrol on their own horses. In the season of 1903, 22 of these rangers were engaged, in addition to a number of other men employed to fight fires as required. Stewart credited the new arrangement with reducing the extent of fire damage on the reserves, and in 1905 reported that rangers had begun cutting trails to improve access in the event of fire on the reserves. A motor launch went into service on Shuswap Lake in the Railway Belt, contributing to the forest protection system. By 1906 the number of rangers numbered about 40, employed principally in the timber-rich Railway Belt; the area north of the Saskatchewan River; along the Athabasca River; and, in the wooded districts of Manitoba and Saskatchewan. Within the Department of the Interior, however, Stewart could only continue to advise his superiors on the need for proper cutting methods.<sup>18</sup>

Perhaps the most impressive of the Forestry Branch's endeavors came in the field of tree-planting on the Prairies. At the turn of the century, the Dominion Government came under pressure from western boards of trade to promote the planting of shelter belts as a way to beautify farms and increase agricultural productivity. Work along these lines began at the Department of Agriculture's experimental farm at Indian Head, Saskatchewan in 1889, with experimental plantings of 30 species to determine survival rates. Maple and ash proved the most promising for windbreaks and plantations, and distribution to farmers commenced in 1893.<sup>19</sup>

The Forestry Branch took on responsibility for cooperating with settlers in the creation of shelter belts and woodlots in 1901. Norman Ross, a graduate of the Ontario Agricultural College and the Biltmore Forest School, moved west to head the program. Initially a few acres on the Brandon and Indian Head Experimental Farms were placed at his disposal for nursery purposes, then in 1903 Ross broke ground on a 65-hectare (160-acre) plot adjacent to the Indian Head facility. During the following summer, buildings, roads, and fences went up and, by 1906, seven million seedlings had been distributed to 3,700 farmers. Annual distribution averaged over two million trees from the nursery — which soon reached its capacity, despite expansion to 194 hectares (480 acres). In 1912, the Branch selected a second facility on the outskirts of Saskatoon, which began production four years later. Together, the two stations achieved an annual output of seven to nine million seedlings by the end of the 1920s, concentrating almost exclusively on broadleaf varieties. The scarcity and expense of labour prompted Ross to rely on a variety of horse-drawn

equipment. Staff employed a modified Massey-Harris fertilizer drill to sow the seed, conserving soil moisture during the growing season by cultivating with a Planet Junior harrow and removing the crop with an "ordinary type two horse tree digger." No other field of Dominion forestry work drew more praise than the tree-planting program. "The beautiful and comfortable homes surrounded with trees seen here and there throughout the west are the best evidence of the value of the work which is being carried out by the government," observed the *Canadian Forestry Journal*.<sup>20</sup>

In addition to the administrative duties that grew in accordance with his Branch's responsibilities, Stewart served as the nation's leading crusader for the cause of forestry. His model in this endeavor was the dynamic Gifford Pinchot, who succeeded Bernard Fernow as head of the U.S. Department of Agriculture's Division of Forestry in 1898. Congress had authorized the creation of forest reserves in that country in 1891, totalling over 12 million hectares (30 million acres) by 1897. Pinchot succeeded in maintaining jurisdiction over the reserves transferred from the Department of the Interior's General Land Office to the Department of Agriculture in 1905, thus coming under the control of his newly-titled U.S. Forest Service. Stewart visited Pinchot in the fall of 1899, adopting the latter's goal of consolidating federal forest management within a single agency.<sup>21</sup>

Although neither Stewart nor his successors would realize this ambition, the Superintendent returned from Washington, D.C. and led the way in organizing the Canadian Forestry Association (CFA) in 1900. This new body exerted strong pressure for a more vigorous Dominion forest policy, and in 1905 Stewart achieved a "fleeting victory" in the fight for consolidation when he was given authority over the new Chief Clerk of the Timber and Grazing Branch, R.H. Campbell. Unfortunately, Sifton's resignation that year halted further progress along these lines. New Minister of the Interior Frank Oliver did not share Sifton's enthusiasm for centralized direction of the economy, and resisted transferring control to the Forestry Branch of logging on timber berths.<sup>22</sup>

Despite Oliver's reluctance to support the full range of Stewart's ambitions, policy initiatives followed after the CFA's first Canadian Forestry Convention, held at Ottawa in early 1906, urged the federal government to develop a national forest policy. Passage of the *Dominion Forest Reserves Act* that spring provided a legislative basis for their creation, and awarded management responsibility for the reserves to the Forestry Branch. Oliver scuttled Stewart's

hopes that the *Act* would give his agency control over harvesting on the timber berths, which included almost all of the commercial timber on the 485,000 hectares (1.2 million acres) of land then held in reserve. The Liberals' national forest policy thus represented a half-measure which perpetuated administrative confusion in the West; confined the Forestry Branch to forest production, survey, and reforestation duties; and, prevented the agency from achieving the status of its American counterpart.<sup>23</sup>

Stewart's resignation in 1907 to enter the lumber business elevated R.H. Campbell to Director of the Forestry Branch. His appointment coincided with the arrival of several graduates of American forestry schools, providing the agency with the technical expertise required to fulfill its limited mandate. Ontario-born A. Knechtel, a graduate of Cornell, became the first Inspector of Forest Reserves. Other additions included Yale's H.R. MacMillan and W.N. Millar, and J.R. Dickson from the University of Michigan. Public support for forestry in the East ensured that the second wave of foresters in Canada came largely from Canadian institutions. In 1907, Bernard Fernow accepted an appointment as Dean of the University of Toronto's new School of Forestry. The following year, he became the first president of the Canadian Society of Forest Engineers (CSFE), and in 1910 the University of New Brunswick established a forestry department. Quebec inaugurated forestry instruction at Laval University that year, and most of its graduates found employment with the new Quebec Forest Service. Education to meet the needs of British Columbia's unique forestry sector did not begin until 1920, at the University of British Columbia.<sup>24</sup>

This new technical elite would eventually find employment opportunities as the federal and provincial governments responded to the conservation movement's



**Figure 5** Firefighting gang on a handcar, Bala, Ontario — August 1916.  
(Source: Boyd, John/Library and Archives Canada/PA-69793)



**Figure 6** Men fighting bushfire, sitting on railway tracks near Bala, Ontario — August 1916.

(Source: Boyd, John/Library and Archives Canada/PA-69794)

pressure for forest management initiatives. Ontario appeared to make progress, hiring Cornell graduate Judson Clark as an assistant to Clerk of Forestry Thomas Southwork in 1904. In other policy initiatives, Ontario's Whitney government required railways to station fire rangers along their rights-of-way in 1906, and expanded patrols within its forest reserves. To compensate for this

expense, it made lumbermen bear the full cost of fire protection on licenced tracts in 1910. However, Whitney also resisted Clark's proposal to create a professionally staffed Department of Forests to enforce much-needed logging and slash-disposal regulations. More concerned with promoting American investment in the expanding pulp sector than with regulating corporations in the public interest, the Whitney administration and its successors pursued an "exploitive ethic" which left little room for sophisticated forest management. Frustrated over his lack of influence, Clark resigned in 1906.<sup>25</sup>

The consequences of Ontario's meagre investment in forest protection soon became evident in a series of destructive fires. The 1911 conflagration in Porcupine burned 202,000 hectares (500,000 acres), killing 73 people. In 1916, the Matheson fire, the most disastrous in Canadian history, consumed several communities and left 200 dead. The provincial government responded with the 1917 *Forest Fires and Prevention Act*, which provided for the appointment of a Chief Forester with authority over forest



**Figure 22** Major fire at South Porcupine, Ontario — July 11, 1911.

(Source: Peters, Henry/Library and Archives Canada/PA-029808)

protection and reforestation. E.J. Zavitz filled the post, and the new Ontario Forestry Branch began its administration of more effective fire-prevention and -suppression measures. Almost 1,000 rangers patrolled the province's districts in 1917, supervised by J.H. White and a staff of chief rangers.<sup>26</sup>

Forestry in Quebec made more dynamic progress, with the 1909 creation of a Forest Service within the new Department of Lands and Forests. The agency supervised fire protection on unlicensed Crown lands, conducted surveys, and made efforts to enforce diameter-limit cutting regulations. Beginning in 1913, limit-holders organized cooperative associations for protection of their holdings, sharing the expense of patrols and improvements, on an acreage basis, with financial assistance from the government. By 1917, the St. Maurice, Ottawa River, Laurentian, and Southern St. Lawrence associations had placed 108,000 square kilometres (67,000 square miles) of licensed forest land under cooperative protection.<sup>27</sup>

Modernization of New Brunswick's forestry administration edged forward with the appointment of a permanent corps of fire rangers in 1908. A decade later, the passage of a new *Forest Act* created a Forest Service within the Department of Lands and Mines, and a forest protection fund supported by taxes on leased land. The province was divided into 36 protection districts, under five inspectors who supervised 40 rangers and 200 cooperative and voluntary fire wardens.<sup>28</sup>

In the far West, British Columbia experienced a timber boom of remarkable proportions after Richard McBride's provincial Conservative government invited a swarm of speculators and lumbermen to the province with attractive tenures in 1905. By the end of the decade, however, the need for rational administration of the industry was evident to all. A Royal Commission set the stage for passage of a *Forest Act* in 1912, creating a Forest Branch within the Department of Lands to collect revenue and administer a forest protection fund jointly supported by government and industry. H.R. MacMillan moved from the Dominion Forestry Branch to become the province's first Chief Forester, and additional fire wardens were hired around the province.<sup>29</sup>

By 1920, then, all of the forested provinces with jurisdiction over natural resources had placed their Crown forest lands under the control of technically trained staff, with the exception of Nova Scotia. In British Columbia, Quebec and New Brunswick, agencies administered fire protection and cutting regulations. Ontario's Forestry Branch found itself confined to protection, survey, and nursery work. In all cases, however, severe fire years such as 1919 proved that provincial organizations needed greater funding to improve protection standards.<sup>30</sup>

The same constraints existed within the federal domain. Despite a continuing shortage of trained foresters, the Dominion Forestry Branch extended its operations in the West after its 1906 legislation. The appointment of permanent rangers improved the quality of fire protection on the 26 reserves. In 1907, rangers began burning meadows along reserve boundaries in the spring, creating fire-lines intended to stop prairie conflagrations from spreading. Ploughed fire-guards were introduced on other lands, and a program of road construction continued to improve access to firefighters in the event of fire. In outlying regions, which had previously been afforded no protection, the Branch appointed one- or two-man patrols to provide minimal coverage of the main travel routes.<sup>31</sup>

The area of timberland under federal administration represented the "largest, the most inaccessible, and the most scattered" of any in Canada, as MacMillan and Gutches noted in 1908. Fire rangers covered only about 400,000 (250,000) of the 1.1 million square kilometers (700,000 square miles) requiring protection, and annual appropriations were utterly inadequate to provide efficient patrols of the whole territory. Thirty-seven rangers patrolled the Railway Belt: the most heavily guarded area under Dominion jurisdiction. Timber limits on the eastern slopes of the Rocky Mountains, the drainage basins of the rivers west of Edmonton, the territory north of Prince Albert, and the country traversed by the Canadian Northern Railway tributary to Dauphin, Manitoba, received "as good protection as possible." Further north, in the Lac La Ronge district, the Peace River, around Great Slave Lake and on the Athabasca River, a few men patrolled districts thousands of square miles in extent. Severe fires that year — one of which levelled the town of Fernie in British Columbia — elicited industry demands for governments to improve the level of forest protection.<sup>32</sup>

Another important endeavour on the reserves involved surveys to provide a basis for forest-management plans. In the summer of 1908, MacMillan headed a party of five forestry students who surveyed the Pines reserve, while Dickson supervised a crew of 13 at Riding Mountain. The surveys assessed the type and maturity of timberstands, studied reproduction, and sought means of encouraging the growth of commercial species. The Branch also established regulations for timber-cutting on the Riding Mountain, Duck Mountain, and Porcupine Hills reserves. Settlers living within 80 kilometres (50 miles) of these reserves were eligible for permits entitling them to remove specified amounts of timber for farm development, and Knechtel introduced a policy of allowing small sawmills on the reserves to cut only marked timber and dispose of debris.

As fires had denuded many of the reserves of forest growth, the Branch also began direct seeding experiments with varieties of spruce and pine. Officials considered

planting too expensive for general application at this time, but small nurseries on the Riding Mountain, Spruce Woods, and Turtle Mountain reserves raised some coniferous stock. Finally, the Branch endeavored to clear the reserves of squatters. Although they were awarded homesteads elsewhere and compensated for improvements, the policy eroded some of the goodwill fostered by the popular tree-planting program.<sup>33</sup>

Protecting the reserves from fire represented the greatest single management objective, and massive conflagrations in the Canadian and American West in 1910 exposed the inadequacy of existing arrangements. "The question is not so much at the present time one of legislation or theoretical speculation or general inquiry,"



**Figure 7** Fire lookout at Pines Forest Reserve, Saskatchewan — 1913.

(Source: Saskatchewan Archives Board/R-A9704-1)

Campbell observed, "but of providing an adequate or efficient organization." The U.S. Forest Service considered one ranger for every 100 square miles sufficient: a standard that would have required increasing the existing staff of permanent rangers from 19 to 250. "Mechanical means of assistance" such as lookout towers and telephones were also needed, in addition to more roads, trail networks, and fire-guards.<sup>34</sup>

The following year, the Forestry Branch introduced a new organizational structure on the Rocky Mountains Forest Reserve, dividing the territory into administrative units with a ranger stationed on each. During periods of low hazard, these men, selected for their "strong, sober, industrious" character and lumbering experience, cleared trails, ploughed fire-guards, cut boundary lines and watched for trespassers. When the danger of fire ran high, they patrolled constantly. A new wrinkle in the protection strategy, borrowed from the U.S. Forest Service, saw the rangers build tool caches at convenient points close to main trails. These structures, built of logs with board roofs, a door and small window, were equipped with a stove, bed, and an array of firefighting equipment. Each cache held 13 long-handled square-point shovels, another 19 of these implements with rounded points, nine axes, a dozen grubhoes, six galvanized buckets, and an equivalent number of brooms. Where the clearing of ploughed fire-guards warranted, a "heavy brush-breaking plough" completed the inventory.<sup>35</sup>

The Forestry Branch's arsenal of hand tools placed it squarely in the mainstream of early-twentieth-century fire-suppression technology: a model largely adapted from common farming and logging tools. The U.S. Forest Service equipped its crews with crosscut saws, mattocks, shovels, and axes to battle the infernos that swept through the northern Rockies in 1910. In addition to these devices, MacMillan and Gutches included blankets and sacks in their 1910 list of recommended suppression implements, which, along with branches, could be wetted and used to beat out surface fires. Other "beating" devices included coats and riding slickers. Where slash was not too abundant, early fire experts recommended raking the leaves and debris from a "trace" in front of the fire to deprive it of fuel, then beating it out along this line.<sup>36</sup>

Such fires might also be checked by shovelling dirt or sand on flames, or using water if available. Since water usually had to be brought from some distance, foresters cautioned against wasteful use. "The best way is to deaden the flames by a little water, and then beat them out with a gunny sack or other device," asserted the U.S. Forest Service's Henry S. Graves in 1910. The agency favoured the use of collapsible canvas pails because of their light weight; it also employed sacks which could be slung on a pack saddle to transport

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water over mountain trails, and hauled barrels or specially constructed tanks where roads permitted wagon transportation. Graves also referred to the efficient use of the "hand spray pump" by northwestern farmers: a device capable of throwing an accurate stream of water up to nine metres (30 feet).<sup>37</sup>

More stubborn ground fires, which burned in the layer of organic material on the forest floor, often demanded that crews dig a trench 0.6 to 1.2 metres (2 to 4 feet) wide with axes, mattocks, and shovels along a chosen line, right down to the mineral soil, making a stand there to stop the advance. Fighting these fires was "hard, mean work," but not unduly dangerous unless high winds whipped them into crown fires, which defied all methods of suppression. In such an event, crews could only withdraw a considerable distance, where a natural barrier such as a road or bare ridgetop might offer the opportunity to ignite a back-fire.<sup>38</sup>

On the policy front, passage of the 1911 *Dominion Forest Reserves and Parks Act* again demonstrated the Laurier government's commitment to compromise. The legislation denied the Forestry Branch authority over the timber berths, which included almost all the commercial stands within the reserves, while increasing the number of these stands to 36, encompassing over 6 million hectares (14.8 million acres). The quality of forestry on Dominion lands would continue to be hamstrung by this administrative anomaly, in distinct contrast to the American model, in which U.S. Forest Service professionals regulated cutting practices and slash disposal to secure a new crop. Thus, even as increased funding enabled the agency to make progress in fulfilling its protection responsibilities, it had little opportunity to practice silviculture, and the Timber, Minerals and Grazing Branch turned a deaf ear to its proposals for reforms.<sup>39</sup>

While this weak-kneed approach to federal forestry remained a source of frustration, expansion of the reserve system, surveys of forested belts north of the prairie region and the severe 1910 fire season convinced officials of the need for "radical changes and elaborations in the general structure of the organization and in the methods of handling business." In 1912, Campbell reported that the Dominion lands would be divided into four districts corresponding to provincial boundaries, each headed by an Inspector. Next in the chain of command came the forest reserve supervisor who oversaw the activities of rangers, each of whom was assigned to a specific district within the reserve. In order to make these positions permanent, the Branch began providing rangers with housing on the reserves.<sup>40</sup>

New legislation, empowering the Board of Railway Commissioners to require railway companies to establish patrols and fight fires along their rights-of-way,

enabled the Branch to extend fire patrols into new areas. The responsibility for protection outside the reserves fell to E.H. Finlayson, appointed Inspector of Fire Ranging in 1913. He administered eight districts with a skeleton staff of rangers, utterly inadequate to the enormous area. All of this activity, in addition to new research endeavors such as T.W. Dwight's investigation of regeneration after fire and logging in the West, called for more foresters. Although Canadian schools had begun to produce "men of the right calibre and abilities," the supply did not meet the demand. By this time, the agency's technical staff included five University of Toronto graduates, three from the University of New Brunswick, and seven graduates of foreign schools; however, the acquisition of technical expertise to meet the agency's goal of making "every acre a producing acre" remained a priority.<sup>41</sup>

A doubling of the Branch's appropriation in 1913 to \$541,000 permitted staff increases, implementation of the reorganization scheme, and the introduction of more advanced methods of fire-detection. The patrol by a mounted ranger, supplemented by canoe where waterways permitted, would remain central to forest fire detection for decades. Standard equipment for a B.C. Forestry Branch horse patrolman included an axe, canvas bucket, and shovel with a short, detachable handle. Even when organized into well-defined districts with adequate trail networks, however, the patrol system could not ensure rapid detection and reporting of fires. When a ranger sighted smoke from a distance, he could rely only on his knowledge of the country to determine its location, perhaps aided by a map. Such determinations were usually approximate, entailing delays while he searched for the fire. He then confronted the problem of suppression alone, or rode off to summon assistance if the fire exceeded his individual abilities. In the interim, the fire inevitably grew in scale and intensity. "The fatal weakness of this system is the slowness and uncertainty with which it operates," former Forestry Branch Inspector W.N. Millar noted in 1922. The stationary lookout, equipped with an array of fire-finding and communication technology, provided the remedy during the early twentieth century.<sup>42</sup>

The U.S. Forest Service led in the evolution of lookout systems to supplement patrols in North American fire detection, with Canadian protection organizations following close behind. In the course of their patrols, rangers found that periodic visits to points of higher elevation permitted them to view large areas of timberland, and detect smoke that could not be seen from trails. This quest for elevation led to a variety of early lookout towers, the most rudimentary involving spikes or steps fastened to a tree trunk as a ladder. The construction of wooden towers with a small platform followed. Such structures provided no protection





**Figure 8** Fire lookout at Mount Valin, Quebec.

(Source: Library and Archives Canada/PA-44053)

from the elements, and served only as temporary vantage points for rangers or patrolmen who visited them occasionally.<sup>43</sup>

The need to provide more constant observation encouraged the construction of log or stone houses on commanding peaks, or rough shelters atop wooden towers. "The chief advantage of lookout patrol is the comparatively large area which it is possible to keep constantly in view," noted an American forester in 1911. Disadvantages included a reduced opportunity for lookout men to undertake administrative work and remain in touch with forest users. Thus, in many national forests, the U.S. Forest Service combined lookouts with horse-back patrols through the lower valleys or adjacent ridges.<sup>44</sup>

The Dominion Forestry Branch began laying plans for a lookout system on its reserves in 1912. The first steel tower on the Riding Mountain reserve probably appeared the following year. Wooden structures — essentially ladders buttressed by supports — also went up, "in order that fires may be seen and extinguished



**Figure 9** Nimrod steel lookout tower and cabin, Sturgeon Forest Reserve, Manitoba — June 8, 1927.

(Source: Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 19194)

before they have time to spread beyond control." Officials credited the system with reducing fire damage on the mountainous Rocky Mountain reserve, where rugged conditions made patrols ineffective. By the end of 1914, the agency had developed 18 lookout points. In mountainous terrain, this involved little more than building trails to elevated points which commanded a clear view of the surrounding area. On the Prairie reserves, simple wooden towers with small platforms were built at little expense beyond the cost of nails and the time of the ranger. The single steel tower proved so satisfactory, however, that officials hoped that appropriations would permit their erection on a wider scale.<sup>45</sup>

Provincial forestry organizations also began to erect lookouts during this period. The B.C. Forest Branch





**Figure 10** Forest Service lookout, Old Glory Mountain, B.C.

(Source: British Columbia Archives NA-09210)

built temporary “ladder-like” structures from available timber, some permanent stations on peaks, and by 1921 maintained 27 “rest cabins and lookouts”. The new Ontario Forestry Branch erected 82 towers in 1917, at a cost of \$10,000, according to one report. The agency operated stations of both steel and timber construction, the latter built by rangers to a height of about 15 metres (50 feet). The steel towers usually rose another 9 metres (30 feet), but officials wondered if their expense was justified. They apparently decided that primary installations merited investment in the steel variety, placing a 1924 order for several of these structures. The Ontario Wind Engine and Pump Company produced a line of steel towers during the 1920s, as did the Gould, Shapley and Muir Company of Brantford. The latter firm manufactured three types: one with an octagonal wood cabin; another featuring a square steel enclosure; and a lighter type with open platform. By the mid-1920s, Ontario had developed a system of primary and secondary towers, manning the former from 8:00 a.m. to 6:00 p.m. Those in the auxiliary category were staffed by men who performed the joint duties of observer and smoke-chaser, and might be occupied only during periods of high hazard.<sup>46</sup>

In Quebec, the private forest protective organizations took action along these lines shortly after their organization. The Lower Ottawa Forest Protective Association built pyramid-shaped structures topped by an open

platform, and the St. Maurice association had 20 lookouts stationed at vantage points by the end of 1915. A 1924 report on Quebec by the *Canada Lumberman* declared that “the forest lands from the Gulf of St. Lawrence on the banks of both sides of the river, to the upper Ottawa, is now dotted with steel lookout towers.” By 1925, the St. Maurice system included 82 towers, all but five of steel construction, 12 to 24 metres (40 to 80 feet) in height with open platforms. The total number of lookouts at this time maintained by the five associations and the Quebec Forest Service on Crown lands numbered 143. New Brunswick followed up the passage of its 1918 *Forest and Forest Fires Acts* by inaugurating a modest program of lookout construction, including steel ladder-like affairs supported by guy-lines, open-platform wooden towers, and more permanent wood and steel structures with enclosed cabins. “The lookout system has come to stay,” declared the U.S. Forest Service’s W.B. Osborne in 1924, “because it has proved to be the most economical method of securing early discovery and prompt action upon fires which occur at random throughout a broad territory.”<sup>47</sup>

The Dominion Forest Branch’s lookout system in the B.C. Railway Belt provided the most thorough coverage in Canada, according to a 1922 report by E.H. Finlayson. Windows on all four walls provided complete visibility, except during periods of prolonged hot



**Figure 11** Conservation Officer R. Ferguson and Patrolman John Evans using fire-finder in the Salt Creek Tower, Saskatchewan — May 1960.

(Saskatchewan Archives Board/60-312-09)

weather when smoke from fires obscured the observer's vision. By this time, the most thoroughly equipped stations included field-glasses or a telescope, and an Osborne Fire Finder, invented by W.B. Osborne at the U.S. Forest Service's Pacific Northwest Forest and Range Experiment Station to pinpoint the location of fires. This device, resembling "a cross between a surveyor's transit and a sundial," consisted of a heavy circular metal base marked off with the points of a compass. Four short legs provided support, these resting on two metal rods which permitted the instrument to slide back and forth. A map of the surrounding territory was mounted on the base, with the lookout station at its centre. Fitted to the top of the base was a sliding metal ring, which could be turned 360 degrees in either direction. Two upright sighting pieces were attached to this ring, with a horizontal horse hair stretched between them.<sup>48</sup>

The lookout man sighted through the eyepiece, obtaining the distance from the station to any point on the map by means of a metal tape, graduated into fractions, that stretched between the two sighting pieces. A vernier attached to the sliding ring at the base of the eyepiece provided a reading of the sighting angle. The best results were obtained when two lookout stations supplied this data, allowing a triangulation that located fires with reasonable accuracy.<sup>49</sup>

After sighting smoke, the observer had to relay the information to headquarters so that firefighting forces could be dispatched. Communication and transportation represented two of the most pressing problems faced by early-twentieth-century forest protection organizations. By mid-1910, the U.S. Forest Service had constructed over 9,600 kilometres (6,000 miles) of telephone line in the national forests: the first stage of a program that expanded in subsequent years. "The benefits of telephone lines in ordinary administration, and particularly in protection from fire, are incalculable, and have already returned many times over to the people of the United States the money expended in their construction," declared Earle Clapp.<sup>50</sup>

As in other areas of technological development, the Dominion Forestry Branch followed American precedent on a smaller scale. The agency first established telephone connections from its tool caches to neighbouring settlements, so that rangers could summon help when fire occurred. The agency laid 160 kilometres (100 miles) of line in the 1912-1913 fiscal year, doubling this amount by the end of 1914. The system achieved its greatest



**Figure 12** Ranger stringing telephone lines.

(Source: British Columbia Archives NA-07725)



**Figure 13** Lookout station telephone set installed in the field — ca. 1920.

(Source: W.N. Millar, *Methods of Communication Adapted to Forest Protection*, Ottawa, 1920, Fig. 48)

efficiency on the Riding Mountain reserve, where it reached all of the ranger districts. Progress was slowed by the First World War, but the communications network totalled 1,142 kilometres (710 miles) at the end of 1916, linking some of its lookouts to reserve headquarters.<sup>51</sup>

In lookout stations without a phone link, the Branch adopted the U.S. Forest Service's example of utilizing the heliograph as an interim measure. Long used as a means of communication by military forces, the signalling device consisted of a mirror and shutter arrangement mounted on a tripod. The mirror reflected the sun's rays in a given direction, with the operator using the shutter to transmit a series of long and short flashes. The U.S. Forest Service found the Myer code, developed by the U.S. Signal Corps, more effective than the Morse code, which had been created primarily for audio signalling. The agency used the heliograph as early as 1909 in Idaho, and later developed a more portable unit made of aluminum alloy which fit into saddle bags. Rangers were trained in the code, so that they could simply ride to the highest available point to signal news of an outbreak.<sup>52</sup>



**Figure 15** Forest ranger sending message by heliograph — ca. 1920.

(Source: W.N. Millar, *Methods of Communication Adapted to Forest Protection*, Ottawa, 1920, Fig. 105)

In spite of the heliograph's obvious shortcomings — they were useless at night, smoky or hazy daytime conditions made communication unreliable, and staff had to be trained in code — the instruments had considerable utility in the absence of a telephone. Campbell announced in 1916 that the Branch would adopt the heliograph for lookout stations until funding permitted completion of the telephone system. As late as 1928, lookout stations in Saskatchewan reported extensive reliance on the heliograph. At least one other also came into use in Ontario at this time. The Mattagami Pulp and Paper Company, finding that wartime shortages made the construction of telephone lines too expensive, purchased several heliograph devices. The firm's forest engineer, formerly a professor of engineering at Kingston's Royal Military College, taught some rangers sufficient Morse code to permit them to flash messages between lookout towers. The Ontario Forestry Branch experimented with a heliograph over a 24-kilometres (15-mile) distance in 1928, but weather conditions prevented a fair trial.<sup>53</sup>

Destined to become an auxiliary communications device, the heliograph did provide valuable service while forestry organizations worked to develop adequate telephone systems. The Dominion Forestry Branch and other Canadian organizations adopted, with minor modifications, standardized methods developed by the U.S. Forest Service. Practices differed from those followed in ordinary rural and commercial construction, in that forest protection lines often penetrated densely timbered lands without the benefit of wide rights-of-way.

Under such conditions, crews hung galvanized iron wire on trees instead of poles, using special “split tree insulators” instead of the glass type found on commercial lines. To guard against damage from falling or swaying trees, it was essential that the lines be hung with considerable slack, and that insulators be attached to trees or supports in such a way that the line could be carried to the ground without breaking when placed under strain.<sup>54</sup>

During the summer of 1916, W.N. Millar lectured rangers and superintendents on equipment and construction at four meetings organized by the Dominion Forestry Branch, which published his *Methods of Communications Adapted to Forest Protection* in 1920, as a guide for its personnel. In addition to permanent lookout station telephones, the agency required portable sets for the establishment of temporary emergency stations on, or adjacent to, the permanent communication lines. “No telephone system can be provided with permanent stations so numerous that considerable time will not be required to reach them from the average point along the line,” Millar observed.

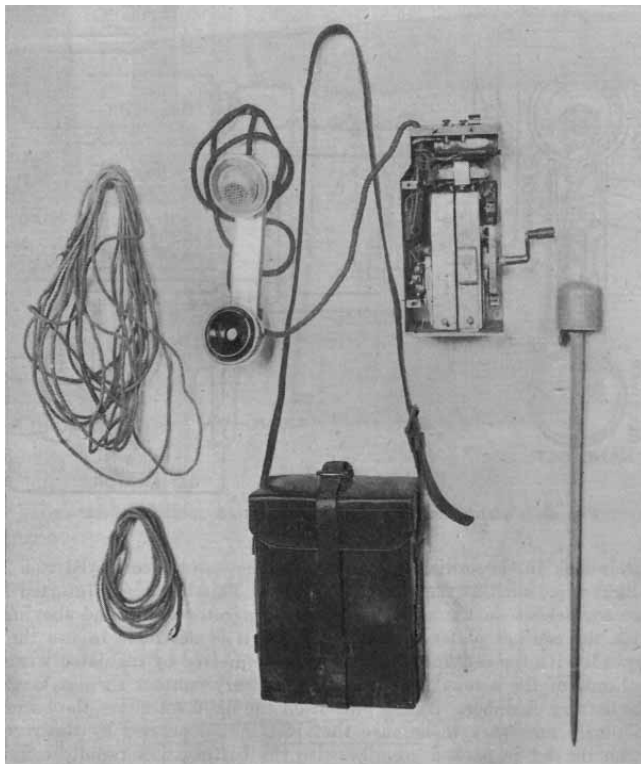
To meet the need for a rugged, lightweight portable instrument for forestry use, the Northern Electric Company designed its 1375-A set, adopted as standard

equipment by the Forestry Branch. Weighing 4 kilograms (9 pounds), and carried in a leather case with adjustable shoulder strap, these battery-powered sets allowed rangers to connect to the line and send emergency messages when the time required to reach the nearest permanent lookout would have lowered protection standards. Particularly suited for railway speeder patrol when mounted in a box and connected to the speeder’s battery, the unit also served well on Prairie reserves where travel by horse team was common; it could also be employed on motorboats. However, as their weight proved a handicap on foot, horse, or canoe patrols, the Branch standardized Northern Electric’s one-kilogram (2.5-pound) 1004-A Adams handset, which was powered by a flashlight battery. Carried as conveniently as a pair of binoculars, and considerably less expensive than the above model, the handset permitted voice transmission, but could not receive calls without auxiliary equipment.<sup>55</sup>

The Branch also developed a self-contained emergency communications kit to provide two-way voice communication from fire-camps and other field installations. Adapted to use with either of the field telephones, the kit featured a wooden box divided into compartments containing an extension bell, howler, battery, condenser, and other standard equipment. Weighing 11 kilograms (26 pounds), complete with a 1375-A telephone, the outfit could be carried by packhorse, and could be lashed to a tree for outdoor use, or placed on a table indoors. In addition, its door opened downwards to serve as a writing shelf.<sup>56</sup>

Among provincial organizations, the B.C. Forest Branch was perhaps the most dynamic in adapting the telephone to forest protection. The province’s telephone companies cooperated in conveying fire reports, but in many timbered districts the absence of settlement demanded that the government build lines to connect to commercial or Dominion systems. The agency hired an “expert telephone-man” to prepare plans and supervise crews after its creation, and in 1913 built 580 kilometres (360 miles) of line at an average cost of \$37.50 per kilometre (\$60.00 per mile). Wall-sets were installed in settlers’ cabins, logging camps, and “stopping places” in addition to Branch offices, and patrolmen carried portable sets designed by the U.S. Forest Service.<sup>57</sup>

Quebec’s forest protection associations began providing their lookout stations with telephone links by the start of the First World War. The St. Maurice organization had over 645 kilometres (400 miles) of line by the end of 1915. Over the next decade, the association constructed another 540 kilometres (335 miles) of line, connecting its 82 towers to district headquarters. Ontario’s Forestry Branch maintained 320 kilometres (200 miles) of line in the province’s forest reserves by the end of 1917,



**Figure 14** Forestry Branch portable telephone set with ground rod and connector — ca. 1920.

(Source: W.N. Millar, *Methods of Communication Adapted to Forest Protection*, Ottawa, 1920, Fig. 62)

increasing this total to 2,415 kilometres (1,500 miles) by the mid-1920s.<sup>58</sup>

The development of wireless communication also captured the attention of forestry agencies during the early twentieth century. The U.S. Forest Service conducted experiments as early as 1913, and interest grew as organizations contemplated the savings to be realized by dispensing with telephone line construction.<sup>59</sup> Reports of the successful military use of the system during the First World War proved particularly intriguing in British Columbia, where much of the patrol on the lower coast was conducted by launches that travelled up and down its many inlets. Coastal geography made the cost of telephone line construction prohibitive, requiring the laying of submarine cables. Anxious to establish reliable communication with its launch patrols, and aware of promising U.S. Forest Service experiments, the agency decided in 1919 to conduct a trial with wireless equipment.<sup>60</sup>

The following year, the British Columbia government awarded a contract to the Marconi Wireless Telegraph Company to erect stations at Vancouver, Myrtle Point and Thurston Bay — home of the Branch's launch station — and to equip five of the craft with communications instruments. Gas engines provided power for the land-based sets, except at Thurston Bay, where a small hydro-electric installation served this function. Those on the launches ran off a friction-drive from the engine's flywheel. Although limited to an average range of about 130 kilometres (80 miles), the sets proved efficient enough for the Branch to consider expanding the system to some interior lookout points. The St. Maurice Forest Protective Association also conducted tests with wireless telephones in 1920, but without success.<sup>61</sup>

Ontario initiated development of an extensive radio communications system in its northern forests in 1927. The Forestry Branch chose the Sioux Lookout District — where a rush of mining activity created a serious fire hazard — for its first trials, with three sets that apparently permitted communication by code only. The system expanded to over thirty stations by the mid-1930s: the first stage in the establishment of a province-wide radio network. Elsewhere, the Quebec Forest Fire Protection Service tested a radio telephone system during the 1920s. The results apparently did not satisfy the agency; but by the end of the decade, the Laurentian Forest Protective Association had installed two Marconi stations in remote areas where telephone lines were costly to construct and maintain.<sup>62</sup>



**Figure 16** Fire Ranger Bill Bailey packing up — 1919.

(Source: Finnie, Oswald S./Library and Archives Canada/PA-100217)

The stationary lookout, equipped with some form of communications system, became a fundamental element in all forest protection organizations, although the moving patrol continued to have a place in fire-detection practice. T.W. Dwight surveyed Canadian patrol methods during the 1914–1916 period. He described travel facilities in the Maritimes — where patrols were conducted in buggies, canoes, or on foot — as “fair”. Canoes provided the standard mode of travel in northern Quebec and Ontario and, in the more settled regions, facilities permitted patrol by foot, horseback, and railway speeder. The St. Maurice Forest Protective Association drew attention by introducing a motorcycle patrol in 1918. “The machine can go faster than the horse, and can get to places where an automobile cannot penetrate,” reported the *Canada Lumberman*. Transportation equipment maintained by the Ottawa River Forest Protection Association in 1918 included 20 horses, 90 canoes, seven motorboats, one steamer, and three railway speeders.<sup>63</sup>

The Dominion Forestry Branch patrolled the prairie provinces primarily by horseback and canoe; it operated steamers on the Slave and Athabasca Rivers; and, gasoline-powered craft travelled the Saskatchewan River and lakes in the Railway Belt. The agency increased its reliance on powered craft to patrol major waterways during the 1920s, introducing “motor scows” on the Peace and Athabasca Rivers.<sup>64</sup>

British Columbia's 1,930 kilometres (1,200 miles) of rugged coastline presented unique challenges. The province operated ten launches in 1910, hiring the craft from their owners. By 1913, the new Forest Branch owned 20 launches — ranging from under nine to over 15 metres (under 30 to over 50 feet) in length, in addition to 20 canoes, dug-outs, and rowboats. With the exception



**Figure 17** Forest Service Patrol Boat, Harrison Lake, B.C. — 1932.

(Source: British Columbia Archives No. NA-11282)

of four smaller craft assigned to interior lakes, all of the launches plied coastal waters. The fleet numbered 30 in 1922, the largest 18-metre (60-foot) “headquarters” launch powered by a 50-horsepower gas engine and capable of sleeping eight. The smaller ranger launch provided accommodation for an engineer-cook and the ranger, who combined office and living quarters in the small cabin.<sup>65</sup>

While the B.C. Forest Branch built up its aquatic force, its determination to “make full use of every modern invention” to ensure speed in reaching fires prompted the introduction of three Ford automobiles and a motorcycle on patrols in the Vernon Forest District in 1916. Results in this heavily settled area justified the expenditure, and the following year additional cars were purchased to replace foot- and horse-patrols in selected regions. When the Fords “proved their worth under all conditions,” the agency expanded its acquisition program, operating 59 automobiles in 1924, along with 16 speeders for patrol along rail-lines. The standardized two-seater Fords with canvas tops featured truck boxes on the rear for carrying firefighting equipment. During the 1920s, the Branch also utilized Stars, Chevrolets, and Whippets around the province.<sup>66</sup>

The Dominion Forest Branch enjoyed no such transportation advantages on the northern Prairies. Finlayson

faced enormous logistical challenges when fires erupted in the territory he administered, sometimes having to round up men in Calgary, arrange for rail transportation, then haul men and supplies by wagon to fire-lines. Continued progress in permanent improvements on the reserves contributed to greater efficiency in fire suppression. By 1915, 480 kilometres (300 miles) of road and over 1,600 kilometres (1,000 miles) of trail were in place, and on some of the older reserves transportation networks neared completion.<sup>67</sup>

Prior to the First World War, suppression forces arrived at a forest fire equipped with the usual array of hand tools. “The shovel, the axe, the hoe, the canvas water bucket, are the great standbys in fighting fire,” Robert Campbell wrote in 1915. Over the next decade, Canadians pioneered the development of portable pumping technology that would revolutionize the fighting of forest fires. Even as Campbell penned his remark, forest officers were engaged in a process of innovation aimed at emulating the principles of urban firefighting, involving the stationing of an engine and pump at a water source and forcing water through a line of hose to the fire.<sup>68</sup>

But forest lands provided no concentration of potential fire locations, no grid of streets to make them accessible, and no convenient water supply. In order to be of value in fighting forest fires, the pumping unit would have to



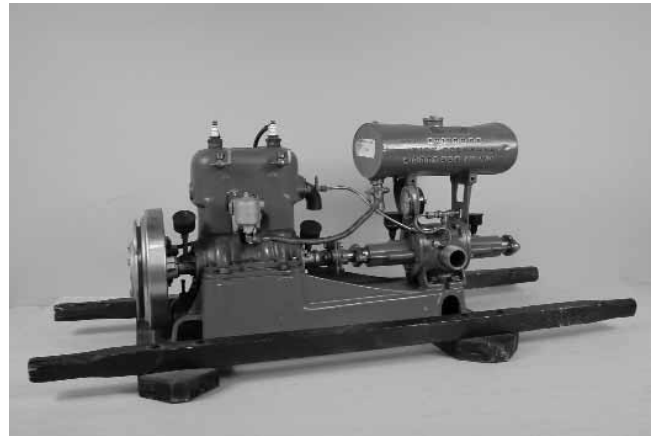
**Figure 18** Fire pump made by Canadian Fairbanks-Morse Co. Ltd. — ca. 1916.

(Source: CSTM, cat. no. 960397)

be portable, capable of delivering a sufficient amount of water without exceeding weight restrictions, and durable enough to withstand rough usage. According to one account, the Fairbanks-Morse Company produced the first North American pump designed for forest fire suppression in 1911 or 1912. Far too heavy to be carried by man or horse, the units were mounted on railway flatcars by Pacific Coast logging operators. By 1917, the CPR and the Canadian Northern and Grand Trunk railways had begun utilizing tank cars with pumps of an unknown type along their lines, but none of these could reach fires far beyond the tracks themselves.<sup>69</sup>

Fairbanks-Morse continued to work in collaboration with H.C. Johnson, a fire inspector with the Dominion Board of Railway Commissioners in Ottawa, to develop and build a pump for the Dominion Parks Branch. Their efforts produced a portable unit in 1915, consisting of a two-cylinder, two-cycle, four- to five-horsepower, water-cooled marine engine, connected to a rotary pump. Mounted on a base and weighing about 59 kilograms (130 pounds), the prototype demonstrated a capacity of 75 litres (20 gallons) per minute during initial tests in Ottawa.

The Parks Branch shipped this Unit No. 1 to Rocky Mountains National Park, where it went into immediate service, controlling slash-burning operations that summer. Johnson claimed that its capacity to discharge 20 pails of water per minute enabled the pump to do the work of 200 men during this procedure. The pump could be transported along roads by an automobile equipped with a suitable box; moved over trails by hand- or horse-power in a two-wheeled truck designed by the



**Figure 19** Fire pump made by the Evinrude Motor Co. — ca. 1920.

(Source: CSTM, cat. no. 960430)

Parks Branch; carried by packhorse; or, by two men on a wooden stretcher-like apparatus aided by shoulder straps. “No forest organization in Canada or the United States has yet brought forward a portable pumping apparatus, that for portability, compactness and efficiency, can approach the apparatus,” Johnson declared.<sup>70</sup>

The Dominion Parks Branch placed six additional units into service for the 1916 fire season, these improved by minor changes and used in conjunction with 4-centimetre (1.5-inch) linen hose which provided better capacity than the rubber hose used on the original model. The St. Maurice Forest Protective Association and Ontario Forest Protection Service also tried the Fairbanks-Morse pump that year, which underwent further development in 1917. A May 9 public test at Ottawa’s Sparks Street Bridge demonstrated its efficiency, and both the Laurentian and Ottawa River Forest Protection Associations introduced the pumps that summer.<sup>71</sup>

When the B.C. Forest Branch began contemplating the purchase of pumps in the winter of 1917, the Fairbanks-Morse product appeared more promising than a portable unit manufactured by the Evinrude Company of Milwaukee, given that it had a more favourable ratio of weight to lifting capacity. A test of the former model in the summer of 1918 proved successful, and early in 1919 the agency received authorization to purchase a pump for each of the province’s eight forest districts. The units demonstrated their value that season, prompting a decision to acquire additional pumps for 1920.<sup>72</sup>

Hoping to develop a more powerful pump, the agency collaborated with the Wonder Pump and Engine Company of Vancouver during the winter of 1919 in the design of a single-cylinder, heavy-duty rotary model. Chief Forester Martin Grainger described the units as





**Figure 20** Fire Ranger operating portable fire pump in Saskatchewan — ca. 1920.

(Source: Library and Archives Canada/PA-44498)

a “distinct improvement over the pump formerly used,” when the Branch placed a \$25,000 order for 34 of them. Their performance in 1920 was not entirely satisfactory, but design modifications corrected the original shortcomings. Weighing in at 77 kilograms (170 pounds), the sturdier Wonder sacrificed portability to achieve a capacity of 170 litres (45 gallons) per minute through 305 metres (1,000 feet) of hose. Either product would “do just as much work on a fire line as twenty men equipped with ordinary fire-fighting tools” wrote R.V. Stuart. The agency continued to purchase pumps from both manufacturers, as well as from the Watson and Jack Company (sic) of Montreal, distributors of the Evinrude line. In 1921, the Branch pumped over 19 million litres (five million gallons) of water onto fires, leaving no doubt in Chief Forester P.Z. Caverhill’s mind that “the use of this mechanical means of fire suppression marks the greatest step forward in recent years in the work of forest protection.”<sup>73</sup>

By 1920, practically every forest protection force in the country had adopted portable gas-powered pumps, and their usage increased dramatically thereafter. Fairbanks-Morse had placed between 200 and 300 machines with private and public protection organizations in Canada in 1920, and Johnson put the number of

motorized pumps at roughly 700 five years later. The Dominion Forestry Branch owned 116 units manufactured by several firms in 1925. Director E.H. Finlayson declared that “this article of equipment has become so standard in our fire fighting work that excepting in certain mountain regions, where no water is available, it is employed on practically every fire when available.”<sup>74</sup>

By this time, organizations had a wider range of equipment to choose from: the result of efforts to develop lighter and more compact units. Evinrude produced a four- to five-horsepower two-cycle model that weighed 47 kilograms (103 pounds) and delivered up to 285 litres (75 gallons) per minute; a single-cylinder type weighing 28 kilograms (61 pounds) which could be carried by a single man with a special pack; and a new lightweight 21-kilogram (47-pound) model. Up to 1,525 metres (5,000 feet) of hose could be used with the larger pumps, and “siamese” connections allowed the operation of multiple hose lines from a single source. Where the distance from water supply to fire exceeded the capacity of a single pump, crews employed a relay system, pumping from the water supply into a portable canvas tank for a second machine. Thus, declared a Watson and Jack publication, firefighters found it “possible to attack and extinguish forest fires in a modern scientific manner at a fraction of the cost and time over the old chaotic methods.”<sup>75</sup>

There is no denying that the first generation of pump technology had an enormous impact on the ability of suppression forces to combat forest fires. Ontario Chief Forester E.J. Zavitz, whose agency spent over \$100,000 on this equipment in the early 1920s, remarked that it made it possible to extinguish fires that previously would have gone unchecked until nature provided rain. Aside from the direct contribution of pumps, officials made frequent reference to the positive influence a pump’s arrival had on the morale of fire crews. There were limits, however, to their application: in the absence of a convenient water supply, firefighters relied exclusively on pre-mechanized methods and prayed for rain. Moreover, the performance and reliability of the early equipment left something to be desired. The Evinrude and Fairbanks-Morse pumps were “good machines”, a Quebec protection manager noted in 1925, but there remained “a good deal of room for improvement in both.” In a 1931 discussion of recent developments in the field, American protection authority W.B. Osborne noted that the first generation of pumps were “too heavy for back-packing, temperamental and balky,” in contrast to current lightweight models which provided dependable service while delivering 130 to 150 litres (35 to 40 gallons) per minute under high pressure.<sup>76</sup>

The portable gasoline-powered pump was the most important, but not the only early-twentieth-century



development in fire-suppression technology. Concerned about fire protection along roads where a heavier unit capable of delivering greater quantities of water would prove valuable, the Dominion Parks Branch had the Canadian Fire Engine Company fit a truck with a rotary pump geared to its transmission. After undergoing tests at Banff in 1920, the unit was stationed there. The B.C. Forest Service mounted Barton pumps on its Model T Fords during the early 1920s, and Ontario employed fire trucks in settled areas.<sup>77</sup>

The hand “trombone” pump — consisting of a metal tank or canvas bag, a short length of rubber hose and a nozzle — also came into widespread use during the 1920s. The Watson Jack & Company introduced a hand pump equipped with canvas water bag and shoulder straps capable of throwing a stream 15 to 18 metres (50 to 60 feet) in about 1924. Grant, Holden and Graham, Ltd. of Ottawa marketed a similar product, and D.B. Smith and Company of Utica, New York produced a well-known line of “Indian” pumps with a steel tank.<sup>78</sup>

Welcomed for its ease of transport, capacity to take water from sources that could not supply a powered pump, and usefulness in extinguishing grass fires or stubborn hot spots, the hand pump proved an instant hit. The B.C. Forest Branch tried out a few in 1923 and promptly ordered 40 more of the devices, finding them “to be of much value in putting out smouldering fires.” By 1925, modifications to the 19-litre (five-gallon) hand tanks had increased their portability and efficiency, and the agency could cite numerous instances proving their worth as an addition to the equipment carried by patrolmen. The St. Maurice and Southern St. Lawrence Forest Protective Associations added hand pumps with water bags to their inventory, experiencing “good success.” In 1924, the Dominion Forestry Branch ordered 36 for rangers in its Saskatchewan district, anticipating their benefits in the patrol of fire-lines and controlling back-fires. By the end of the decade, the New Brunswick Department of Forestry possessed some 200 hand pumps, to go along with 24 gasoline-powered units.<sup>79</sup>

Fighting forest fires had entered the “mechanical era,” H.C. Johnson declared at the conclusion of a 1925 summary of developments. But the ability to bring water to bear on many fires did not diminish the importance of hand tools in the “dirty work” of suppression. Axes were needed to cut logs and brush, fell small snags, and place undercuts in large ones. Crosscut saws remained essential for felling larger snags and cutting out logs that lay across fire-lines. Long-handled shovels came into play in digging out the edges of fires, cleaning out lines, throwing dirt onto fires, or smothering sparks. Western fire experts considered the hazel hoe to be the best implement for digging fire-lines, along with the grub

hoe and mattock. Workers wielded heavy rakes in pine forests to rake up the thin layer of grass, litter, and needles to check advancing fires.<sup>80</sup>

Hand implements also underwent considerable innovation, as a generation of “ranger inventors” tinkered with existing tools and developed new designs. They devoted much of their energy to the invention of combination tools: a field that became “something of a rage” according to Stephen Pyne. The most famous is the Pulaski, a combination axe-mattock named after its supposed inventor, U.S. Forest Service ranger Ed Pulaski.



**Figure 21** Pulaski mattock made by Welland Vale Mfg. Co. of St. Catharines, Ontario — ca. 1950–1965.

(Source: CSTM, cat. no. 880808)

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According to legend, he designed the implement after the 1910 fires in Idaho. A combination axe and hoe tool, manufactured by the Collins Tool Company for land clearing, had also exhibited at the 1876 Centennial, however. The Pulaski, then, is apparently a case of “independent rediscovery” of an original tool that had faded from sight by the late 1800s.<sup>81</sup>

Accounts by Pyne and Davis suggest that Pulaski may have worked on a new tool after the 1910 fires, then dropped the project. That winter, however, Pulaski’s superintendent W.G. Weigle asked Joe Halm and Ed Holcomb to build, at Pulaski’s home blacksmith shop, a shovel, axe, and hoe tool for tree-planting work. When the result proved unsatisfactory, Pulaski continued to refine the design, rejecting the shovel attachment. In 1913, he presented his superiors with an improved version that enjoyed instant popularity for fire control in the Rocky Mountain region. By 1920, demand reached sufficient proportions for the U.S. Forest Service to contract for commercial production of the Pulaski tool. In 1936, the agency developed a standard design for nationwide use.<sup>82</sup>

The timing of the Pulaski’s introduction to Canada is unknown, but over time it became a fundamental fire-suppression tool throughout North America. Canadian protection organizations had at least one other option during the 1920s. The Nelson Iron Works of Nelson, B.C. produced a fire ranger’s combination tool, adopted as standard equipment by the B.C. Forest Service. Either a shovel or hoe attachment could be threaded into the pole of the axe and tightened with a wing nut. With the hoe blade attached, the implement bears a rough resemblance to the Pulaski. Popular and professional forestry journals provided another basis for diffusion of the Pulaski as it entered mass-production. The American Fork and Hoe Company of Cleveland, Ohio advertised its Pulaski tool in the pages of *American Forests* in the late 1930s. A decade later, the Welland Vale Manufacturing Company announced the production of its Pulaski Mattock Axe as a “new contribution to Canadian forestry” in the *Forestry Chronicle*.<sup>83</sup>

Other early-twentieth-century contributions to forestry technology from American rangers which stood the test of time include the Koch tool, a combination shovel and hoe, and Malcolm McLeod’s combination rake and hoe. Little is known at this point about Canadian inventions, but a Dominion Forestry Branch ranger named Mobley developed a firefighting tool in 1927 that he modestly described as “one of the most efficient tools ever taken on a fire line.” No details of its design have

been uncovered, and although some were apparently manufactured in eastern Canada, Mobley’s apparatus may fall into the category of the many combination tools that failed to find a lasting place in the technology of forest fire suppression.<sup>84</sup>

Over the first two decades of the twentieth century, then, Canadian forest protection organizations made some headway in the fight against fire. The stationary lookout linked to headquarters by some form of communications system provided a supplement to the foot, canoe, and mounted patrols. Suppression techniques retained their link to nineteenth-century hand methods, but took on a more mechanized character that made the application of water to fire viable in many cases. Reflecting on a decade’s worth of experience on the Manitoba forest reserves in 1929, C.B. Gill remarked that “the system of lookout towers for detection, telephones for communication, roads for transport, and a properly equipped staff of rangers and patrolmen for suppression has advanced so that we can at least see our way clear to a time in which all fires can be kept within reasonable bounds.”<sup>85</sup>

Perhaps most importantly, technological and organizational changes introduced a new division of labour to forest protection. Increasingly, fire detection and control became separate functions. The airplane patrol, a subject discussed in Chapter II, contributed to this process. The jack-of-all-trades ranger still played a fundamental if diminishing role, but foresters took this application of the principles of scientific management from industry to their field as a positive step. “Specialization is the basis of modern industry,” W.N. Millar asserted in 1922, “and the gain in efficiency that resulted from the industrial revolution is no more striking than is the improvement of results from the adoption of similar specialization in forest protection.”<sup>86</sup>

Millar and his colleagues assessed the period as one of significant progress, even as they kept up the pressure for greater financial support. Canadian forest protection methods in 1915 were as much advanced over those in 1895 as “is the modern motor fire truck an improvement over a bucket brigade,” Dominion Director of Forestry Campbell observed. Five years later, however, he pointed out that annual forestry expenditures in Canada lagged behind any other “progressive country in the world,” when considered on the basis of forested area. The 1920s did not alter this picture fundamentally, and the Great Depression made it even more bleak; in the interim, however, Canada would accomplish a great deal in adapting the airplane to forestry purposes.<sup>87</sup>

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## **CHAPTER II**

# **Aerial Forestry During the 1920s**







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# Aerial Forestry During the 1920s

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By the early 1920s, forest fire protection in Canada had begun to reflect a degree of specialization, as organizations separated the functions of detection and suppression. The most dramatic technological innovation, however, followed the First World War, when an abundance of idle military aircraft and pilots created the opportunity for foresters to take to the air. The following decade saw Canadian foresters take a leading role in the application of aircraft to a variety of purposes. Here, it seemed, was the ideal technology for a vast forested land of sparse settlement, with abundant waterways to serve as take-off and landing points for the first generation of flying boats. The introduction of aerial fire-detection patrols, the aerial transportation of firefighters and equipment, and aerial forest surveying mark the 1920s as a point of transition for Canadian forestry.

In the decade following the Wright Brothers' 1903 flights, American and Canadian forestry officials considered the use of aircraft for detecting fires on wildlands. As early as 1909, a meeting of U.S. Forest Service officials proposed aerial patrols of the national forests. The agency took no action at that time, but in 1915 L.A. Vilas made the first patrol flight in Wisconsin's lake region. Volunteering his services to the state, Vilas piloted a Curtiss Flying Boat and apparently spotted one fire at a distance of 48 kilometres (30 miles). The following year, Minnesota's state forester submitted a plan that would have had the U.S. Navy undertake patrols from its Duluth militia station, but failed to obtain approval. Canadian foresters took note of these developments, and expressed hopes "that some cooperative arrangement will be possible in Canada for the testing of machines and training of men."<sup>1</sup>

Not content to hope, Laurentide Company Chief Forester Ellwood Wilson visited an airplane factory in 1916 to assess their usefulness in fire patrol. He concluded that the difficulty of launching and landing the machines rendered them impractical at present, but had no doubt that improved models would soon do away with both lookout towers and "slow-moving rangers." By 1917, the St. Maurice Forest Protective Association was attempting to arrange for a test, intrigued by the airplane's potential for a cheaper and more effective alternative to the ranger system.<sup>2</sup>

Meanwhile, in British Columbia, the final stages of the war prompted a similar line of thought among forestry officials. In the spring of 1918, the provincial Forest Branch began gathering data on the use of airplanes in fire-detection, seizing the initiative that summer by

contracting with the Hoffar Motor Boat Company for the construction of a flying boat based on the Curtiss H-2 design. The arrangement called for the government to lease the plane for a year with an option to buy, and the Hoffar Brothers completed construction of a machine in their Vancouver shop that summer. Initial tests in late August were encouraging, but the plane crashed on the roof of a Vancouver house during a September 4 flight.<sup>3</sup>

The pilot emerged without serious injury, explaining that the engine had simply stopped in mid-flight. Embarrassed, Minister of Lands T.D. Pattullo promised to pay for the damages and contract for the delivery of another plane during the next fire season. An analysis shortly after the crash, however, revealed that the cost of an adequate system involving at least three planes and two flights daily would run between 0.4 and 0.8 cent per hectare (one and two cents per acre): well above the existing provincial average of 0.08 cent (0.2 cent). If patrols were confined to areas of extreme hazard such as the Gulf of Georgia, if planes were utilized in aerial survey work during the rest of the year, and if the cost of machines fell as anticipated after the war, the scheme would be feasible, P.Z. Caverhill concluded. But the prospect of such appropriations apparently cooled Pattullo's enthusiasm. The government's initial foray into aerial forest protection lapsed: a victim of the unfortunate crash and financial constraints.<sup>4</sup>

With the end of the war, interest in the civilian use of aircraft grew more urgent, and forestry organizations exerted pressure on the Dominion government to make use of its machines and pilots. "Why should Canada wait any longer to test the efficiency of the aeroplane in forest fire protection?" asked the CFA's *Canadian Forestry Journal*. Impatience turned to indignation in the spring of 1919, when Dominion Minister of Marine and Fisheries C.C. Ballantyne rejected Quebec's proposal that two idle flying boats be loaned to the province for experimental patrols over the St. Maurice Valley. The directors of the St. Maurice Forest Protective Association had approached the Minister of Lands and Forests with the idea, who then contacted Ellwood Wilson to review the options. Wilson concluded that the difficulty of providing landing fields made seaplanes the only suitable craft, and learned that the Dominion's Department of Naval Affairs had twelve planes in storage at Halifax, turned over by the U.S. Navy after the Armistice.<sup>5</sup>

After meeting with representatives of the CFA and Aerial League of Canada, Ballantyne reversed his decision,



**Figure 23** Curtiss HS-2L Flying Boat G-CYAG operated by the Air Board, Manitoba — ca. 1922.

(Source: Library and Archives Canada/PA-92356)

marking the beginning of Dominion involvement in aerial forestry work in central Canada. The St. Maurice Association engaged former Royal Navy Air Service pilot Stuart Graham, who travelled to Halifax and flew the first Curtiss HS-2L Flying Boat to its base at Lac La Tortue, Quebec, arriving on June 8, 1919. After making the same flight with a second identical craft, Graham began patrol and aerial photographic work, making this perhaps the first use of seaplanes in Canada for civilian purposes.<sup>6</sup>

To the south, U.S. Forest Service and Air Service cooperation resulted in the inauguration of fire-patrol flights over national forests in California and Oregon during the summer of 1919. These continued in 1920, and included Washington in 1921. The experience convinced the Dominion Forest Service that airborne patrols were of particular value in remote areas. Elsewhere, they might provide a valuable supplement to ground patrols and lookout stations.<sup>7</sup>

Great Britain's gift of over 100 aircraft of various types to Canada in June 1919 provided the new Dominion Air Board with the resources to initiate a major program of air operations. With the establishment of bases at Vancouver; High River, Alberta; Victoria Beach, Manitoba; Sioux Lookout and Ottawa, Ontario; Roberval, Quebec; and Halifax, the Air Board gave considerable emphasis to forestry in its administration of civil aviation. In 1920, the Department of the Interior arranged for experimental aerial patrols in Alberta and British Columbia. The

Alberta patrols began in September from a base at Morley. Preparations for the British Columbia flights, which involved shipping a Curtiss HS-2L from Vancouver to Mara Lake near Sicamous, weren't completed until November. Dominion and provincial forestry officials took part in several flights over the Railway Belt that demonstrated the utility of aircraft in exploration, fire patrol, and mapping.<sup>8</sup>

Cooperation between the Air Board and Forestry Branch continued during the 1921 season, now including Manitoba. In the forested area of that province, with many lakes and rivers available as landing places, larger flying boats capable of carrying eight to ten persons produced the best results. When the pilot and spotter discovered a small fire, they landed and attempted to suppress it themselves. Larger fires necessitated a flight to the nearest village or trading post to secure firefighters and equipment. Land-based patrols in the Alberta inspectorate involved the first installation of wireless telegraph apparatus on aircraft. Messages sent to the base were relayed by telephone to the nearest ranger station, "with the result that very few fires attained large proportions," Campbell explained. In British Columbia, the Air Board's Jericho Beach station at Vancouver included four F-3s and six HS-2Ls. The B.C. Forest Branch and Dominion Forestry Branch used both types for patrols, transportation of men and equipment to fires, and reconnaissance to determine appropriate suppression strategies. Planes proved particularly valuable when the smoke haze rendered the



**Figure 24** Air Board Station, Jericho Beach, B.C. — ca. 1921.  
(Source: Library and Archives Canada/C-28590)

precise location of fires from lookout stations impossible. Although the southern coast received priority, the stationing of an HS-2L at Kamloops allowed for patrols in the eastern part of the Railway Belt.<sup>9</sup>

Together, the stationary lookout and aerial patrol permitted the Dominion Forestry Branch to reduce its reliance upon the traditional mounted fire ranger. Officials considered the program a great success by 1922, and extended it the following year under an agreement with the Department of National Defence, which replaced the Air Board. Planes from Jericho Beach patrolled the Railway Belt while those at High River provided protection for the Bow River and Crowsnest forest reserves and Waterton Lakes Park. In addition to the main base at Victoria Beach on Lake Winnipeg, Manitoba's scheme included sub-bases at Norway House and The Pas. Reconnaissance flights over northern Saskatchewan gathered data in preparation for extending patrols to that region. "The fact that aircraft can be used successfully in forest protection is now fully established," Campbell declared in 1924. The task now was to develop organizational methods and equipment to ensure efficiency at an affordable cost.<sup>10</sup>

As the Dominion aerial protection plan expanded, the B.C. Forest Branch curtailed airborne patrols over provincial timberlands. The method did not suit the province's mountainous coastal terrain as well as it did the relatively level topography of the Prairies and northern Ontario, Chief Forester P.Z. Caverhill concluded. Fires could start and reach serious proportions in the intervals between patrols, whereas the stationary lookout provided constant observation. Moreover, the real problem in mountainous country was reaching fires once they had been detected. Such costs represented an even more serious drawback. His agency, then, would

devote its resources to the road and trail construction needed to make even the remote mountain valleys more accessible to protection forces.<sup>11</sup>

In central Canada, on the other hand, the application of aircraft to forest protection and survey work continued under private and governmental auspices. Air Board cooperation with the Ontario Forestry Branch began in 1920 with an experimental flight to James Bay. Fire-detection patrols from bases at Whitney and Parry Sound commenced in 1922, with Air Board aircraft providing reconnaissance of Parry Sound, the Muskokas, Algonquin Park, and surrounding districts. Coverage increased to a total area of about 65,000 square kilometres (40,000 square miles) in 1923, taking in the Sudbury and Soo districts.

The patrols demonstrated that aircraft had a permanent place in Ontario's protection scheme, both for detection and for carrying a limited quantity of men and supplies to remote fires. Rangers who had formerly conducted canoe patrols of remote areas could now be stationed in groups at strategic locations, ready to be dispatched to fires. But some questioned the new emphasis on air operations when the province slashed the number of rangers. Government officials, foresters, and rangers met in Sudbury in May 1924 to discuss plans for the season: a forum veteran rangers used to blame the heavy investment in aircraft for reductions to an already undermanned fire-ranging staff. The intermittent nature of aerial observation dictated that lookout construction would continue in Ontario, however.<sup>12</sup>

Canada's hosting of the second British Empire Forestry Conference in 1923 provided the opportunity for a critical appraisal of Canadian forest protection standards. The Conference's committee on fire protection described the general situation as unsatisfactory and called upon governments to increase their legislative and financial support, but also found grounds for optimism. The Canadian initiative in aerial patrol represented one hopeful sign. "We are impressed not only with the value but with the necessity of using air-craft in protecting the forests of the inaccessible and uninhabited north country of Canada where absence of means of transportation and communication prohibits fire detection or quick action on fire starting, by any other means," the committee reported. Since government air services fell short of requirements, the members recommended that commercial air companies be subsidized to bring costs within the means of forest authorities.<sup>13</sup>

Mackenzie King's Liberal government followed up the British Empire gathering by convening a national forest protection conference at Ottawa in early 1924, hinting at its willingness to extend federal aid to the provinces, in the area of fire control. Momentarily, the prospects for

the creation of a truly national forest policy along American lines seemed bright. In the United States, the 1911 Weeks Law permitted federal cooperation with the states in protecting private forestland on the watersheds of navigable streams: a principle extended in June 1924 with passage of the *Clarke-McNary Act*.<sup>14</sup>

In the end, the Canadian conference floundered on King's reluctance to challenge the existing basis of federal-provincial relations. A resolution calling for Dominion research on the application of meteorological data to fire protection produced action on this front, but the proposal for federal subsidization of aerial patrols fell on deaf ears, despite industry support. Gillis and Roach maintain that British Columbia received assistance, but no supporting evidence for this claim has been found. Disagreement over policy and timetables doomed most of the resolutions.<sup>15</sup>

Ontario, however, forged ahead on its own in the field of air operations, after officials returned from the Ottawa conference. Determining that the province could purchase and operate its own planes at less cost than hiring commercial aircraft, Minister of Lands James Lyons established the Ontario Provincial Air Service with 14 Curtiss HS-2Ls acquired from the Laurentide Air Service. These served until 1932, supplemented by 16 DeHavilland Moths purchased in 1927.<sup>16</sup>



**Figure 25** Curtiss HS-2L Flying Boat operated by the Ontario Provincial Air Service, on patrol near Lake Timigami, Ontario — 1924–1930.

(Source: Library and Archives Canada/PA-49802)

The new age of aerial forestry generated so much enthusiasm that foresters feared that press reports created “a misconception in the public mind.” Dominion forester D. Roy Cameron cautioned in 1926 that aircraft did not offer the final solution to protection problems. Given suitable topography, reasonable means of ground communication and transportation, and an available labour supply, the lookout provided “the cheapest, most effective, and most satisfactory method of discovering and suppressing fires in their initial stages.” None of these conditions prevailed in the North, of course, where the Flying Boat offered the only feasible method of fire control.

The cost structure remained troubling, but officials were confident that the inevitable period of trial and experimentation would result in more cost-effective equipment. As the First World War-era planes became obsolete, Cameron looked forward to the development of specialized aircraft which would permit the segregation of air operations into detection and control functions. Light, two-seater aircraft equipped with wireless communications would perform patrols, while heavier models capable of carrying crews and equipment stood by at strategically located bases.<sup>17</sup>

By the end of the decade, Dominion Forest Service air operations in northern Manitoba and Saskatchewan followed this pattern. Seventeen RCAF seaplanes operated from five main and three sub-bases, providing patrol and suppression service over 26.7 million hectares (66 million acres) of forest land. Ski-equipped De Havilland Moths carried out late winter patrols, seeking out unextinguished campfires left by prospectors and trappers, which could burn deep into the muskeg and flare up again in the summer. Floats replaced skis following spring breakup. The new Vedette, built by Canadian Vickers along lines recommended by a CSFE subcommittee — and the first aircraft designed specifically for Canadian conditions — joined the Moths in patrols. Larger twin-engine Varuna and Fairchild aircraft were stationed at the bases, ready to transport firefighters, pumps, hoses and tools to the landing point nearest a fire. Flying patrols diminished in importance in Alberta with the completion of the lookout system on the eastern slopes of the Rockies, but in the North two planes operated from a base established at Grande Prairie in 1928.<sup>18</sup>

Concurrent with its expanding role in fire protection, the airplane found an even more important place in forest surveying. Indeed, by 1930, innovation in aerial surveying gave Canada a position of international leadership in the field. This technique provided a cost-efficient alternative to ponderous ground surveys in areas where government forestry agencies and corporations required an overview of timber density and

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forest types on large tracts of land. Ground crews could then be sent out to areas which had been selected for more intensive inventory.

The first Canadian “timber cruisers” travelled by foot and canoe, gathering data in a subjective manner to determine if sufficient mature timber existed on a given tract of land to justify logging, and help compile rough maps which would serve as a guide for future exploitation. As the federal and provincial governments assumed greater forest management responsibilities, the need for inventories of public timberlands expanded. The Dominion Forestry Branch began surveying its reserves in the early twentieth century, assigning cruising parties to the task. They based stand estimates upon investigation of sample areas: typically strips one- to two-fifths of a kilometre (one-eighth to one-quarter of a mile) across, running through a tract of land, totalling perhaps five per cent of the area. Larger crews consisted of four men, headed by the compassman who maintained the correct direction, recorded the distance travelled by means of a chain, and noted topographical features. A man on each side of the chain used calipers to measure the trees within the strip, calling out to the rear chainman, who tallied the data. Such strip surveys provided the basis for working plans, and if supplemented with elevation readings from an aneroid barometer, could help create contour maps.<sup>19</sup>

The Forestry Branch also went further afield to examine areas for reserve designation. Immigration to the Peace River region prompted a journey by D. Roy Cameron to investigate conditions around Lesser Slave Lake in 1912. He travelled west by rail to Edmonton, arriving on May 17. There he met J.A. Doucet, who had preceded him to arrange for supplies and have them forwarded by team to Athabasca Landing. R.G. Lewis and F. McVickar reported to Cameron on May 25, and the party departed for Athabasca Landing. From there, a steamer carried them to the mouth of Lesser Slave Lake, where they commenced their fieldwork.

Under instructions to run survey strips at intervals from the rivers, Cameron found the tributaries along the Lesser Slave River impassable to canoe travel after a few miles. He resorted to sending two-man parties out across the muskeg on foot, carrying supplies on their backs. Only the purchase of packhorses allowed further exploration along trails that ran back into the hills. Rainy weather had left the trails in poor condition, slowing the work and making travel through the thick brush “very disagreeable.” In September, both McVickar and Lewis returned to their forestry studies, with Cameron continuing until October 25. After selling the packhorses, the remainder of the party travelled down the Athabasca River by canoe among “floating ice cakes,” reaching Athabasca Landing just three days before the freeze-up.<sup>20</sup>

By the end of 1914, the Forestry Branch had surveyed a continuous belt about 160 kilometres (100 miles) wide through northern Manitoba, Saskatchewan, and Alberta, in addition to extensive areas in the northern Rockies and the Railway Belt. Forestry students and party supervisors faced frontier conditions on these western expeditions. “A forester needs to be here, besides all other professional titles, a real bushman, an all-man, and a jumper,” wrote Doucet. When C.H. Morse explored the northern Rockies, snow-covered passes made travel hazardous: as they returned to camp one day, a blizzard trapped his party in a canyon, forcing them to spend the night there.<sup>21</sup>

The 1909 establishment of the Commission of Conservation by the Laurier government, as a scientific and advisory body, gave a much-needed boost to forest investigative work in Canada. Under Bernard Fernow, the Commission’s forestry committee undertook surveys in British Columbia, Ontario’s Trent Watershed, and Saskatchewan. H.N. Whitford and R.D. Craig’s *Forests of British Columbia*, published in 1918 after four years of fieldwork and compilation, classified the province’s forests according to composition, climatic and soil conditions, and physiographic units. The study represented the most thorough inventory of any province’s forest resources for many years. New Brunswick, Quebec, and Ontario also began forest surveys during this period, but without the sustained commitment that marked the Commission’s British Columbia project.<sup>22</sup>

Canada’s vast, relatively inaccessible forest area prompted governments and pulp-and-paper companies to adopt the airplane for inventory work immediately following the First World War. During the 1920s, two approaches to obtaining estimates of forestland from the air evolved: aerial sketching and aerial photography. Sketching provided a fast, inexpensive method of gaining an overview of topography, timber types, and transportation routes. First, a skeleton map of the area was prepared at a scale of one inch to a mile (approximately one centimetre to four kilometres), a square grid pattern marked in, and known points entered for reference. The map was then mounted on a board for the sketcher’s use while in the airplane.<sup>23</sup>

Once over the area, the sketcher began by recording prominent topographic details from an altitude of 1,525 to 3,050 metres (5,000 to 10,000 feet). The pilot then descended to about 900 metres (3,000 feet), permitting the boundaries of timber types to be recorded. The sketcher directed the airplane’s flight by a set of pre-arranged signals to the pilot. When the plane came to the end of one leg, sketchers such as the Ontario Forestry Branch’s Holly Parsons would “make a thumb jerk over my shoulder and he’d spin around and head for home down the same course.” Parsons described the pusher-type HS-2Ls as ideal for the work; no obstructions blocked his view

from the front cockpit, and their slow speed facilitated close observation. Although aerial sketching did not permit an estimate of timber quantities or growth, a competent sketcher could map the location of types, burns, while also delineating timber into rough categories such as mature or sapling growth.<sup>24</sup>

The Ontario Forestry Service began aerial sketching in about 1921, developing the technique "to a remarkable degree of efficiency," as University of Toronto Forestry School Dean C.D. Howe remarked. By 1925, the Forestry Service had sketched over 55,000 square kilometres (35,000 square miles) from the air, allowing more efficient use of ground survey parties, which then cruised tracts of land which had been chosen for more intensive analysis. Combining the two approaches, officials found, provided surveys at a lower cost than the traditional ground cruise alone. The only drawback was a complete dependence on the skill and judgement of sketchers, who were "difficult to obtain and expensive to train."<sup>25</sup>

Although Ontario continued its sketching program well into the 1940s, aerial photography provided foresters with a more accurate survey method. Vertical photography produced the most detailed representation of topography and forest types, accomplished by flying parallel strips over territory and compiling the photographs into a complete mosaic. The cost of covering forest lands in this manner outweighed the benefits in most cases, limiting the forestry applications of the technique during this period. Oblique photography, a Canadian contribution to the field, filled the need for faster and less expensive aerial surveys of large, relatively flat areas in which forestry organizations did not require a fine degree of accuracy.

Instead of photographing a limited area directly beneath the plane, the camera was angled so that the image encompassed the entire territory from a point about 1.6 kilometres (one mile) ahead of the plane to the horizon. Similar pictures taken over each side of the aircraft overlapped the centre photograph, making it possible to map the topographic features and forest types for a distance of five kilometres (three miles) on each side of the flight line, covering from 580 to 965 kilometres (360 to 600 square miles) in an hour.<sup>26</sup>

Ellwood Wilson played a key role in introducing aerial photography to Canadian forestry. In 1919, he and Stuart Graham visited with Eastman Kodak Company experts at Rochester, New York to discuss the subject, and the St. Maurice Forest Protective Association installed an Eastman K-1 camera on one of the HS-2Ls. The first photos exceeded expectations, Graham reported, revealing watersheds, swamps and burnt-over areas, while also allowing the identification of hardwood and

coniferous stands. During 1920, Wilson's Laurentide Company, Price Brothers, and the Spanish River Pulp and Paper Company conducted trials, the Price company operating two Martynside seaplanes with Thornton Pickard cameras. Both the cameras and photographers were veterans of First World War photographic work in Europe. The brief Spanish River experiment involved an Eastman K-1 mounted on an Aeromarine 44L plane. The B.C. Forest Branch used the HS-2L stationed at Kamloops to photograph limits in the area that summer.<sup>27</sup>

The Laurentide Company's system combined visual observation and photography to compensate for the inability of plates to capture different shades of green. An initial flight produced a strip of photographs which were mounted on a board, followed by a second pass with a "skilled woodsman" as observer to note the species composition and other details not shown on the photographic outline. The resulting map depicted waterways, muskeg, burns, hardwood, and softwood stands according to species, with sufficient precision to facilitate logging plans and identify areas for more detailed work by survey crews.<sup>28</sup>

Commercial air survey companies emerged during the early 1920s to undertake survey and mapping opportunities. The original St. Maurice operation became Laurentide Air Services in 1922. At the same time, Sherman Fairchild, inventor of a new aerial camera, came to Canada and set up Fairchild Aerial Surveys (Canada) Ltd. The two companies operated on a cooperative basis, Laurentide doing the flying for Fairchild. The future looked bright when the Ontario government hired Laurentide to conduct a 320,000-square-kilometre (20,000-square-mile) aerial survey of its northern timberlands. Laurentide purchased a British-built Vickers Viking for the project: an amphibious aircraft with retractable wheels for water landings. The company also provided 3,700 square kilometres (2,300 square miles) of Spanish River Pulp and Paper Company property. Then, in 1924, the entire Laurentide organization, including pilots, maintenance crews and aircraft, became the Ontario Provincial Air Service.<sup>29</sup>

In 1922, the Topographical Survey of the federal Department of the Interior began experimenting with aerial methods in the West. These trials continued the following year utilizing fire patrol aircraft, with the Forestry Branch arranging for photography of districts between Calgary and Edmonton. The Topographical Survey made aerial methods a standard practice in 1924, employing both oblique and vertical photography. The Forestry Branch also relied more heavily upon the technique. The 1926-1927 Manitoba Pulpwood Survey by the newly named Dominion Forest Service inventoried 35,000 square kilometres (22,000 square miles) of forest in that province from the air.<sup>30</sup>



**Figure 26** Photo taken by the Air Board of dense mixed timber in the Birch River District, Lake Winnipeg. Taken from Victoria Beach Air Station, Manitoba — ca. 1923.

(Source: Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no.15930)

During this period, H.E. Seeley began his research into the interpretation of aerial photographs for forestry purposes, seeking methods of tree measurement that would make estimates of stand volume possible. Since diameters were impossible to measure in most aerial photos, Seely focussed on height as an indicator of volume. By 1932, he had developed an approach measuring the length of tree shadows, calculating heights by applying a formula that considered geographic location, date, and time of day. Seely's technique enabled the average height of stands to be determined "with practical accuracy" in either vertical or oblique photographs. This, coupled with a determination of stand density, made it possible for an experienced forester to arrive at an estimate of stand volume.<sup>31</sup>

The Forest Service began conducting wintertime aerial surveys in 1928, finding that conifers stood out in

greater contrast against deciduous growth, and that distinct shadows enabled more accurate measurement of tree heights. The following year, as negotiations for the transfer of natural resources to the prairie provinces and British Columbia neared completion, Minister of the Interior Charles Stewart called a Dominion-provincial conference to discuss a national forest inventory. The meeting produced an agreement to proceed, with provinces to conduct the surveys according to standard methods. The Dominion Forest Service would collate the data and compile a national database. Although the Great Depression disrupted provincial efforts, by the mid-1930s Canada had become the world leader in aerial photographic mapping. By that time, the Dominion government — with the cooperation of the Department of the Interior's Topographical and Air Surveys Bureau, the RCAF, and other agencies — had photographed over 800,000 square kilometres (500,000 square miles) from the air. Together, the Dominion Forest Service, provincial forest agencies, and companies had mapped about 320,000 square kilometres (200,000 square miles) of forest with the aid of aerial photographs, largely displacing sketching as a survey method.<sup>32</sup>

Aircraft became increasingly valuable in the forester's quest to provide employers, both public and private, with the information needed in investment and management planning. The Dominion Forest Service made research and development in the field a priority after 1930, with H.E. Seely becoming an international authority in air-photo interpretation. Much of the groundwork, however, was laid during the 1920s in First World War-vintage open-cockpit planes that served as flying platforms for the first generation of sketchers, foresters, and camera operators. Although forestry and engineering problems continued to demand considerable field analysis, aerial surveying provided a "bird's-eye-view" of vast areas, at a cost that ensured its ongoing utility in forest management.

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## **CHAPTER III**

# **Dominion Silvicultural Research 1900–1930**





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# Dominion Silvicultural Research, 1900–1930

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Faced with the daunting tasks of protecting and surveying its western domain, the Forestry Branch had few resources, during its first decade, to devote to silvicultural research as a basis for forest management. Moreover, the policy that maintained the Timber, Minerals and Grazing Branch's control over timber berths eliminated much of the incentive for investigation aimed at "the perpetuation and improvement of the forest by judicious lumbering." Officials confined themselves to selling timber, preventing trespass, monitoring the quantity of timber removed, and collecting royalties.<sup>1</sup>

General regulations for the cutting of timber on Dominion lands imposed a 25-centimetre (10-inch) minimum diameter limit, provided for the leaving of seed trees, and the disposal of slash, but the Timber Branch took "little or no interest in this aspect of forest administration," H.R. MacMillan noted in 1915. This lack of enforcement may have been a blessing in disguise. When T.W. Dwight undertook the Forest Branch's first serious study of the relationship of logging to regeneration — surveying conditions on the Rocky Mountains Forest Reserve — he observed the diameter limit's shortcomings as a silvicultural measure. If enforced in spruce stands, it permitted the removal of too many trees, and the few left behind to provide natural seedfall over the area usually blew down.<sup>2</sup>

The regulation provided a larger residual stand in pine forests, but no better silvicultural result. As a shade-intolerant species, pine reproduced best on open ground. When enough trees remained after logging to avoid windfall, seedlings developed poorly under the forest cover. More extensive cutting, on the other hand, prevented effective seed distribution over the entire area. Dwight's solution — to leave fairly dense blocks of timber distributed throughout logged areas — occurred on only a small proportion of the cutovers he examined.<sup>3</sup>

The establishment of the Commission of Conservation in 1908 provided a critical impetus for scientific study of Canadian forests. Along with its pioneering survey work, the Commission began to devote attention to the question of forest renewal. C.D. Howe accepted an appointment to examine the impact of fire and logging in British Columbia's coastal forests for the Commission in 1913. The Forestry Branch also entered the research field that year with the founding of a forest products laboratory at McGill University, devoted to the investigation of ways to increase industrial uses of Canadian woods. A second facility came into existence



**Figure 27** Forest Products Laboratories of Canada at McGill University in Montreal, Quebec.

(Source: Reproduced by permission of the Canadian Forest Service, Natural Resources Canada, 2004)

at the University of British Columbia in 1919 to study the use of Sitka spruce in airplane construction.<sup>4</sup>

Convinced of the pressing need for scientific research on a national scale, in 1915, Dominion Director of Forestry R.H. Campbell organized an advisory committee comprised of industrial, university and provincial foresters to set an agenda for future inquiry. The First World War prevented the body — which included chairman Bernard Fernow, the Commission of Conservation's Clyde Leavitt, Ellwood Wilson, Judson Clark and H.R. MacMillan — from fulfilling Campbell's original vision; that summer, however, Fernow inspected conditions on the Dominion's western reserves as a basis for their management. The following year, the Commission began an investigation of conditions on cutover pulpwood lands in Quebec, Ontario and New Brunswick.<sup>5</sup>



**Figure 28** R.H. Campbell, Director of the Forestry Branch (1907–1923).

(Source: Reproduced by permission of the Canadian Forest Service, Natural Resources Canada, 2004)

Campbell's advisory committee also urged the Dominion's new Council for Scientific and Industrial Research to consider the need for scientific research in the nation's forests. These provided annual revenues of \$7 million to the various governments, the committee pointed out, and the forest industry ranked second only to agriculture in exports. Surely, then, Canada should have joined the United States, India, and European countries in conducting the research essential to forest management. The Council's recommendation for a \$6,000 appropriation coincided with a request from the Department of Militia and Defence to the Forest Branch for help in managing the Petawawa Military Reserve in Ontario. Examination of the tract proved its suitability for a study of white pine regeneration and growth, leading to the establishment of the Petawawa Forest Experiment Station in 1918. Thus, despite losing much of its staff to military service during the war, by the time of the Armistice the Forest Branch was in a position to embark upon its scientific mission.<sup>6</sup>

While the agency went ahead with initial survey work at Petawawa from a small tent camp in the summer of 1918, and Swedish forester Hugo Wallin established the first permanent research plot in Canada at the site, the Commission of Conservation obtained the cooperation of provincial governments and pulp-and-paper companies for its reproduction and growth studies. These surveys led to the establishment of permanent sample plots in Quebec on cutover lands of the Laurentide and Riordan firms, with the Laurentide project evolving



**Figure 29** First staff house at the Petawawa Forest Experiment Station, Petawawa, Ontario — ca. 1920.

(Source: Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 22111)

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into an experimental station at Lake Edward. C.D. Howe did much of the fieldwork under a cost-sharing agreement between the Commission and the companies. In 1919, the Abitibi Pulp and Paper Company joined the program and, in the Atlantic region, the New Brunswick Forest Service and Bathurst Lumber Company became partners in an experimental cutting project. The surveys showed conclusively what many observers already knew: "that the productiveness of the forest is not being maintained by present methods of cutting." Throughout central and eastern Canada, the white pine had largely vanished from vast areas, replaced by species with little commercial value. Spruce, the premier pulpwood species, was being "driven out of our eastern forests" at a steady rate, creating silvicultural slums dominated by hardwoods and balsam. Commission of Conservation Chief Forester Clyde Leavitt expressed confidence that the problem would be solved by the combined effort of companies and government agencies, and that the remedies would be "practical from the viewpoint of the operator, as well as correct from the technical aspect."<sup>7</sup>

The diameter-limit regulations which governed cutting in Quebec and New Brunswick came under intense scrutiny as a result of the Commission's investigations. In even-aged stands, the system resulted in removal of the thrifty, fast-growing trees, leaving only culls to furnish the next cut and provide seed for reforestation. Too long suppressed or unhealthy to put out much new growth or produce abundant seed crops, many of the trees succumbed to blowdown after logging opened up the stand. Inspection of such areas revealed "a veritable jungle of slash, fallen trees, and debris," new Dominion Director of Forestry D.H. Finlayson declared, in calling for "the entire abandonment or . . . radical modification of the diameter limit system."<sup>8</sup>

Pulp-and-paper companies, troubled by intense competition during the 1920s, were receptive to arguments that supported a turn to clearcutting. Quebec's companies discussed new regulations with provincial authorities, leading to a 1923 policy that permitted the submission of working plans as an alternative to the diameter limit. By 1925, about 12 million hectares (30 million acres) had been placed under these plans, permitting firms to clear-cut all commercial timber, leave seed trees, or cut to a specified diameter limit as conditions warranted.<sup>9</sup>

When the Commission of Conservation lost favour with the federal government, leading to its 1921 demise, the Forestry Branch stood ready to absorb its most prominent foresters and take over its research projects in Quebec, Ontario, and New Brunswick. The agency, known as the Dominion Forest Service after 1923, organized a research division under H.G. Wright and secured the cooperation of additional companies to study ways of fostering the regeneration of commercial softwoods.

In 1923, Wright acknowledged that "we know very little about methods of ensuring continuous production of commercial species by natural means, and we know very little about the economic possibilities of establishing forests by artificial methods." But a start had been made in determining the research methods necessary to yield useful data.<sup>10</sup>

This emphasis on scientific methodology resulted in the publication of a research manual in 1924, authored by Wright, W.M. Robertson, and G.A. Mulloy. The report set forth the proper methods of establishing sample plots for studying the effects of cutting on windfall, growth, and regeneration. It went on to discuss the forestry instruments needed to lay out and conduct periodic examinations of plots, including the compass, diameter tapes and calipers used in measuring trees, measuring poles and hypsometers for determining tree heights, and the use of an increment borer for assessing growth rates.<sup>11</sup>

On the western reserve lands under its jurisdiction, the Forest Service made only marginal headway in improving silvicultural standards. The 1917 introduction of slash-burning regulations on new timber sales in the reserves represented progress in fire prevention, but forestry regulations on the timber berths still went unenforced. The Canadian Forestry Association (CFA) took up this cause in 1919, advocating the transfer of lumbering on all Dominion lands from the Timber, Minerals and Grazing Branch to the Forest Branch. The Commission of Conservation supported this policy change before being disbanded. "The fact that there is no provision for a technical administration of cutting regulations on these lands is a complete anomaly," declared a Commission report.<sup>12</sup>

While waiting in vain for an opportunity to achieve a real measure of influence over prairie and Railway Belt logging, the agency disposed of small amounts of timber on the reserves through settlers' permits and sales to commercial operators. Forest officers marked timber designated for removal, reserving about 12 per cent of the stand for reseeding purposes. "It cannot be claimed that any great advances have been made in the silvicultural treatment of the stands," T.W. Dwight conceded in 1922, but their appearance at least represented "a great improvement over unregulated logging." Subsequent examination of sale areas and others cut under the older diameter limit regulation suggested that the investment in selective marking of even-aged mature stands was wasted. Accordingly, foresters began issuing instructions to rangers for the reservation of seed trees. Marking as few as one per hectare (2.5 per acre) would ensure some seed supply at an acceptable cost, given the limited funds available for practical silviculture. Although administrative and forest protection duties left foresters little time for research, the Forest Service

made a minor commitment to the investigation of conditions on the western reserves during the early 1920s. The lion's share of its scientific work remained concentrated at Petawawa, where over 100 permanent sample plots yielded data by 1926.<sup>13</sup>

Although the 1924 Ottawa protection conference failed to produce a national forest policy, settling instead for an agreement to initiate a nationwide survey, it did have apparent implications for the management of Dominion lands. In the meeting's aftermath, the federal government made a long-awaited commitment to introduce meaningful control over harvesting on its western timber berths. Under the idealistic leadership of new Director E.H. Finlayson, the Forest Service appeared poised to challenge the Timber, Minerals and Grazing Branch for supremacy. Deciding to make a start on the introduction of sustained yield management with the timber berths granted to the Manitoba Pulp and Paper Company in that province, the Forest Service conducted aerial surveys of the area as a basis for the development of working plans. The Timber, Minerals and Grazing Branch managed, however, to retain most of its authority, agreeing only to regulate slash disposal on the Manitoba berths.<sup>14</sup>

Another opportunity for a Forest Service triumph came with the Mackenzie King government's 1926

announcement of a new policy aimed at achieving natural regeneration on all Dominion forestlands, including the western timber berths. This commitment faded, however, in the face of Western support for the Progressive Party. Unwilling to pursue any reforms that might alienate public opinion and subvert his attempt to bring the Progressives back into the Liberal fold, and anxious to eliminate the expense of managing the reserves, King embarked upon a course that would result in the transfer of natural resources to the prairie provinces and British Columbia at the end of the decade.<sup>15</sup>

Finlayson argued strongly against the transfer, but in the end was helpless against the political tides that swept away his agency's administrative role in the West. For Gillis and Roach, loss of the reserves symbolizes the "political drift" they see as the dominant characteristic of federal forest policy during the 1920s. Left with only the forest products laboratories and the Petawawa experimental station, the Dominion Forest Service faced an uncertain future. Finlayson's challenge was to carve out an expanded research role for his agency, in order to compensate for its lost forest protection and management duties. Ironically, the Great Depression would provide this opportunity even as it curtailed work on the national forest survey and brought deep cuts to Forest Service appropriations.<sup>16</sup>

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## **CHAPTER IV**

# **Canadian Forestry in Depression and War**







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# Canadian Forestry in Depression and War

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Federal forestry was affected by complex trends during the fifteen hectic years that separated the onset of the Great Depression from the end of the Second World War. Stripped of its administrative responsibility over western forests with the transfer of natural resources, the Dominion Forest Service immediately fell victim to severe fiscal restraints. Ironically, the same economic circumstances that made the agency vulnerable to Depression-era budget cuts gave substance to Chief Forester E.H. Finlayson's vision of a new scientific identity for the organization.

Massive unemployment gave Finlayson access to relief labour that made it possible to establish a system of experimental stations early that decade, and by its end, federal-provincial cooperation had given brief life to a national experiment in forestry work and training for young men. The first unemployment scheme collapsed under the weight of its own repressive objectives, while the more enlightened National Forestry Program had but a single summer of existence before the Second World War wiped out support for work relief among policy-makers.

Production from Canadian woodlands declined sharply in the early years of the Great Depression, began to recover at mid-decade, and boomed during the war years. Neither context worked to the advantage of provincial agencies in their forest-protection endeavours. Government austerity programs took a heavy toll on staff levels and equipment budgets during the slump, and war inspired a commitment to all-out production, which undermined conservation concerns. But if progress in the fight against fire stalled, the period did witness some promising developments. Dominion Forest Service researchers began accumulating insight on the relationship of weather factors to the moisture content of fuel and fire behaviour at Petawawa and, by the end of the Second World War, several provinces had introduced the agency's system of forecasting fire hazard levels from weather observations. Canadian authorities were also aware of American investigations into the use of aircraft for transportation, and the even more exciting technique of bombing fires from the air with water or chemical retardants. Depression and war, then, bred both frustration and anticipation in forestry circles.

With the transfer of resources to the western provinces, anxious Dominion Forest Service officials looked to the American system of forest experiment stations as a model for survival. There, passage of the 1928 *McSweeney-McNary Act* boosted funding for U.S. Forest Service

establishments in each of the nation's major forest regions, ensuring that the federal government would continue to play a leading role in research. After examining that arrangement early in 1930, W.M. Robertson proposed a Canadian equivalent. Finlayson followed up by outlining an ambitious research program in silviculture — an area with marginal provincial participation — as well as forest protection, forest management, and continued federal involvement in forest products research and the national forest inventory.<sup>1</sup>

The election of R.B. Bennett's Conservative government in 1930, coinciding with the onset of the Great Depression, scuttled Finlayson's immediate hopes for a more aggressive federal research initiative. Bent upon slashing expenditures, the Bennett regime found the Forest Service an easy target. A cut to the agency's 1930 budget from \$1.5 million to \$325,000 forced reductions in personnel and the closure of offices in Winnipeg, Calgary and Kamloops. Some Dominion foresters in the West found places with the new forest services established by Manitoba, Saskatchewan, and Alberta, but elsewhere provincial agencies fell under the knife as well.<sup>2</sup>

Finlayson's relentless drive to make research the basis for Forest Service renewal began to bear fruit in 1933, winning the Bennett government's commitment to federal participation in forest science. Another of Bennett's policies would provide the manpower necessary to give substance to Finlayson's vision. By 1932, an estimated 70,000 single unemployed men had been uprooted by the Great Depression, leaving home to search for work and ease the burden on their families. Although the *British North America Act* made the provinces responsible for health and welfare, they shifted the relief burden downward to the municipalities. These local governments adopted strict residency requirements, disqualifying transients from eligibility beyond perhaps a meal and bed for the night.

Provinces and municipalities pressed Bennett to assume responsibility for the jobless, but Canada's long experience with cyclical and seasonal unemployment, misplaced faith in a quick recovery, and a conviction held by elites that relief too easily obtained would diminish the work ethic, discouraged federal initiative. While steadfast in refusing to accept responsibility, Bennett provided grants to the provinces for public works during the first two years of his tenure. The federal Parks Department also received funding for park development in the West in the autumn of 1931: a program renewed the following year, even as the cost of mounting works

projects prompted a general turn to direct relief. The new policy unleashed a flood of transients back to the cities, where they encountered the usual barriers to relief. Demonstrations by the unemployed grew in scale and intensity, while the three levels of government continued to evade responsibility for the transients.<sup>3</sup>

The threat of civic disorder and the growing popularity of radical solutions among the unemployed overcame Bennett's constitutional reservations in 1932. That autumn, the Conservative cabinet approved a plan for Department of National Defence (DND) administration of a national system of relief camps for single homeless males. By the summer of 1933, camps had opened in every province except Prince Edward Island, providing accommodation and work for over 7,000 inhabitants. During their three-plus years of existence, over 170,000 people passed through the DND camps, receiving board, clothing, tobacco, medical care, and a paltry allowance of twenty cents a day for their labour in establishing aircraft landing fields, building roads, restoring historic sites, improving military facilities, and a variety of other undertakings.<sup>4</sup>

The relief scheme intersected with Finlayson's aspirations when he secured DND cooperation in the development of experimental stations in several of the country's main forest regions, adding to its existing facility at Petawawa. In 1933, the New Brunswick government transferred a 109-square-kilometre (68-square-mile) area northeast of Fredericton to the Dominion, which reserved over half of the logged and burned-over land for research as the Acadia Forest Experiment Station. The DND also agreed to assign a small portion of its Valcartier Military Reserve north of Quebec City to the Forest Service for investigative work. Manitoba turned over part of the Duck Mountain Forest Reserve as a field laboratory for the study of prairie conditions. Negotiations with British Columbia for the transfer of East Thurlow Island to the Dominion collapsed, a failure that had long-term consequences for federal forestry in that province. Alberta, however, made available 100 square kilometres (62 square miles) in the Kananaskis Valley available as an experimental area early in 1934.<sup>5</sup>

The availability of relief labour from DND camps, located on or adjacent to these sites, enabled the agency



**Figure 30** Panoramic view of the Petawawa Forest Experiment Station headquarters with main office, staff house and weather instruments grouped in the foreground, Petawawa, Ontario — 1938.

(Source: Photo by J.W.B. Sisam, Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 23373)



**Figure 31** Headquarters of the Valcartier Forest Experiment Station in winter, Valcartier, Quebec — March 18, 1940.  
(Source: Photo by R.G. Ray, Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 25663)



**Figure 32** Duck Mountain Forest Experiment Station's office, Manitoba — 1937.  
(Source: Photo by J.B.D. McFarlane, Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 36343)



**Figure 33** Kananaskis Forest Experiment Station boundary and road sign, Kananaskis, Alberta — October 1956.  
(Source: Photo by L.A. Smithers, Natural Resources Canada/Canadian Forest Service)

to develop its new research facilities while also carrying out improvements at its flagship Petawawa installation. About 1,000 men laboured at Petawawa in 1933, many arriving with signs of malnourishment, lacking suitable clothing, and possessing no relevant skills. Those assigned to forestry work planted trees, built protection roads, cut timber in accordance with the station's working plan, and produced lumber for nearby relief projects. Over a two-year period, crews at the Acadia station erected an administration building, residence, garage, workshop, warehouse, cookhouse, bunkhouse, stable, and other structures. They also laboured on road construction, tree-planting, and silvicultural projects. Relief workers at Valcartier, Duck Mountain, and Kananaskis carried out a similar range of improvements, and by mid-1936 the new stations were ready to commence research programs.<sup>6</sup>

The Forest Service's R.H. Candy reported that the majority of Petawawa internees put in a reasonable day's work, and cautioned that their supervision called for patience and tact, but concluded that they were "happier, healthier, and in a much better moral and physical condition than they would be . . . wandering aimlessly from city to city." Canadian foresters welcomed the limited program, but urged the federal government to follow the example of Franklin D. Roosevelt's Civilian Conservation Corps (CCC): a massive relief scheme that employed over 500,000 men in 2,514 camps at its peak in September 1935. Over half of these camps were located on national forest lands, providing the U.S. Forest Service with manpower for massive fire-control, tree-planting, stand-improvement, and recreational projects.<sup>7</sup>

Hailed as the crown jewel of Roosevelt's New Deal, the CCC flourished, while Bennett's DND camps experienced 359 strikes, protests, and riots during their existence, culminating in the June 1935 On-To-Ottawa Trek. Over 1,400 strikers left Vancouver for the nation's capital on Canadian Pacific Railway freights, to protest project conditions and military administration. Bennett ordered them stopped in Regina, and when the RCMP moved in to arrest the Trek's Communist leaders during a peaceful gathering, a riot ensued, leaving one policeman dead and 39 injured. An equal number of trekkers and citizens were injured, and there were thousands of dollars in property damage.<sup>8</sup>

Bennett's handling of the Trek, coupled with his failure to bring the country out of the Great Depression, produced a landslide victory for Mackenzie King's Liberal Party in the federal election that summer. King closed the camps in favour of a less costly farm placement program in 1936, disappointing those in industry and the forestry profession who still hoped for a Canadian version of the CCC. Research projects continued at the experimental stations, and that summer the Forest

Service's J.D.B. Harrison began studying the economic implications of introducing silvicultural principles into commercial logging operations at the request of the Canadian Pulp and Paper Association.<sup>9</sup>

The Forest Service described Depression-era forestry affairs in Canada as highly unsatisfactory. "Generations of unregulated cutting and frequent and extensive fires have depleted the more accessible and valuable stands," warned a 1934 report. Fire and disease reduced the nation's forest capital at an "alarming rate" each year and, as exports revived in the mid-1930s, industrial consumption began to climb once again. A joint annual meeting of the Canadian Pulp and Paper Association's Woodlands Section and CSFE, at Petawawa in the summer of 1935, generated a consensus that the prevailing conditions called for a greater investment in research. Recently appointed Liberal Minister of the Interior Thomas Crerar endorsed the gathering's call for a national forest research conference, and in late November the National Research Council (NRC) hosted over 100 federal, provincial, university, and industry representatives at Ottawa. The delegates urged the Council to establish a forestry committee, and the NRC's new Associate Committee on Forestry held its first meeting in Ottawa the following April.<sup>10</sup>

The Committee's members — an elite group of government, industry, and university foresters — reviewed the scientific work done in Canada to that time. They met again in January 1937 to appoint four subcommittees aimed at promoting specific projects in the fields of silviculture, protection, utilization, and economics. In addition to monitoring research by the provinces and the Dominion Forest Service, over the next few years the NRC sponsored a major study by K.M. Mayall on the influence of fire on white pine succession; collaborated with H.G. Wright on his research into the relationship between weather and fire hazard; conducted tests of suppression equipment; and, investigated the use of radio communications in forestry work.<sup>11</sup>

Finlayson had thus managed to guide the Forest Service through the worst of the Great Depression, but at enormous personal cost. Pushed to the breaking point, and presumably distraught over his organization's prospects, he vanished on February 26, 1936. Finlayson's disappearance, ruled a suicide, elevated D. Roy Cameron to Forest Service leadership just as the Liberals dealt the agency another blow. The creation in 1936 of a new Department of Mines and Resources, in place of the Department of the Interior, represented a loss of status for the Forest Service, now listed as a division in the Lands, Parks, and Forestry Branch.<sup>12</sup>

Existing scholarship provides contrasting views of the agency during this period. Gillis and Roach depict the

Depression years as an “unmitigated disaster,” brightened only by the presence of the new experimental stations and the NRC’s role in coordinating research. Johnstone, conversely, sees the organization gaining strength during the decade. Whichever characterization is valid — and evidence can be found to support either position — behind the scenes, Forest Service researchers made progress on the forest protection front, even as the agency’s leaders struggled against the prevailing view of forestry as a provincial responsibility.<sup>13</sup>

The work of J.G. Wright and H.W. Beall in measuring fire danger represents the agency’s most important scientific contribution during the 1930s. Scientific study of the relationship between weather and wildfire in North America began in California and Idaho under U.S. Forest Service auspices shortly after the organization gained authority over the national forests. Early studies dealt mainly with fire causes, damage assessments, and protection methods, but the U.S. Weather Bureau’s E.A. Beals contributed the first analysis of the influence of weather conditions on fires in 1914. That same year, the Western Forestry and Conservation Association, a Pacific Northwest industry group, secured Weather Bureau forecasts of weather conditions affecting fire hazard levels, after severe summer winds contributed to a disastrous series of fires. Canadian meteorological officials participated in the scheme, supplying daily weather reports from British Columbia recording stations to the B.C. Forest Service. Special forecasts were



**Figure 35** J.G. Wright setting experimental fires in the Valcartier Experiment Forest, Valcartier, Quebec.

(Source: Natural Resources Canada/Canadian Forest Service)

issued during the most severe periods, and the Forest Service charted temperature and precipitation data in an effort to develop an awareness of approaching hazard conditions. This arrangement showed promise for a couple of years before diminishing government support during the First World War curtailed further progress.<sup>14</sup>

S.B. Show of the U.S. Forest Service conducted the first quantitative experiments into fire behaviour in California in 1915. The field drew other American researchers over the following decade, including H.T. Gisborne and J.V. Hoffman. Most early investigators concentrated on determining a single weather factor as a determinant of fire hazard levels, with relative humidity showing more predictive promise than temperature.<sup>15</sup>

Humidity readings could be obtained in the field by hygrothermographs, or the less-expensive sling psychrometer, which consisted of a pair of wet and dry bulb thermometers attached to a piece of metal, with a length of chain secured to the apparatus by a swivel. When placed in a draft of air, evaporation from the wet bulb reduced its temperature below that of the dry bulb, the variance depending on the amount of moisture in the air. The operator placed the wet bulb, wrapped in a piece of muslin, into water and then whirled the instrument through the air for fifteen or twenty seconds. After reading both thermometers, he repeated the process, took another reading, and whirled it a third time before taking a final reading of the wet bulb thermometer. He then subtracted its lowest reading from the temperature recorded by the dry bulb, and consulted a set of tables which provided the degree of relative humidity.<sup>16</sup>

Around 1920, Hoffman and Osborne, working at the Wind River Experiment Station in the state of Washington, demonstrated the importance of relative humidity as a factor in the ignition and spread of fire. Publication of their theory in 1923 gained nationwide attention, appearing to provide a single index of fire danger. Their finding that forest fuels dried out more rapidly during periods of low humidity led foresters to base their hazard predictions on this factor alone. Over time, however, evidence accumulated that humidity readings alone were not enough. Not only did fuels not respond instantly to changing air moisture levels, but other weather factors also exerted an influence. Temperature, wind velocity, and rainfall complicated the picture, demanding additional research which would provide a means of weighing the complex relationships between the variables that affected a forest’s flammability.<sup>17</sup>

The research Gisborne conducted in the northern Rocky Mountain region during the 1920s brought new insights to the emerging field of measuring fire hazard levels, demonstrating that the moisture content of forest fuels controlled the degree of hazard, and that

fluctuations in humidity, temperature, wind, and precipitation influenced moisture levels. Further studies on the rate at which various types of fuels responded to weather changes highlighted the critical importance of the “duff” layer of organic material which coated the forest floor: a frequent source of ignition because it absorbed and released moisture more rapidly than any other factor.<sup>18</sup>

By 1927, Gisborne had defined six zones of flammability for western white pine forests. When the moisture content of the duff measured over 25 per cent, no danger existed. Between 18 and 25 per cent, protection officials had to be wary of lightning and slash fires. Campfires might be a source of ignition when the moisture content reached between 13 and 18 per cent, and at 10 per cent blazing embers and matches posed a hazard. Below that point, a lit cigarette butt might trigger a fire. The duff hygrometer, invented by M.E. Dunlap of the U.S. Forest Products Laboratory in 1923, served researchers in gathering moisture content data. This metal instrument held a strip of rattan in a foot-long perforated spike, arranged so that changes in the length of the rattan registered on a scale enclosed in a fan-shaped housing attached to the spike. Inserted horizontally into the duff at the start of the fire season, the instrument provided a fairly reliable indication of the duff’s flammability.<sup>19</sup>

The duff hygrometer caught on slowly among American protection organizations — perhaps because it was not until the development of Gisborne’s fire danger meter in 1934 that the importance of measuring moisture content became clear. The initial meter integrated six of the most important variables in assessing fire danger: season, activity of lightning and people, visibility, wind velocity, minimum relative humidity, and the moisture content of the fuel. The meter itself resembled a slide rule, allowing each of the factors to be assigned a percentage value from one to 100. The total provided a final danger rating expressed in terms of seven classes, from nil to a condition of extreme hazard indicating “the need of

every conceivable type of action that can be economically justified by the resources at stake.”<sup>20</sup>

The existence of the danger meter highlighted the need for accurate fuel-moisture measurements, and the wood cylinder method of securing this data proved more popular in the American West than the duff hygrometer. Gisborne’s idea was to use cylinders of various sizes to reflect the moisture content of forest fuels, first determining their oven-dry weight. The cylinders, which commonly measured 1.3 centimetres (0.5 inch) in diameter and about 50 centimetres (20 inches) in length, were exposed in the field on wire brackets close to the ground, and were weighed on a scale each day during the fire season. Any surplus weight represented the moisture present in the wood, providing an easy and accurate way to quantify this important variable. Anemometers were already available for measuring wind velocity, but since their expense prevented widespread use, the U.S. Forest Service cooperated with a manufacturer in the design and production of an affordable instrument.<sup>21</sup>

Although Wright and Beall did not initiate systematic wildfire research in Canada until about a decade after the American program had begun, Dominion foresters were not without prior interest in the relationship between weather and fire. E.H. Finlayson began charting weather patterns in 1916 while stationed in Alberta, assigning daily values to rainfall, temperature, wind, and relative humidity to gauge the level of fire hazard. Finlayson’s procedure may have yielded insights if continued, but apparently fell into disuse after his transfer to Ottawa. T.W. Dwight’s survey of the forest fire situation in Canada over the 1914–1916 period related mean monthly temperatures and rainfall to fire occurrence across Canada as a basis for suppression planning. It wasn’t until the late 1920s, however, that Wright and Beall founded the Dominion Forest Service’s rigorous program of fire weather studies.<sup>22</sup>

The application of meteorology to fire protection attracted a great deal of attention during this period. The recognition that dry fuels posed the greatest hazard, and that such fuels dried out more quickly during periods of low humidity, generated interest in weather forecasting as a means of predicting dangerous conditions before they arrived. By 1928, the Dominion Forest Service had forest officers operating weather-recording stations in Manitoba, Saskatchewan, Alberta, and the B.C. Railway Belt, correlating the data with fire behaviour in each district to develop an understanding of changes in hazard conditions.

This work took on a practical application in Alberta, where several stations telegraphed data daily to the Meteorological Service in Toronto, which issued special forecasts during the fire season. By this time, the B.C.



**Figure 37** Duff hygrometer made by E.J. Romare of Madison, Wisconsin, U.S.A. — ca. 1928.

(Source: CSTM, cat. no. 960643)

Forest Service had also strengthened its efforts along these lines. Following a bad fire season in 1924, the agency installed hygrothermographs at Vernon, Williams Lake, Cranbrook, Smithers, Nanaimo, and Nelson, in order to secure information on the relationship between relative humidity and the incidence of fire. Officers sent readings to the Dominion Meteorological Station at Victoria for integration with other data, resulting in the issuance of daily fire weather forecasts from Forest Service telegraph stations. In addition, rangers carried sling psychrometers so that humidity readings might be used as a basis for issuing fire warnings, adjusting patrol strength, and planning suppression activities. By 1926, Victoria and Vancouver radio stations cooperated by broadcasting forecasts to warn logging operators and the public of impending fire danger.<sup>23</sup>

Quebec timber leaseholders also investigated the utility of weather reports and relative humidity readings during the late 1920s, and in 1930 the Canadian Forestry Association asked the federal government to establish Meteorological Bureau forecasting offices at appropriate points to foster closer contact with protection agencies. Despite the obvious potential meteorology held, early forecasts provided protection officials with an imprecise planning tool, at best. Humidity and weather

conditions varied widely over fairly small areas, as C.H. Morse observed in 1927, and much work remained if forecasts were to become a reliable protection aid.<sup>24</sup>

Fundamental to this project would be the study of the relationships between fuel moisture, weather, and fire behaviour: a field still awaiting its Canadian birth. Foresters knew that rain reduced the fire hazard, but had not quantified its effects; they knew that wind, temperature, and relative humidity influenced the rate at which fuels dried out, but had not studied how these factors related to each other or conditioned forest flammability over time. The lack of a unit for measuring the hazard left decisions regarding travel through the forests, fire patrols, the staffing of lookout towers, and other matters to the individual judgement of forest officers. In 1925, John Patterson of the Meteorological Service and James G. Wright, a civil engineer recently employed by the Dominion Forest Service, discussed the need for study that would place the solution to such questions on a scientific basis, and later that year Wright urged Finlayson to launch a research program.<sup>25</sup>

Wright began fieldwork at Petawawa in the summer of 1928, joined later that year by Herbert W. Beall. Together, they dominated the field of fire research in



**Figure 36** H.W. Beall on his horse "Bugle" in Banff, Alberta — 1940.

(Source: Ashley, H./Library and Archives Canada/PA-177454)



Canada for the next two decades, developing the Wright system of fire-danger rating, which later evolved into the modern Canadian Fire Weather Index System. That first season, Wright and Beall installed several duff hygrometers in the field at Petawawa to trace daily variations in fuel moisture within red- and white-pine forests under varying conditions of precipitation, temperature, wind, and relative humidity. With an understanding of how meteorological changes affected the moisture content of critical fuels, protection agencies would be better able to interpret and act upon weather forecasts.<sup>26</sup>

The following year, Wright and Beall initiated an intensive study at Petawawa, setting up a complete weather station at the facility's headquarters for recording wind direction and velocity, precipitation, temperature, relative humidity, and evaporation. Over the next two years, they conducted empirical tests on the moisture content of fuels under a wide range of conditions, determining the rate at which they dried, in order to translate daily weather records into categories of fire hazard, and develop corresponding charts.

The two researchers established the weather's influence on moisture content at three different sites by weighing, twice daily, those fuels which provided fire with its source of ignition and initial spread, by measuring the moisture of the top layer of organic material with a duff hygrometer. They obtained these data for the full layer of duff by weighing a section cut from the forest floor in an open wire tray or basket lined with cheesecloth. The rate at which larger fuels absorbed or gave off moisture was determined by weighing a basket of twigs lying on the duff, and a suspended wire cylinder to which twigs were tied. The former test simulated the condition of twigs in contact with the forest floor; the latter those attached to fallen branches.<sup>27</sup>

Another phase of the study sought insight into the relationship of fuel moisture to flammability. Test fires set with matches, cigarette butts, and campfires provided these answers — a distinctive feature of their research method. Wright and Beall found that fire would not start by typical means in the mixed red- and white-pine forests at Petawawa when the moisture content of the top 1.3-centimetre (half-inch) layer of duff exceeded 23 per cent of its oven-dry weight. Between 23 and 20 per cent of the heat generated by a campfire or slash fire ignited the duff. Below this point, flammability increased sharply; when the moisture content of the duff fell below 11 per cent, a match, spark, or cigarette butt invariably ignited a blaze that would quickly reach uncontrollable intensity.<sup>28</sup>

With this data, Wright and his associate formulated five flammability categories, based upon the moisture content of the top layer of duff. Their hazard scale,



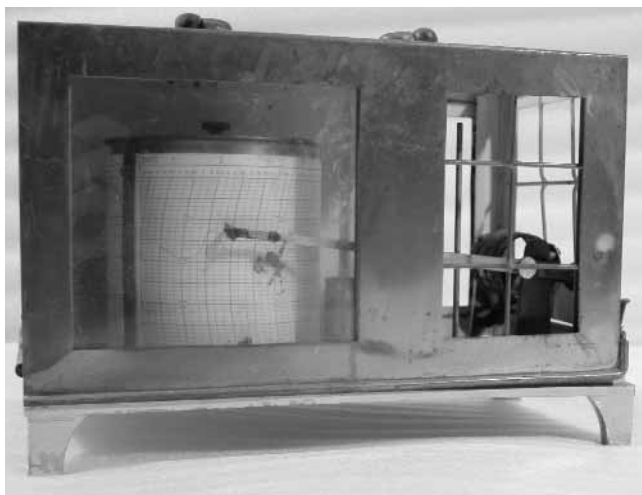
**Figure 38** Wright evaporimeter made by the Ottawa Brass Co. of Ottawa, Ontario — ca. 1930–1946.

(Source: CSTM, cat. no. 960496)

resembling Gisborne's, ranged from nil (over 23 per cent), to extreme (under 11 per cent). Over time, observation of the relationship between the various weather factors and forest fuels enabled Wright to work up tables for computing a flammability index. These — in conjunction with a daily record of relative humidity, rainfall, and rate of evaporation — made it possible to estimate the fire hazard for a given area without taking fuel-moisture measurements. Forest officers could compute the effect of rainfall in reducing the flammability index, and then calculate the daily increase in hazard simply by measuring the rate of evaporation with Wright's evaporimeter. Once the index entered the "low" range, the table's humidity and evaporation records allowed the hazard to be traced as it rose through the "medium," "high," and "extreme" ranges.<sup>29</sup>

Wright's system — intended to permit protection officials to organize their forces, regulate woods travel and slash-burning, and plan suppression activities in accordance with changing danger conditions — received a successful trial in Quebec during the 1931 fire season. Publication of the first official tables for the mixed-pine forests of eastern Ontario and western Quebec followed in 1933. By that time, the Ottawa River Forest Protective Association had achieved a "fair degree of accuracy" in computing the daily danger index with the tables, which were soon widely used across Quebec. The Meteorological Bureau of the province's Forest Protection Service supplied instruments for a series of weather stations. Standard equipment included an evaporimeter — a





**Figure 39** Thermograph made by Negretti & Zambra of London, England.

(Source: CSTM, cat. no. 960488)



**Figure 40** Rain gauge made by Short & Mason of London, England.

(Source: CSTM, cat. no. 960502)



**Figure 41** Psychrometer made by Negretti & Zambra of London, England.

(Source: CSTM, cat. no. 960493)

device of Wright's invention to measure the rate of evaporation; a psychrometer to obtain humidity readings; a rain gauge; and, thermometers. Some stations were also provided with automatic-recording thermographs, barographs and hygrographs.<sup>30</sup>

The Dominion Forest Service extended its fire-hazard research to include Quebec's cutover pulpwood lands, commencing study at the Valcartier Forest Experiment Station in 1935. Two years later, the New Brunswick Forest Service built a fire-hazard research laboratory near Fredericton to develop tables for that region. Beall operated the facility in 1938, complementing work carried out at the Dominion's Acadia Forest Experiment Station. On the Prairies, weather stations were established in the Prince Albert and Riding Mountain National Parks and at the Duck Mountain Forest Experiment Station in 1934. Later that decade, Wright and Beall computed the danger index from weather data recorded during over 100 fires in these districts, using a 1938 edition of Wright's tables for eastern Canadian forests. This analysis indicated that the tables developed for eastern pine types also provided a reliable guide for the Prairies, as the occurrence and size of these fires tended to increase as the hazard index rose. Prairie forest officers would now have some basis for adjusting their protective activities to conform with changing fire-danger conditions, pending the accumulation of more data in the region.<sup>31</sup>

The Dominion's forest-fire research did not begin at its Kananaskis station in Alberta until 1939, just as the outbreak of the Second World War caused a drastic curtailment of the entire program. Beall joined the RCAF in 1941, and Wright left the fire-research field two years later. By 1939, however, Wright's system had come into use in Quebec, New Brunswick, and the national parks of western Canada, and the research undertaken by the two scientists remains "the first reference stop whenever old problems require new solutions in the light of modern science and technology." Failed negotiations for a Dominion research station in British Columbia ruled out federal participation in fire science in that province

until after the war. The B.C. Forest Service obtained promising results in the coastal forests from a U.S. Forest Service danger-rating system involving hazard-stick readings in conjunction with measurements of relative humidity and wind velocity.<sup>32</sup>

Unemployment remained the most pressing social problem confronting policy makers as the Great Depression dragged on. For three years after closure of the DND camps, the federal government adopted a number of short-term measures to deal with the crisis. During the winter of 1936–1937, farm placement and other temporary plans were implemented to clear single unemployed men from the cities, and the following spring Mackenzie King approved \$1,000,000 to fund a Youth Training Program on a shared-cost basis with the provinces. British Columbia, which introduced a Young Men's Forestry Training Plan of its own in 1935, joined other provinces in conducting training programs in a variety of fields between 1937 and 1939. From 1936 to 1938, the province also operated a series of wintertime Forest Development Projects on the coast for transients, sharing expenses with the federal government.<sup>33</sup>

Canada's relief effort intersected once again with the aspirations of the Dominion Forest Service in the spring of 1939, when Parliament made a special \$1-million appropriation to establish a National Forestry Program (NFP), modelled on both British Columbia's Young Men's Forestry Training Plan and the American CCC. The scheme, administered jointly by the Department of Labour and the Department of Mines and Resources, sought to "combine training and employment of young unemployed men with protection and development of Canadian forests and wildlife conservation."<sup>34</sup>



**Figure 34** National Forestry Program camp at Valcartier, Quebec, seen from the east — October 11, 1939.

(Source: Photo by R.G. Ray, Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 24805)

Unlike the CCC, which was a strictly federal undertaking, the NFP embodied a principle of federal-provincial cooperation that Finlayson would have applauded. At long last, it appeared, governments had overcome the constitutional obstacles to a vigorous national forest policy. Separated into federal and provincial sections, the NFP featured a prominent role for the Dominion Forest Service. The agency assumed responsibility for developing and supervising projects on the Dominion experiment stations and national parks with the \$400,000 federal share of NFP funds. Cameron's staff also had the right of approval and inspection of provincial projects, supported by the balance of the federal allotment and matched by the provinces.<sup>35</sup>

Unemployed young men in "necessitous circumstances", ages 18 to 25, were eligible for the NFP program, which operated through the summer of 1939. Enrollees earned a dollar a day, plus board and lodging, but a deferred pay system held the bulk of their earnings until completion of service, limiting the monthly draw to \$10. Operations ranged in size from 100-man camps to small trail crews of six to ten which moved as required. Most of the provinces organized mobile tent camps, while some semi-permanent Dominion establishments featured huts. Each camp had its own cookhouse and mess tent or hut and, in Dominion Forest Service facilities, trainees gained an average of 2.7 kilograms (six pounds) in weight over the summer, despite the vigorous eight-hour workday.<sup>36</sup>

Seeking to bolster morale and ensure that all had access to appropriate clothing, the program funded half the cost of a standard uniform that remained the enrollee's property after his training. The outfit consisted of a forage cap, two khaki shirts, green tie, belt, khaki trousers, socks, work boots and running shoes, sweater, windbreaker and slicker. A "National Forestry Program" badge completed the ensemble, but retention of this item was conditional upon satisfactory work and conduct.

Provision for education and recreation added to the NFP's lustre, although commitments varied according to the nature of the camp. In larger Dominion projects, instruction in forestry subjects, tool and equipment maintenance, first aid, health, citizenship and other topics might be given during the half-day per week devoted to education, and Saturday afternoons were reserved for organized recreation. About 200 trainees in eight units, working around Banff National Park, enjoyed a field day that involved track-and-field events and competition in woods skills. Smaller trail crews did not benefit from these advantages, receiving their training solely during the course of their work.<sup>37</sup>

All nine provinces took advantage of NFP funding to conduct projects employing at total of 4,000 young men. Prince Edward Island operated training in the care of woodlots for about 30 men at the Acadia Forest Experiment Station, and employed nine six-man crews in the improvement of 28 woodlots. Two 60-man camps in Nova Scotia's Chignecto Game Sanctuary cleared roads and trails, thinned stands, prepared 32 hectares (80 acres) of land for planting, constructed over five kilometres (three miles) of telephone line, and built two suspension bridges. New Brunswick administered 18 mobile tent camps, initially manned chiefly by urban enlistees. High turnover among these men led officials to select subsequent recruits from rural areas, with more satisfactory results. By the end of the summer, three lookout towers, 160 kilometres (100 miles) of portage road, and an equal amount of telephone line had been constructed to improve forest protection in the province. Training in the cutting of pit props for export to Great Britain, and some stand improvement in woodlots and along highways rounded out the season's work.<sup>38</sup>

In central Canada, Quebec operated 30 projects devoted to forest protection, the enhancement of tourist facilities, silviculture, and nursery development at Berthierville and Duchesnay. Ontario established 42 small camps, mostly in the North, and assigned 40 trainees to assist rangers in park areas. Although the respective forest services typically administered projects in the NFP's provincial section, Manitoba's Commission for the Employment of Single Men and Youth Training did so in that province. Three camps, each accommodating 100 men, went up on the Sandilands Forest Reserve to carry out forest-protection work. These projects, among the best-equipped within the provincial section, housed their occupants in ten-man tents framed and floored with rough lumber. Cookhouses were of frame construction, each with a large attached tent where the men dined. Each camp included another large tent featuring a radio, table tennis, books, games, and lectures, supervised by Frontier College representatives.<sup>39</sup>

Saskatchewan's five 40-man projects drew men from both urban and rural districts, providing physical training, organized recreation and class instruction. Neighbouring Alberta opened a 30-man facility on the Cypress Hills Forest Reserve, housing trainees in pre-fabricated huts for thinning work in the reserve's dense lodgepole pine stands. Another seven, ten-man, mobile units operated away from the main camp, clearing roads and fireguards, laying out telephone lines, building small dams for water-conservation projects, and improving ranger stations and tourist sites.<sup>40</sup>

British Columbia, with four years' experience in youth forestry training, conducted a total of 40 NFP projects. Sixty-eight per cent of the trainees' time went into forest

protection measures, clearing over 320 kilometres (200 miles) of access roads and trails, building lookout towers and cabins, felling snags, establishing fireguards, and burning slash. Progress in the development of parks, the existing Green Timbers nursery, a new facility at Campbell River, and the Cowichan Lake Experiment Station also continued under NFP auspices. Game Commissioners supervised projects in stream clearance and work at fish hatcheries that summer.<sup>41</sup>

Around 1,000 young men participated in 27 projects from Nova Scotia to British Columbia under the NFP's Dominion section, carrying out work at the forest experiment stations and national parks. Crews at Petawawa, Valcartier, Acadia, and Kananaskis concentrated on forest protection and silvicultural cuttings. Enrollees also assisted technical staffs in sample plot measurements, inventory surveys, fire hazard studies, and forest disease and insect research. Units stationed in the Cape Breton, Riding Mountain, Prince Albert, Jasper, Banff, Elk Island, Waterton Lake, Yoho and Revelstoke parks built trails, tourist shelters, campsites, fireplaces and ski-runs, enhanced fishing sites, and worked to improve the appearance and health of stands along highways.<sup>42</sup>

Over the course of the season, almost 5,000 youths took part in the NFP, averaging about three months of employment. Cameron described the undertaking as a "complete success," a sentiment echoed by provincial officials. The prospects for renewal of the NFP in 1940 seemed bright, but after the outbreak of war in Europe, a large number of enrollees left the projects to enlist. Cameron argued that the NFP had "a definite place in Canada's war effort," given the status of the nation's forests as the Empire's "storehouse of softwoods," but enlistments and economic revival under wartime conditions spelled the end of this promising experiment in Dominion-provincial cooperation in forestry, after a single season.<sup>43</sup>

Dominion Forest Service officials regretted the termination of an organization that "would undoubtedly have produced valuable results not only for the forest, but for society itself," if permitted to continue. Wartime also brought much of the Forest Service's research activities to a standstill, with the exception of the Forest Products Laboratories. With much of its personnel absent on military leave, or on loan to various war departments and other Mines and Resources Branches, the best that could be hoped for was care and maintenance of existing silvicultural projects. Development of the Riding Mountain Forest Experiment Station halted, and Valcartier closed down for the duration. The agency's fire hazard research was another casualty of the war, although weather stations continued to accumulate danger index data in the western national parks.<sup>44</sup>

Like other branches of the federal government, the Forest Service devoted itself to making the "maximum possible contribution to the war effort." The agency's war work took a variety of forms. Cameron served on the Interdepartmental Committee on Timber Depletion, the Subcommittee on the Conservation and Development of National Resources, and in 1942 went to the Wartime Prices and Trade Board as the Deputy Administrator of Wood Fuel. The Forest Service also participated in programs for the "safekeeping and useful employment" of those considered undesirable in the context of global conflict. In June 1941, the Mackenzie King administration authorized the establishment of work camps for conscientious objectors. The Prime Minister also reluctantly agreed to take in British prisoners of war and internees: a policy that eventually resulted in the holding of over 34,000 German prisoners at 25 sites across the country. Government officials identified several national parks, forest experimental stations, and Indian reserves as sites where prisoners of war and alternative service workers, known as "conchies," might pick up work where the Depression-era relief projects had left off.<sup>45</sup>

The vast majority served on development projects in the national parks or in British Columbia, where concerns about enemy attack legitimated a major commitment to forest protection by alternative service workers; however, internment camps were also established at the Acadia, Petawawa, and Kananaskis experiment stations. Internees at Acadia concentrated on cutting fuelwood, providing an opportunity for stand-improvement studies. Similar conditions prevailed at Petawawa, where crews engaged in road construction and other development work, in addition to cutting operations which kept the camp supplied with wood. The Kananaskis project's principal assignment involved the logging of a mature spruce stand to supply a portable sawmill which cut lumber for the Timber Controller's use on war projects.<sup>46</sup>

Booming wartime domestic and export markets for wood products generated frantic logging activity in Canada's most accessible forests, despite acute labour shortages. Cameron and his staff alerted Department of Mines and Resources officials to the inevitable consequences of the increased rate of depletion for timber-dependent regions, in yet another plea for the extension of federal aid to the provinces for forest protection. Support for the principle of cooperation along American lines also began to emerge from the provinces, led by British Columbia. Mackenzie King refused to entertain such proposals, made in the context of federal-provincial wrangling over Ottawa's plan to take the areas of personal and corporate taxation away from the provinces in order to finance the war effort.<sup>47</sup>

The failure to bring about agreement on a new fiscal basis for Confederation, at the Dominion-Provincial

Conference of 1941, dashed Cameron's hopes for progress toward a national forest policy for the time being, but provincial demands for assistance gained coherence when Ontario hosted a meeting of forestry ministers and officials at Toronto in 1943. Representatives from all of the provinces save Prince Edward Island attended, then pressed on to Ottawa to present their case to Minister of Mines and Resources, T.A. Crerar. The CFA and trade associations joined in the call for Ottawa to aid provincial forest protection efforts, to strengthen its commitment to research, and to consider "the whole question of conservation and utilization of forest resources as a permanent national forest policy."<sup>48</sup>

The Mackenzie King administration gave the overture a lukewarm response; Crerar expressed no fundamental disagreement with the brief, while maintaining that prosecution of the war effort made immediate federal financial support impossible. Planning should continue, however, in preparation for the opportunities that would arise in the context of postwar reconstruction planning. This, according to Gillis and Roach, signalled the beginning of a shift in Ottawa's attitude toward forestry in Canada. Ongoing pressure from professional, trade, and conservation groups; concern with the impending transition to a peacetime economy; and, recognition of the forest industry's contribution to trade and revenue, all contributed to a growing acceptance of the federal responsibility to "maintain the health of Canada's forests for both their economic and social values."<sup>49</sup>

Seizing the initiative, Cameron pressed home the need for a national forest policy which would provide his agency with the authority to approve and inspect provincial initiatives undertaken with federal funding. He linked this goal to a broader package of aspirations for the Dominion Forest Service, including a revival of the NFP, the establishment of additional experimental stations, resumption of the national forest inventory, a renewed emphasis on forest protection research, and new scientific inquiry in watershed protection and soil classification. Dominion commitments in the immediate postwar period fell short of Cameron's goals, but a 1943 report by the Advisory Committee on Reconstruction's Subcommittee on Conservation and National Resources which proposed a *Forest Resources Rehabilitation Act* to assist the provinces, set the foundation for the *Canada Forestry Act* of 1949.<sup>50</sup>

The most significant development in Canadian forest administration, during the 15-year period of Depression and war, came as a consequence of the natural resources transfer in the West. Manitoba, Saskatchewan and Alberta each established their own forest services. They absorbed existing Dominion Forest Service staff, and generally followed its systems, leaving Prince Edward Island as the only province without a forestry agency.

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The B.C. Forest Branch's patrol area increased by about 18 per cent with the addition of the Railway Belt and Peace River block to its jurisdiction.<sup>51</sup>

The withdrawal of direct Dominion participation in forest protection, with the exception of the North, Native reserves, national parks, and other federal properties, left the field in provincial hands. The whirlwind of global economic crisis, however, rolled back the progress in fire control which had been made during the 1920s. Budget-cutting by the provinces after 1930 further crippled protection agencies. Ontario reduced the number of rangers, slashed their wages, curtailed purchases to replace aging tools and machinery, and simply allowed fires on unlicensed Crown land in the North to burn themselves out. Fiscal restraint in British Columbia resulted in suspension of government contributions to the Forest Protection Fund in 1932 and 1933, and a reduction in patrol staff from 260 to just 40 men. Here too, a lack of funds prevented maintenance of protection facilities and purchases of much-needed equipment.<sup>52</sup>

Already hamstrung by financial circumstances, protection organizations faced a period of unusually severe fire hazard during the first half of the Depression. In 1932, with staff levels at rock-bottom across the country, fire losses reached their highest point since 1923. Government support increased gradually over the remainder of the decade, although statistics revealed that the average fire increased in extent by 7.5 per cent during the 1935–1939 period. This record ran counter to a more positive long-term improvement in fire-control efficiency that saw a “progressive and gratifying” downward trend in average fire size of 58 per cent between 1918 and 1939. The Second World War then dealt protection agencies another blow. Enlistments and full employment reduced the reserve of manpower available for firefighting, and the conversion of manufacturing plants to war production made it difficult to secure new equipment and replacement parts. Looking back in 1946, H.W. Beall concluded that fire-control efficiency had declined over the previous decade: a period during which the average forest fire in Canada increased in size by 20 per cent before being brought under control. Depression and war, then, had combined to forestall any measurable advance in forest protection from the standards of the late 1920s.<sup>53</sup>

The technologies of fire detection and suppression gained little in sophistication in this context. Firefighting methods remained largely in the “war club stage,” British Columbia forester George Melrose noted in a 1931 commentary on the scant attention forest protection received as a subject of scientific study. With the exception of research into the relationship of weather and fire behaviour by American and Dominion Forest Service investigators, the field lacked a structure for the

systematic accumulation and transmission of knowledge, both within and between organizations. An Ontario forester took issue with Melrose's discussion after surveying professional journals, but few would have disagreed with his premise that the major concern of forestry organizations merited more scientific inquiry.<sup>54</sup>

In the field of fire detection, foresters concluded that a well-planned system of lookout towers, linked by telephone or radio, provided a more cost-effective approach than the airplane patrol. Isolated regions beyond the tower network represented an exception to this rule. Both Manitoba and Saskatchewan established air services after the natural resource transfer terminated RCAF forestry work, taking over aircraft made available at a nominal cost. The Manitoba Forest Service maintained lookout towers in the settled regions, conducting aerial patrols in the unsettled North and communicating between planes and bases by carrier pigeon after the withdrawal of Dominion radio service facilities. The agency also received good cooperation in reporting fires from the commercial air companies which operated in northern mining districts. Saskatchewan's Department of Natural Resources phased out detection flights in favour of a “more effective and less expensive” system of radio-equipped towers during the 1930s. Ontario continued to combine aerial patrols in the northwest with a network of lookouts in other regions, maintaining 212 steel towers along with some of wooden construction by 1943. Mrs. Raoul Languerand served as Ontario's only woman fire lookout at that time, taking her soldier husband's place.<sup>55</sup>

In the rest of the provinces, detection by horseback or automobile patrol and stationary towers predominated. Hoping to ease transportation of building materials by pack-train to difficult sites, in 1942 the B.C. Forest Service installed two experimental lookouts fabricated from plywood panels. Their performance promised an expanded use of this construction technique after the war. In Quebec, over 400 towers provided detection service by the mid-1930s. The Forest Protection Service conducted no aircraft patrols, but did put a man in the air to sketch fires, in order to facilitate deployment of ground forces.<sup>56</sup>

As the economic outlook brightened somewhat in the mid-1930s, Ontario resumed development of its radio system, in anticipation of equipping patrol planes with the devices, thus permitting aviators to report fires without doubling back to their base. Testing of the new shortwave units, developed by the Department of Lands and Forests Radio Section, began in 1936 between Red Lake and Sioux Lookout. These sets, about the size of a large portable typewriter, allowed two-way voice communication instead of the traditional transmission of messages by code. By 1943, the agency had 160 radio

sets in use, and maintained about 6,900 kilometres (4,300 miles) of telephone line for forest-protection purposes. Much of the latter system required rebuilding, however, as a result of neglect during the Depression and war years.<sup>57</sup>

While Ontario's Radio Service personnel built sets during the winter months for use in that province, the Canadian Marconi Company continued to cultivate a market for its products. In 1935, the firm introduced a "compact portable radio telephone for forestry communication," arranging for the Laurentian Forest Protective Association to try out one of the 41-kilogram (90-pound) PRS1 units the following year. Twenty-seven radio-

telephone sets, presumably Marconi devices, provided voice communication over a 40-kilometre (25-mile) range in isolated forest regions of Quebec in 1940. Although war interrupted the flow of radio equipment to forestry organizations, rapid development of communications systems for military purposes ensured that the technology would play an increasing role in forestry thereafter. In 1949, the B.C. Forest Service operated the largest radio network in the Dominion, consisting of 350 stations which ranged from portable sets to large installations at district headquarters. Interference plagued operators of the B.C. Forest Service's early postwar low-frequency radio equipment, but the establishment of FM stations subsequently provided static-free reception.<sup>58</sup>



**Figure 42** BCFS radio, Nanaimo, B.C.  
(Source: British Columbia Archives NA-07309)

Ontario had equipped 41 of its forestry aircraft with radios by 1954, and operated a large number of mobile, marine, and portable sets on the same high-frequency system. Nearly 300 lookout towers used a separate very-high-frequency (VHF) network, seeking to eliminate costly maintenance of telephone lines; the Alberta Forest Service also made headway in radio communications after appointing engineer Tony Earnshaw to develop a system for the eastern slopes of the Rocky Mountains in 1938. The early 27-kilogram (60-pound) portables worked only if atmospheric conditions were “just right”, but in the 1950s a new FM system with Motorola equipment provided more reliable communication between lookouts, ranger stations, trucks, “walkie-talkie” units carried on horseback patrols, and offices in Calgary and Edmonton.<sup>59</sup>

Fire-suppression methods in Canada would benefit greatly from the technological advances made as a consequence of the Second World War; in the interim, however, protection organizations and manufacturers contented themselves with relatively minor improvements to existing equipment. “In the past nine years, little if anything new has been achieved in the development of firefighting equipment or technique except in the field of transportation,” the Dominion Forest Service’s D.A. MacDonald observed at the 1935 Ottawa fire research conference. The use of aircraft for carrying firefighters represented a step forward, but manpower remained the “primary defence” at fire-lines. Power pumps used in conjunction with linen hoses still offered the “most expeditious and certain means of fire suppression,” along with 19-litre (five-gallon) backpack tanks.<sup>60</sup>

Research and development by provincial forestry organizations and manufacturers focussed on improving pump performance. Watson Jack Ltd. of Montreal obtained the Canadian manufacturing rights to the Evinrude line in 1930, equipped a factory in the city, and began marketing the “Wajax Forest Fire Pump”. New Brunswick’s Chief Forester G.L. Miller claimed that the model outsold all others of a similar type across Canada in the mid-1930s. Perhaps 2,500 Wajax pumps, powered by a twin-cylinder engine and weighing almost 45 kilograms (100 pounds), were in use nationally by 1936.<sup>61</sup>

The early Wajax units, like those made by Fairbanks-Morse, were rotary pumps featuring gear mechanisms that demanded the availability of clean water, as sand, silt, or twigs rendered them inoperable. The Canadian Johnson Motor Company of Peterborough introduced its Johnson-Tremblay line around this time: the first



**Figure 43** Set-up for pump-testing at Pumps and Power Ltd., Vancouver, B.C.  
(Source: British Columbia Archives NA-06001)

centrifugal pumps to come into widespread Canadian use. The absence of contact between moving parts in pumps of this type permitted operation in water sources that would have fouled rotary models. This feature, coupled with high-speed performance, light weight, and the ability to work in relay, contributed to the growing acceptance of centrifugal pumps. Pumps and Power Ltd. of Vancouver introduced its Paramount Senior centrifugal pump in 1937, followed in 1941 by the Paramount Cub, a 34-kilogram (75-pound) model that came supplied with a pack-board for one-man transport. Wajax models in this weight class were also available by the end of the Second World War.<sup>62</sup>

The forest services of British Columbia and Ontario also engaged in the development of pumping technology during this period. Concerned that the emphasis on portability had come at the expense of reliability, the West Coast agency collaborated in 1932 with a Vancouver manufacturer to build a centrifugal pump to work with an Austin engine. Weighing over 90 kilograms (200 pounds), it offered dependability and a capacity of 295 litres (78 gallons) per minute, more than offsetting the increased weight. Dissatisfied with existing commercial pumpers, the Ontario Forestry Branch’s research in the design of light, compact, and reliable pumps produced at least two models during the 1930s: one a 36-kilogram (80-pound) unit assembled in the agency shop in 1938, that delivered up to 132 litres (35 gallons) per minute.<sup>63</sup> B.C. Forest Service fire inspector J.G. MacDonald took portability to new heights in 1941 with the development of an ultra-light 27-kilogram (60-pound) pump for one-man transport and operation. Fitted with shoulder straps, driven by a small one-horsepower air-cooled motor, and equipped with 30 metres (100 feet) of 2.5-centimetre (one-inch) hose, the backpack unit delivered just 38 litres (ten gallons) per minute. The Hayes Manufacturing Company of Vancouver

built 12 of these in 1941 for Forest Service use in rugged locations, achieving good performance.<sup>64</sup>

With equipment development by public agencies and private companies now spread across the country, Dominion Forest Service officials called for the establishment of a national fire research laboratory to study, design, and standardize firefighting technology and methods. The NRC began conducting tests of pumps and accessories at Petawawa by the end of the 1930s, in an effort to establish performance ratings for the guidance of purchasers.<sup>65</sup>

North American forestry organizations gained another valuable mechanical ally during this period in the form of earth-moving equipment. The U.S. Forest Service utilized one of the earliest bulldozers for fire-line construction, and Canadian agencies followed suit during the 1930s. Although the horse-drawn plough remained in use, the development of the tractor fostered the design of a wide variety of larger ploughs capable of doing the work of large crews. Graders and gas-powered shovels achieved a similar effect in the building of protection roads.<sup>66</sup>

While provincial forestry organizations concentrated on improving existing technologies and adapting new construction equipment to their needs, more generous funding to meet protection needs in the national forests of the United States continued to encourage a strong commitment to innovation by the U.S. Forest Service. That organization also endured budget cuts and equipment shortages during the early 1930s, but managed to support several undertakings that explored the potential uses of aircraft in fire control. One experimental project, initiated in 1936, sought to develop techniques for dropping equipment to fire crews by parachute. Supplies had been free-dropped with special wrapping prior to that study, resulting in the invention of the static-line for opening cargo chutes automatically.<sup>67</sup>

The agency had “about perfected” its paracargo technique by 1939: the same year it conducted its first smokejumping tests in Washington’s Chelan National Forest. Seeking to speed response time to fires in remote, mountainous territory beyond road or trail access, the agency secured the services of professional jumpers to train volunteers, and began developing techniques and



**Figure 44** Caterpillar bulldozer in fire-suppression operation — 1938.

(Source: British Columbia Archives NA-07023)



equipment that summer. The project continued in 1940 under "actual fire conditions" in the Northern Rocky Mountain Region, demonstrating conclusively that men could "fly out over practically any type of forest, jump and land successfully and extinguish fires." The smoke-jumpers were equipped with padded suits and football helmets with wire masks to prevent injury; specially designed parachutes that provided control over the rate and direction of descent; and a harness that allowed a man to free himself and reach the ground by means of a rope, if caught in the branches of a tree. Smoke-jumpers quickly became an important part of the U.S. Forest Service's initial attack force in the American West, with over 300 men operating annually from several bases during the 1950s.<sup>68</sup>

Finally, the American agency began experiments in the late 1930s to determine the feasibility of dropping water or chemicals from aircraft to slow the advance of fires. Problems in accuracy and the dispersal of water or retardants, when released from above, led to termination of the trials in favour of the smokejumping program; however, officials remained hopeful that aircraft development would make water-bombing an effective suppression technique in the future. They expressed particular enthusiasm about the helicopter's potential for crew and equipment transport in mountainous regions, and in dropping suppressants accurately while hovering over fires.<sup>69</sup>

Canadian foresters monitored the American trends and, after hearing a 1938 summary by the U.S. Forest Service's Fire Control Division Chief, an Ontario official declared, "One cannot but feel that we in Canada are lagging far behind in this [mechanized] method of fire control." Over the next several years, modern warfare produced many technological advances, along with a great deal of surplus equipment that would be available for conversion to fire-protection purposes after the Allies' victory. "The era of mechanization," an American commentator predicted in 1946, "is dawning over the forest."<sup>70</sup>

If government and industry had made substantial, some called it revolutionary, achievements in fire control between the turn of the century and the end of the Second World War, the same could not be said for their progress in forest renewal. Ontario had established its first nursery in 1905, providing seedlings to farmers for planting on wastelands and woodlots. By 1938, the province operated three nurseries, with an annual capacity of about 14 million trees. Quebec established a facility at Berthierville in 1908, and several of the province's pulp-and-paper companies conducted small planting programs during the 1920s, with seedlings grown at private facilities. New Brunswick's first small nursery opened at Fredericton in 1923, with Nova Scotia following three years later at Lawrencetown. By the time the Dominion Forest

Service nurseries on the Prairies were transferred to the Department of Agriculture in 1931, about 117 million trees had been distributed to farmers in the region. Following the transfer of nursery responsibilities to the provinces, Manitoba, Saskatchewan, and Alberta tried to maintain production from small nurseries the Dominion Forest Service had established on several forest reserves; the Depression curtailed these efforts, however. British Columbia opened its first permanent facility near New Westminster in 1930, another at Campbell River in 1940, and a third at Duncan in 1946. By 1941, the total area planted in Canada, excluding the Prairie shelterbelts, amounted to about 68,000 hectares (168,000 acres), mostly agricultural rather than commercial forest lands.<sup>71</sup>

The limited scientific and financial resources devoted to artificial reforestation placed the burden on Nature. The wintertime horse-logging practiced everywhere east of the western rainforest provided much better opportunities for natural regeneration than the mechanized systems that came into the woods after the Second World War, but foresters had made little or no progress in introducing silvicultural principles into cutting plans. The consequences of mechanized logging practices, governed solely by the dictates of the market, were already evident on the British Columbia coast, where the clearcutting that accompanied the introduction of steam-powered overhead logging systems ignited a debate over the regulation of cutting practices during the 1930s.<sup>72</sup>

Foresters such as British Columbia's Ernest Manning and the Canadian Pulp and Paper Association's Alexander Koroleff had already begun pressing for silvicultural reforms, but when the Dominion Forest Service's R.H. Candy reviewed regeneration reports, compiled by that agency and the Commission of Conservation over the 1918-1936 period, he came to a surprisingly optimistic conclusion. Although white-pine reproduction remained notable for its absence, and the logging of commercial species from mixed stands allowed shade-tolerant hardwoods to dominate new growth, Candy concluded tentatively in 1938 that the problem of obtaining natural reforestation was "not a serious one." In most cases, ample reproduction followed logging, light fires, and insect attacks, indicating a "promising future" for forest renewal across Canada.<sup>73</sup>

Even the wartime boom in wood demand, which generated an increase of 22 per cent in the national cut over the previous five-year period, failed to create a sense of urgency. Inventories located new sources of supply, providing a rationale for increasingly generous estimates of Canada's forest wealth, despite the heavy war-fuelled drain on the resource. In the immediate aftermath of the war, the Dominion Forest Service called for progress in the adoption of cutting methods to foster prompt natural regeneration; already, however, anticipation of a postwar

slump was fading under the influence of an economic boom that extended industry's search for timber into unexploited forests. Strong markets, new technologies,

and corporate concentration would fuel an ever-widening quest for fibre that would outweigh concern for forest renewal in the coming decades.<sup>74</sup>

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## **CHAPTER V**

# **The Rise of Federal Forestry in the Postwar Era, 1945–1965**





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# The Rise of Federal Forestry in the Postwar Era, 1945–1965

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In the two dynamic decades following the Second World War, federal forestry came to enjoy a level of security and prominence that would have pleased early leaders. More abundant funding created opportunities for researchers to advance their knowledge of wildfire behaviour; to develop new forest inventory techniques; and, to gain further insights into the impact of natural disturbances and industrial activity upon forest renewal. Although the forest services of British Columbia, Ontario, and Saskatchewan maintained their own research branches, industry and the provinces came to regard the federal agency as Canada's principal scientific body.<sup>1</sup>

Long-awaited initiatives in federal-provincial cooperation contributed to the Dominion Forest Service's national profile. Finally, following the American policy model of providing federal funding to approved state programs, in 1949 Louis St. Laurent's Liberal administration passed the *Canada Forestry Act*. For almost two decades, shared-cost agreements supported provincial inventory, reforestation, forest protection, and access road development programs. The agency, known as the Forestry Branch after a 1950 shuffling of government departments, administered the agreements to ensure that the provinces met their obligations under the *Act*.

The awakening need for reforestation, the introduction of new regulatory structures by provincial governments, and the arrival of a meaningful federal policy in the context of postwar resource-driven prosperity, encouraged foresters to view the future with optimism. "The most significant development in Canadian forestry during the past ten years is that we are now making a conscious effort to grow forests," the Branch's A. Bickerstaff declared in 1954. "Economic, social, and legislative forces are gradually changing a policy of forest liquidation to one of sustained yield forest management."<sup>2</sup>

The creation of a full-fledged Department of Forestry in 1960, under its own Minister, capped postwar progress in the federal sphere, but cracks were already evident in the sustained yield framework of Canadian forestry. The mechanization of logging west of the Pacific rainforest, after the war, increased cutting levels and created less favourable conditions for the regeneration of cutover lands. Together, industry and governments drained enormous revenues from the forest, with too little regard for its protection and renewal. As long as another fibre frontier beckoned, policy-makers and corporate leaders would exhibit more enthusiasm for exploiting the new frontier than for investing in those lands that had been

stripped of commercial timber. By the mid-1960s, it was not a question of if timber shortages would develop, but when.

The return of staff from military service, the recruitment of additional personnel, and increased funding, breathed new life into the Dominion Forest Service as the agency shifted to a peacetime role. Although the booming economy dashed Cameron's hopes for an NFP revival, the Mackenzie King government was giving consideration to proposals for federal assistance to provincial forest development programs. In addition, rising harvest levels during the immediate postwar years accentuated the need for research into forest protection, aerial survey, and silviculture at the Acadia, Valcartier, Petawawa, Riding Mountain, and Kananaskis experimental stations.<sup>3</sup>

Industry's concern with resource supply prompted the Canadian Pulp and Paper Association to request a survey of reproduction on cutover and burned-over lands in 1946. Over the next three years, Forest Service field parties conducted a three-stage project east of the Rockies which considered the entire question of regeneration following human and natural disturbances, beginning with the restocking survey. The second phase, involving fundamental study of the factors contributing to natural reforestation, began in 1949, setting the stage for long-term cutting experiments designed to foster the reproduction of commercial species. R.H. Candy summarized the initial survey findings in 1951, just as the first generation of wheeled skidders appeared in eastern Canada. He described conifer reproduction after logging of the mature forests from east of Lake Superior to the Atlantic Coast as "most encouraging." Balsam fir tended to dominate after removal of the spruce, however, and field crews found "disastrous" conditions on areas disturbed by both logging and fire. On these sites, fire destroyed advance growth that had survived logging, and the decaying wood that retained the moisture required for seedling survival, as well as any remaining seed trees. The drier climate of the prairie region contributed to a much less favourable rate of restocking after any sort of disturbance.<sup>4</sup>

Candy's observations on the long-term impact of fire highlighted the need for improved forest protection: an objective the agency's researchers sought to achieve through revisions aimed at simplifying the use of Wright's danger tables and reducing the number of weather instruments required. Published in 1946, the new tables were adopted by numerous organizations east of the

Rockies for measuring hazard conditions in a wide variety of fuel types. Studies resumed at Kananaskis after a four-year lapse to refine the danger-rating system in the western national parks. The Manitoba Forest Service introduced the Wright system in 1946, and Ontario initiated trials by the end of the decade. A further 1948 revision incorporated J.C. MacLeod's research on the influence of high-elevation temperature and humidity inversions. By this time, daily measurement of fire danger, using the Dominion Forest Service method, had become "standard practice" in all but three of Canada's forested provinces, and it served as "a model for foreign investigators." In the far west, however, the B.C. Forest Service continued to rely on hazard sticks for the direct measurement of relative humidity as a basis for decision-making.<sup>5</sup>

Aerial inventory of forest lands also made a resurgence immediately after the war, benefitting from military developments in air-photo interpretation and photogrammetry, and the availability of surplus aircraft. H.E. Seely returned to the Dominion Forest Service from military intelligence work to become Chief of the Aerial Surveys Division in Ottawa, heading a team of foresters and technicians that introduced the forestry "tri-camera" method of aerial photography, in the winter of 1947, on a survey of Riding Mountain National Park. The technique, designed to provide "maximum forestry information at minimum cost," combined vertical with starboard and port oblique photographs for coverage of large areas at a single pass. Another focus of Seely's group involved the development of instruments for transferring details from aerial photos to maps.<sup>6</sup>

Pressure from industry, provincial governments, and forestry organizations for more complete inventories of the resource, in order to facilitate postwar expansion and new management initiatives, played a key role in passage of the *Canada Forestry Act* in December 1949. A 1948 Canadian Pulp and Paper Association policy statement called for joint Dominion-provincial financing of a national survey of commercial forest lands. Pulp-and-paper company executive Gordon Godwin, chairman of the CFA's executive committee, informed the CSFE's 1948 annual meeting that the \$100 million in taxes generated annually by the forest industry warranted a significant increase in federal support from its current \$2-million yearly investment. Provincial governments were also anxious to promote development of the forestry sector. Royal Commissions in British Columbia and Ontario paved the way for the introduction of long-term sustained yield tenures, which gave integrated corporations assured access to vast timber supplies. New Brunswick began enforcing its 1937 legislation, which required large licence holders to submit management plans, thus joining the above provinces and Quebec, the pioneer in this policy area. Several provinces invested in large-scale aerial inventory

projects to cope with industry expansion. Ontario contracted with the Photographic Survey Company in 1946 for the mapping of over 200,000 square kilometers (125,000 square miles) of forest, and the B.C. Forest Service established a separate Inventory Division in 1949.<sup>7</sup>

The *Canada Forestry Act* set in motion a two-decade period of expansion for the Dominion Forest Service, providing "a statutory foundation for a national forest policy." The legislation authorized the creation of national forests and experimental areas, and empowered the federal government to enter into agreements with the provinces "for the protection, development, or utilization of forest resources." Early in 1950, the agency, renamed the Forestry Branch, emerged as part of a new Department of Resources and Development under Director D.A. MacDonald. Officials carried out negotiations with provincial representatives over how best to implement the *Act* during the next year and, on May 2, 1951, Minister R.H. Winters announced his government's intention to assist the provinces in financing forest inventory and reforestation projects.<sup>8</sup>

The federal offer gave priority to the inventory work needed to satisfy industry's demand for more precise information about the nature and extent of Canada's forest resource, making provinces eligible for 50 per cent of the costs of completing and maintaining their inventories over the next five years. New Brunswick, Manitoba, Saskatchewan, Alberta, Ontario, British Columbia, Prince Edward Island and Nova Scotia signed agreements by July 1952, inventorying over 1.6 million square kilometres (one million square miles) of forest during the initial period. Dominion payments in support of these projects amounted to \$4,471,125, with administrative responsibility belonging to a new Provincial Agreements Section in the Forestry Branch's Operations Division. Methods varied from region to region, depending upon forest conditions and provincial requirements, but all relied upon aerial photography and ground examination of representative sample plots to meet federal standards. Data from across the country contributed to the Canadian Forest Resource Data System, established to compile nationwide statistics. Despite this promising revival of federal-provincial cooperation, Canadian inventory practices would draw increasing criticism as timber shortages developed later in the century.<sup>9</sup>

The six provinces signing reforestation agreements qualified for funds amounting to one-fifth of their expenditures in restocking Crown lands. Federal payments under this component of the program totalled \$678,923 to 1956: a contribution that resulted in the planting of nearly 60 million trees on 2,700 hectares (6,700 acres) and the establishment of four new provincial nurseries. The agreements were renewed for a subsequent five-year period in 1956, and by 1960 the federal government



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had shared in the cost of planting over 100 million trees, and forest inventories covering 1,816,900 square kilometres (1,129,000 square miles).<sup>10</sup>

Provincial agencies welcomed this support, but deplored the federal government's failure to extend assistance for forest protection in the initial agreements. "Without federal financial assistance," a British Columbia official argued, "the burden of adequate protection of fire of any one province's share of the Canadian forest is too great for that province alone to carry." The CSFE, now known as the Canadian Institute of Forestry (CIF), resolved at its 1954 annual meeting to press for the inclusion of protection agreements under the *Act*. The same bodies pushed their arguments further in demanding federal help in constructing access roads: an appeal that had more to do with opening timber to exploitation than providing for its protection from fire. The logic of sustained-yield forestry, however, dictated that mature timber be harvested to make way for dynamic young stands. "Possibly the most important task foresters have to face in Canada is to develop the means of rolling back this frontier of inaccessible forest," an industry spokesman declared in 1953.<sup>11</sup>

In addition to continuing its support of provincial efforts in the original fields, the federal government broadened the scope of a second round of agreements to include forest protection improvements and the construction of access roads. All ten provinces took advantage of the first option, accepting a total of \$3,729,584 to offset capital expenditures in the prevention, detection, and suppression of forest fires. Nine provinces agreed to share the expense of building access roads and trails: a program that had absorbed almost \$5 million in federal funds by the end of the 1960 fiscal year.<sup>12</sup>

Adoption of a new policy in 1952 provided direction for the Forestry Branch's silviculture and forest management, inventory, and forest fire research sections. Planning at the Ottawa headquarters and district offices in that city, Calgary, Winnipeg, Valcartier, Fredericton, and St. John's set five-year objectives for fact-finding surveys and fundamental and applied research projects.<sup>13</sup> The Silvicultural and Management Section's 48 foresters were assigned to review existing knowledge concerning the major forest types east of the Rockies; devise a standard site classification system and improved methods of determining growth and yield; and continue studying restocking as a basis for cutting practices which would balance economic and silvicultural objectives. The opening of a new laboratory at Petawawa in 1956 enhanced the agency's genetics research, which concentrated on developing improved strains of spruce.<sup>14</sup>

The need for a more thorough knowledge of the relationship between growth and depletion became more

acute as the annual cut continued to rise above wartime levels. Pulp-and-paper production alone increased by 71 per cent in the decade after 1945, but a 1952 Forestry Branch publication conceded that "the growth rates for the forests in many regions are still unknown, sufficient data on the length of time needed for natural regeneration after logging are lacking, and such problems as the changing requirements of industry with regard to quality and kinds of wood precluded any but tentative estimates for Canada as a whole."<sup>15</sup>

The provinces continued to place their faith in natural restocking, resorting to planting only on limited numbers of high-quality sites where the cheaper alternative had failed to restore productivity. Reforestation funds available under the *Canada Forestry Act* permitted a modest increase in acreage planted during the 1950s. British Columbia led the way in artificial regeneration, its four nurseries producing an average of 7.3 million trees annually during the first half of the decade. Ontario followed with an annual output of 28 million trees, and a 1954 amendment to the province's *Crown Timber Act* made pulpwood and timber licencees responsible for maintaining the productivity of their forest land. Quebec, which did not participate in the federal program, ranked as the third greatest producer of planting stock. Saskatchewan planted almost 405,000 hectares (one million acres) between 1951 and 1955, with seedlings from a single nursery, and Manitoba also established a facility that contributed to its total of 2.8 million trees planted over the same period. Prince Edward Island established a Division of Forestry in 1951, along with a nursery that produced its first stock in 1955. Alberta, New Brunswick and Newfoundland carried out little or no reforestation.<sup>16</sup>

Although the development of mechanical planters excited considerable interest among foresters, rough terrain, stumps, and logging slash ensured that manual methods would dominate Canadian efforts in artificial regeneration. British Columbia concentrated on the production of Douglas fir stock, as operators depleted reserves of the coastal region's most valuable species at a frightening pace. The Forest Service purchased cones from individuals, exercising considerable care in selecting areas for cone collection, so that planting sites matched the elevation of seed sources. The cones were dried in sheds or placed on screens exposed to direct sunlight, and a private firm extracted the seed for storage in 18-litre (four-gallon) airtight metal containers.

Each spring, workers laid out seedbeds at the nurseries, framing them with boards to protect the seedlings from frost. After rolling the beds with an ordinary garden roller, staff broadcast the seeds by hand, and covered them with a five-centimetre (two-inch) layer of soil. About ten days later, the beds were burned over to kill the surface weeds. Initially, a worker wielding a long-handled gasoline



**Figure 45** Duncan Forest Service nursery, Cowichan Valley, B.C. — 1959.

(Source: British Columbia Archives ZZ-95250)

torch called the Hawk Burner performed this procedure, but by the mid-1950s three high-pressure blowtorches mounted on a tractor-drawn trailer which straddled the seedbeds had been developed. When the seeds germinated, and for the first year of growth, sections of lath fencing, placed over the beds, provided protection from the sun's rays. Root pruning at the end of the first year encouraged the development of a shallower root system. Green Timbers nursery superintendent Tom Wells mechanized this process by mounting a saw blade on a tractor so that it moved back and forth beneath the soil when pulled the length of the bed. After two years of growth, workers lifted the seedlings by hand and tied them in bundles of 100. Fifty of these made up a bale, each wrapped in heavy waxed paper, covered with burlap, and secured with steel straps. Placing the roots in wet peat moss retained moisture, followed by storage in a root cellar in preparation for transportation to planting sites by truck, boat, or a combination of both.<sup>17</sup>

The typical postwar planting crew in British Columbia consisted of fifteen planters, one staker-packer, and a foreman. The staker-packer marked out rows for the planters to follow, and supplied them with seedlings, carrying bundles which they broke open and transferred to their canvas bags. Using an ordinary mattock, the planter made a hole roughly 20 centimetres (eight inches) deep with a single stroke of the tool, inserted the seedling and

allowed the soil to fall back into place. After pressing the surrounding soil with his boot and giving the seedling's tip a gentle tug to straighten it, he advanced 1.8 metres (six feet), the most productive repeating the process between 700 and 800 times a day on favourable sites.<sup>18</sup>

Reforestation of spruce and pine in Ontario began with autumn cone collections, followed by seed extraction at the Department of Lands and Forests Reforestation Division seed plant at Angus. Nursery practices resembled those described for British Columbia, but manual planting operations involved the use of long-handled, round-tipped shovels. On stony ground, planters favoured a shorter spade with a D-shaped handle and narrow, rounded blade. The prospect of accelerated reforestation and reduced labour costs also led Ontario foresters to initiate trials with American-made planting machines on abandoned farmlands during the 1940s.<sup>19</sup>

The Department's initial foray into mechanized planting came in 1944, with the purchase and modification of a tobacco-planter. Trials in the spring of 1945 proved unsuccessful, but that autumn the agency's I.C. Marriot attended a demonstration of a planter developed by a Michigan forester. Impressed, the Reforestation Division purchased four modified versions of these tractor-drawn units from the L.W. Merriam Company of Elsie, Michigan. The machines, consisting of a plough and planting shoe



**Figure 46** Planting crew in action, Lindsay District, Ontario — 1955.

(Source: Natural Resources Canada, Canadian Forest Service, National Historic Photograph Collection/no. 34463)

which opened up a furrow for the manual insertion of seedlings, produced “very satisfactory results” in 1947 operations that achieved an output of 1,000 to 1,500 seedlings per hour with a three-man crew. Another planter developed by a Purdue University professor — this unit attached to the hydraulic lift of a Ford tractor — provided the pattern for six models the agency had built for use in 1949.<sup>20</sup>

By 1950, several American planters were available, all tractor-drawn and operating on the same basic principles. In addition to the Merriam Company, the Harry A. Lowther Company of Joliet, Illinois, the Wagner Equipment Company of Milwaukee, and the Waldron Machine Works of Valdosta, Georgia manufactured machines. The Lowther, introduced in 1947 for use in the southern states, appears to have been the most popular. Ontario purchased one of these “odd-looking” units, with an advertised daily capacity of 10,000 trees, in 1948. Its basic structure consisted of a narrow frame 1.8 metres (six feet) in length, the front end mounted on ordinary farm tires. The operator sat close to the ground, immediately behind the two rear pneumatic-tired “packing wheels”. The trenching and planting components, suspended within the frame, consisted of a heavy disc coultter and plough with attached planting guides.<sup>21</sup>

In operation, release of the tractor’s hydraulic lift allowed the coultter and plough to settle into the soil. Following in the track cut by the coultter, the plough opened a narrow furrow which permitted passage of the planting guides: heavy wings of sheet metal on the back of the plough. The operator planted the seedling by

placing its roots within the guides until they were gripped by the soil, which the packing wheels forced back into place. Able to operate only on level ground free of rocks, stumps, and brush, the planting machines offered no solution on sites in northern Ontario. By the mid-1950s, existing designs offered little further hope of development, and hand-planting remained the primary approach to artificial reforestation in the province.<sup>22</sup>

Planting programs in the Atlantic region were limited in scale, and dominated by manual techniques. Prince Edward Island utilized a mechanical planter on appropriate sites, but relied primarily on hand methods. Nova Scotia’s Department of Lands and Forests made no use of planting machines, organizing small projects for suppression crews, Boy Scouts and students. They used a spade-shaped planting dibble featuring a blade measuring 7.5 centimetres (three inches) in width, with a foot piece attached to ease penetration of the ground. These tools proved superior to shovels in the heavy, stony soil that characterized most reforestation sites.<sup>23</sup>

On the Prairies, provincial nurseries relied on standard stock production methods and equipment. The Manitoba Forest Service focussed its reforestation efforts on open, grassy sites that suited mechanized planting. The agency owned a total of four Lowther and Tac-Lite machines by 1957, and rangers supervised some hand-planting projects in the southeastern part of the province. Saskatchewan’s Forestry Branch also used Lowther machines drawn by crawler tractors to establish pine and spruce plantations.<sup>24</sup>

Artificial reforestation took on increasing importance within the forestry profession as rising labour costs, a shortage of teamsters and horses, and thriving wood product markets encouraged firms to mechanize their woodlands operations during the 1950s and 1960s. Operators on the British Columbia coast had long since erected a factory-like production process dominated by sophisticated overhead cable systems: technology which was poorly adapted to the smaller timber and sparser stands east of the rainforest. The challenge of introducing a second crop on the clearcuts created by this mode of production generated a growing postwar conviction among the region’s foresters that planting offered the only viable reforestation approach.<sup>25</sup>

The task of reconciling the conflict between economic and silvicultural principles grew more and more pressing for their colleagues in the forests of eastern Canada, the Prairies, and the British Columbia interior after the Second World War, as the wheeled skidder and feller-buncher technology displaced horses. By the mid-1960s, federal foresters such as Ross Silversides had no doubt that mechanized harvesting equipment caused more damage to residual stands and advance growth than

the horse. The agency's K.W. Horton argued at the Canadian Pulp and Paper Association's 1965 annual meeting that the clearcutting practiced with modern machinery left sites with no potential for restocking by

natural means. The Department of Forestry undertook regeneration surveys on mechanically logged areas at the request of the Pulp and Paper Research Institute of Canada in 1965. Preliminary results suggested that



**Figure 47** Fred Warburton, Fire Control Supervisor, studying fire danger sign outside the Department of Natural Resources office at La Ronge, Saskatchewan — September 1957.

(Source: Saskatchewan Archives Board/no. 57-346-13)

mechanized harvesting did not preclude future crop development, although landings and skid trails required immediate planting.<sup>26</sup>

Industry and provincial governments fostered the impression that the postwar boom in the Canadian forestry sector rested upon the application of sustained yield management principles. Crop would follow crop, the credo held, thanks to prompt regeneration of forest lands by natural and artificial methods. But even before public awareness of the gap separating rhetoric and reality developed, the statistics told a more pessimistic story. A federal estimate put the area cut annually from 1961 to 1965 at 910,000 hectares (2,250,000 acres). Another 506,000 hectares (1,250,000 acres) of commercial and young-growth forest burned every year. Even if one assumed that 80 per cent of this area would regenerate naturally — a wildly optimistic forecast — about 283,000 hectares (700,000 acres) a year would require treatment. In 1965, artificial regeneration took place on just 61,000 hectares (150,000 acres), while another 25,000 hectares (63,000 acres) regenerated naturally. Thus, an annual total of up to 202,000 hectares (500,000 acres) would lie unstocked after harvest or fire. “It is evident that the creation of both man-made and man-assisted forests must be increased appreciatively if Canada’s forest estate is to be maintained,” concluded a 1968 report.<sup>27</sup>

Protecting mature timber from fire continued to rank far above reforestation in the funding afforded provincial forest services, and the federal agency’s Forest Fire Protection Section supported their efforts by enhancing the precision of its fire danger rating system during the 1950s. The research program’s other objectives included the development of a rating system for assessing the severity of the risk during fire season. Field analysis of fuel types over large areas went into the formulation of a fire rating system, based upon the rate of spread and difficulty of control, to indicate the measures needed to suppress fires burning various fuels at different levels of fire danger.<sup>28</sup>

The opening of the new laboratory at Petawawa in 1956 enhanced the agency’s study of fuel and fire behaviour characteristics under controlled conditions. Researchers conditioned forest fuel samples to an exact degree of moisture content in a climate chamber, then conducted burning tests at selected wind speeds under a smoke hood. They also evaluated the efficiency of chemical suppressants by extinguishing laboratory test fires. Others studied actual forest fires in the field, making detailed observations on fuel behaviour under natural conditions of weather and topography. Canadian forest fire science remained in its infancy, however, its subject a phenomenon that defied precise quantification. “The mechanism of fire is so complex, especially when running free in the open, that even the best-trained specialists

in the world do not fully understand it,” Fire Protection Section head J.C. MacLeod observed in 1960.<sup>29</sup>

The agency extended its fire-hazard studies to British Columbia in 1957, establishing field stations at Cowichan Lake and 100-Mile House to gather the data needed to prepare danger tables for coastal and interior forests. During the same period, researchers at other field stations across the country carried forward, in the tradition of Wright and Beall, work that enabled the agency to publish new tables for Newfoundland, New Brunswick, Ontario, Manitoba, Saskatchewan, and Alberta in 1956. These revised editions simplified the calculations required of forest officers, requiring a knowledge of relative humidity at noon, wind velocity, and precipitation over the previous 24 hours to determine the danger index. The British Columbia danger tables were issued in 1961, followed the next year by a set for the Northwest Territories. Special fire-related weather forecasts from the Department of Transport’s Meteorological Branch offices in Vancouver, Edmonton, Winnipeg, Toronto, Montreal, Halifax, and Gander allowed protection staff to estimate the following day’s danger index by combining existing and forecast weather values.<sup>30</sup>

Research practices at the field stations continued to involve the daily observation of meteorological conditions, measurement of the moisture content of fuels, and analysis of test fires. Instrumentation to document weather parameters in this era included hygrothermographs and psychrometers (temperature and relative humidity), anemometers (wind velocity and direction), rain gauges, maximum and minimum thermometers, barographs (pressure), ocular estimates (cloud cover), sunshine recorders, dew gauges, and Wright evaporimeters. Staff took fuel moisture measurements by collecting, oven-drying, and weighing representative samples, placing match splints on exposed trays to simulate light fuels, and by using hazard sticks as a substitute for twigs, branches, and other medium fuels. Investigators estimated the moisture content of heavier fuels by boring into a wind-fallen log with an auger, and removing chips from various depths. Insertion of the prongs of an electric moisture meter into the log provided less reliable results. Large weigh-beam logs were also set up at field sites, one end suspended while the other rested on a knife-edge. Cross-sections cut into each end of the log gave an initial measure of its moisture content. Finally, the installation of water-level recorders over “seepage pits” dug in undrained swamps or stagnant ponds allowed researchers to relate fluctuations in the water table to heavy moisture content in fuels and the long-term drought factor.

Observation of test fires over the course of several seasons in widely varying conditions, together with simultaneous weather and fuel moisture measurements, provided a guide to the behaviour of large fires



**Figure 48** Conservation Officer F.E. Clinton of Arborfield, Saskatchewan checking a hygrometer at a fire tower — 1959.  
(Source: Saskatchewan Archives Board/no. R-A11465)

in most fuel types. This procedure involved placing a lighted wooden match in the chosen fuel, and rating the fire's flame height, vigour, area burned, degree of smouldering, and ease of suppression. Three to five years' investigation at a field station went into the acquisition of data required in the analysis of the relationships between weather, fuel moisture and fire behaviour.<sup>31</sup>

Despite federal forestry's new prominence, dissatisfaction with the Branch's status and appropriations grew during the late 1950s. In 1958, the Canadian Lumbermen's Association informed Prime Minister John Diefenbaker of its dissatisfaction with the share of funds allotted to the Branch by the Department of Northern Affairs and National Resources, its current home. *Timber of Canada* joined in condemning the federal government's paltry investment in the forestry sector. Hearings before the House of Commons Standing Committee on Mines, Forests and Water Resources in 1958 and 1959 gave

industry representatives an opportunity to argue for both a greater voice for forestry in government, and for additional financial assistance. British Columbia forester Ian Mahood made a particularly strong case for an extension of silvicultural research in the province: the only forest region in Canada without a federal experimental station.<sup>32</sup>

In its July 1959 report to Parliament, the Committee endorsed the forest industry's request for "equitable treatment and recognition of their vital role in the national welfare," recommending increased federal funding of provincial forest protection, inventory, and access-road construction programs, elevation of the Forestry Branch to full departmental status, and a greater investment in scientific research. The Diefenbaker government responded the following summer, removing the Division of Forest Biology and the Forestry Branch from their respective homes in the Departments of Agriculture and Northern Affairs,

merging them into a new Department of Forestry. Hugh John Flemming became the first Minister of Forestry, with then-Forestry Branch Director J.D.B. Harrison accepting the appointment as Deputy Minister. The Department's terms of reference expanded upon those set out in the *Canada Forestry Act*, permitting the Minister to enter into agreements with provinces or individuals for forest protection, management, or utilization, associated research, in addition to education or publicity.<sup>33</sup>

Forestry had finally attained the status its economic contribution warranted, promising a larger and larger role for the new Department. Expansion over the next few years seemed to justify such expectations, but changing political tides would make the Department's life a short one. Retention of the pre-existing branch structure proved a barrier to program development, and a 1965 reorganization unified them into a single administrative unit which permitted closer integration of regional activities and a more coherent planning process.<sup>34</sup>

The overhaul created seven regional establishments, each under a Director with responsibility for coordinating research to address problems within those forests. St. John's was the home of the Newfoundland centre, with Fredericton, Sainte-Foy, and Sault Ste. Marie becoming the locations for administration of the Maritimes, Quebec, and

Ontario regions, respectively. A Winnipeg establishment served Manitoba and Saskatchewan, and a Calgary office oversaw activities within the Alberta-Northwest Territories-Yukon region. The opening of the \$2.5 million Pacific Forest Research Centre (PFRC) at Victoria in 1965 provided federal forestry with a secure base in British Columbia. Regional forest advisory committees with university, provincial, industry and federal representatives provided input on program development.<sup>35</sup>

Problems of national scale became the responsibility of research institutes, which included the Ottawa and Vancouver Forest Products Laboratories, the Petawawa station, an Insect Pathology Institute at Sault Ste. Marie, and the Ottawa-based Forest Economics, Forest Fire Research, and Chemical Control Institutes. The reorganization, announced by Lester B. Pearson's Liberal government as a component of a major expansion of scientific aid to the forest industry, capped a five-year period of growth for the agency under full departmental status. Although the following two years were not without positive developments — including the opening of a laboratory in Edmonton — by the end of the decade federal forestry's fortunes had entered another period of decline, marked by its absorption into large new departments, termination of the federal-provincial shared-cost agreements, and drastic cuts to budgets and staffing levels.<sup>36</sup>

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## **CHAPTER VI**

# **Fighting Fire from the Sky: Aviation and Fire Protection in Postwar Canada**





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# Fighting Fire from the Sky: Aviation and Fire Protection in Postwar Canada

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Foresters traditionally depicted their crusade against forest fire as the civilian equivalent of armed warfare, and the military analogy took on added weight following the Second World War. Aircraft were new to neither war nor forestry, but just as the aerial bombings of the recent conflict demonstrated the technology's destructive capacity, they also held out the potential for a new weapon in the forester's struggle against the fires that destroyed an estimated 809,000 hectares (two million acres) each year across the country. Thus, the dominant theme in the story of postwar fire protection is that of innovation devoted to aerial technologies of detection and suppression. It involves a wide variety of aircraft, from small crop-dusters to war surplus fighter-bombers, to the massive Martin Mars flying boat, and culminates with the modern Canadair CL-215 and CL-415 air-tankers, designed and manufactured in Canada specifically for dropping water and chemical retardants on fires.

Postwar innovations in fire detection saw the stationary lookout tower lose ground to the aerial patrol, sometimes equipped with infrared technology for locating small fires. Computer-linked lightning location devices added another dimension to provincial fire-control structures. Supporting all this sophisticated technology was the modern Canadian Forest Fire Danger Rating System. Agencies continued to extend the area under protection, especially in the northern reaches of Canada's forest lands. By 1968, almost all of Canada's 250 million hectares (620 million acres) of productive forestland were afforded some level of protection. The average fire burned an area of 66 hectares (164 acres) between 1962 and 1966, down from the 1943–1947 average of 89 hectares (220 acres) and almost one-third less destructive than the 1923–1927 average of 190 hectares (470 acres).<sup>1</sup>

In the end, however, the work of extinguishing a forest fire remains the same physically demanding, labour-intensive process it has always been. "Pound for pound of weight, and dollar for dollar of cost, there is probably no piece of the firefighter's equipment that can match the fire shovel in usefulness," a Canadian authority observed in 1967. A study of air-tanker use in British Columbia, Ontario, and Manitoba published three years later found that the 141 fixed-wing and helicopter aircraft available to these provinces were used on only 7.5 per cent of their fires. Although the tankers had a significant impact on over 80 per cent of these fires, the job of putting them out still fell to the hot, dusty, firefighter wielding an axe, pulaski, or shovel, supported by pumps if in proximity to a water source.<sup>2</sup>

Ground-based fire suppression techniques changed in accordance with the technologies of resource exploitation. In British Columbia, the postwar transition from railway to truck logging encouraged the development of pump-equipped portable tanks for fighting roadside fires. MacMillan Bloedel mechanics designed a 1,890-litre (500-gallon) rubber-tired model for truck-towing in 1948, and the Forest Service introduced a small "drop-on" tank that could be loaded or removed from a pickup truck in minutes. Large containers fabricated in company shops, such as the 11,350-litre (3,000-gallon) "Porta-Tank" model designed by Crown Zellerbach master mechanic Larry Lehtonen in 1961, converted logging trucks to fire-tankers.<sup>3</sup>

Mechanical equipment took a more important place in fire suppression, although high purchase or lease costs and the limited availability of access roads placed constraints on the use of bulldozers. In northern Saskatchewan during the 1950s, for example, the absence of roads and prevalence of rocky terrain ruled out the use of tractors. Firefighters in the region relied on traditional "strong-arm" methods involving "the axe, shovel, pulaski tool, back water pack and power pumps."<sup>4</sup> Fire-pump manufacturers, including Wajax, Terry, Pacific Marine, McCulloch, and Gorman-Rupp, continued to develop their products following the Second World War. By the 1960s, they had a range of models on the market — from heavy-duty pumps to lightweight versions easily carried on a firefighter's back — able to produce water pressures in excess of 200 pounds per square inch. The arrival of light synthetic hoses during the 1970s further eased the transportation burden.<sup>5</sup>

Provincial fire control agencies improved response times by placing this equipment in the hands of mobile standby suppression crews. The B.C. Forest Service maintained four such crews comprised of male high school students on Vancouver Island during the 1947 season, trucking them to nearby fires and assigning them to forest improvement projects when not occupied in initial attack. This form of organization appears to have become standard across the country during the 1950s, and Saskatchewan's smokejumping program joined the principle of the standby crew to airborne transportation methods.<sup>6</sup>

Foresters placed considerable emphasis upon refining the tools and techniques of ground-based fire suppression, and new experiments in airborne assault captured the lion's share of public attention. The Alberta Forest Service conducted successful trials in parachuting supplies and equipment to fire crews in 1945, fabricating

the chutes out of burlap. Manitoba's Provincial Air Service adopted this equipment for drops from Fairchild Huskies the next year, and in British Columbia Kamloops District Forester Alan Parlow obtained small nylon U.S. Army chutes formerly used in dropping anti-personnel bombs for trials. In 1950, Ontario adopted a system of para-dropping supplies to fire crews with inexpensive cotton parachutes, maintaining pre-packaged shock-absorbing containers at bases.<sup>7</sup>

The availability of surplus aircraft also contributed to a resurgence in aerial fire detection in the immediate post-war years. In 1946, the B.C. Forest Service chartered four aircraft to supplement coverage provided by stationary lookouts in interior districts. The number increased to six in 1948, employed in patrols, transportation of fire crews, and some parachute drops of equipment. The New Brunswick Forest Service contracted for aerial patrols in 1947 to enhance its 36 lookout stations, and a light Fleet Canuck plane proved useful in sketching and photographing fires. The agency's 1949 contract with Maritime Central Airways provided for patrols by a twin-engine Anson and two single-engine Stinsons. Nova Scotia's Forest Service also employed some patrol aircraft on a contract basis by the end of the decade.<sup>8</sup>

Ontario, the province with the strongest historical commitment to aerial forest protection, began laying the foundation for Canadian achievements in the direct attack of forest fires by air-tankers during the late stages of the war. During the summer of 1944, Provincial Air Service pilot Carl Crossley made the first efforts to develop the "water-bombing" potential of the technology at the organization's Temagami air base. He rigged a 150-litre (40-gallon) tank on a Stinson Reliant float-plane so that it could be filled by a scoop while the aircraft taxied along the surface of a lake: a concept of enormous importance in the history of aerial fire suppression. Undeterred by the inaccuracy of drops during tests that autumn, Crossley turned his energies to developing a system permitting water to be taken directly into the floats of the Norseman bushplane, which was manufactured in Montreal by Robert Noorduyne. Because existing floats lacked compartments, and pilots had no way of monitoring either the amount of water taken in or the dropping of the load, he devised a valve system, compartmentalized floats, and cockpit pickup and bombing controls.<sup>9</sup>

Tests established the utility of the intake valve mechanism, and Crossley attacked a fire near Temagami in August 1945 with some effect. Drop accuracy remained a shortcoming, however, as did the load's tendency to dissipate too widely when released. Crossley's larger problem — despite having demonstrated that aircraft could scoop up and transport water in small quantities without seriously impairing flight performance — was

a lack of enthusiasm among Air Service officials. Frustrated, he left the organization and made an unsuccessful attempt to sell the federal government on his water-bombing idea.<sup>10</sup>

American interest in the transfer of military bombing techniques to fire suppression remained active, but lacked sustained institutional support. The U.S. Forest Service collaborated with the U.S. Air Force in a series of tests in Montana in 1945, dropping water-filled wing tanks on test fires from a Boeing B-29 Superfortress and P-47 Thunderbolts. The results proved sufficiently promising for officials to recommend the program's extension, but the high cost of maintaining aircraft and crews caused its termination in 1948. Australia's Forestry Commission followed the American trials, and conducted experiments with Mustangs and Liberators.<sup>11</sup>

Airborne forestry gained an asset of longstanding value as a result of participation by Ontario's Department of Lands and Forests in the development of the Beaver bushplane. While making good use of its Norseman bushplanes, agency personnel worked with De Havilland engineers after the war in the design of a new aircraft capable of a wide variety of duties over Canada's forests. Introduced in 1947, the Beaver gained instant approval. Ontario soon had 27 on order, eventually operating some 40 of the planes in fire detection and suppression. The B.C. Forest Service put one into service in 1948, and soon had six chartered Beavers operating during fire seasons. Manitoba officials praised the Beaver's take-off performance, which improved the standard of fire control by allowing access to smaller lakes that other aircraft could not utilize.<sup>12</sup>

De Havilland followed with the larger and more powerful Otter in 1951, which replaced the last of the older Norseman planes in Ontario's fleet. The new airplanes would take centre stage in that province's revived water-dropping experiments. In 1949 and 1950, the Air Service conducted trials at Sault Ste. Marie, dropping latex-lined paper bags, each containing 11 to 15 litres (three to four gallons) of water, from a Beaver. This technique, and later attempts to release water from a tank in the aircraft's cabin, proved unsatisfactory, but probably inspired Alexander Koroleff of the Pulp and Paper Research Institute of Canada to proclaim the need for research in aerial fire suppression "an important and urgent problem of national importance."<sup>13</sup>

While Canadian forest-protection organizations continued to extend the use of aircraft in traditional fields, public and private cooperation in the United States produced a major research program in aerial attack methods. Operation Firestop — launched in 1954 by the U.S. Forest Service, the State of California, the Federal Civil Defense Administration, the Air Force, the Marine Corps,

and private equipment manufacturers — demonstrated that the more powerful and manoeuvrable aircraft developed during the Second World War could drop un-contained water and chemicals from low altitudes to good effect. The insights gained during the 1954 tests, and through further experiments over the next two years, were applied in 1956 to help suppress several large California fires. The U.S. Forest Service contracted Stearman crop-dusting planes to cascade both water and chemical retardants, employing a specially designed valve in the bottom of their 454-litre (120-gallon) holding tanks. That winter, the agency acquired several Grumman Avenger torpedo bombers from the U.S. Navy and fitted them with 1,890-litre (500-gallon) tanks. Much remained to be learned, but by the end of the 1950s there was no longer any doubt that air-tankers would play an increasingly important role in the American West.<sup>14</sup>

Ontario continued to lead research and development of airborne fire suppression in Canada, making a breakthrough in 1957 with the development of float-mounted cylindrical aluminum tanks. Attached to the floats of an Air Service Otter, and equipped with a scoop device which conducted water into them while the plane taxied, the tanks were open-topped to facilitate dumping. The pilot released the load by pulling a lever, which in turn activated a cable-and-pulley arrangement that rotated the 300-litre (80-gallon) tanks. Testing demonstrated satisfactory drop density, and the 18-second interval between touch-down and take-off with a full load eliminated the time lost under the old technique, when aircraft landed for the reloading of water bags. The agency enjoyed success with the system on a fire in the Sudbury District that summer, and equipped its six Otters and 40 Beavers — the latter with smaller tanks — for the 1958 fire season.<sup>15</sup>

Field experience that first season established the benefits of water-bombing, which were reduced somewhat when heavy smoke and wind created adverse flying conditions. Although aerial attacks had a negligible impact on intense, fast-moving blazes, they retarded the spread of small fires and subdued hot spots on larger burns until ground crews could arrive. An Otter operating from a lake within a few kilometres of a fire could drop up to 15,000 litres (4,000 gallons) an hour, prompting the agency to replace some of its Beavers with the larger-capacity aircraft. Over the next two years, the introduction of aluminum fairings to “streamline” the tanks increased air speeds, and an electronic dumping mechanism operated by a button on the control column improved pilot control during drops. In 1964, the Department began fitting some Otters with 750-litre (200-gallon) detachable “belly tanks” attached to the fuselage, after testing revealed improved water-dropping and flying characteristics. Still later that decade, the introduction of the more powerful Turbo Beaver and the Twin Otter prompted a revival of Crossley’s original concept. Field



**Figure 49** *De Havilland Otter water-bomber making a water-drop — 1961.*

(Source: SMFPA-66, album photo de la SMFPA, SOPFEU, Centre provincial de lutte, Québec)

Aviation’s in-float tank system permitted larger loads to be dropped in more effective patterns without diminishing aircraft performance. In 1970, Ontario considered departing from its strict reliance on water-drops, acquiring three Avengers from British Columbia to initiate an experiment in retardant-carrying land-based aircraft.<sup>16</sup>

Unlike Ontario, where government ownership fostered a direct role in the research and development of aerial tankers by the provincial forest agency, commercial air services and industry led the way in British Columbia. Prior to 1958, chartered aircraft functioned primarily in a patrol capacity, but by the end of that disastrous fire season several aircraft had been converted to water-bombing. After learning of Ontario’s success, Al Michaud of West Coast Air Services equipped three Beavers with float tanks for use on the coast. Skyways Air Services had the Fairey Aviation Company fit Grumman Avenger torpedo bombers with 2,270-litre (600-gallon) belly tanks, and converted four Stearman crop-dusters to drop water or chemical suppressants. Sources indicate that MacMillan Bloedel pilot Dan McIvor equipped the company’s Grumman Goose with float tanks after experimenting with dropping water-filled plastic containers.<sup>17</sup>



**Figure 50** Martin Mars water-bomber in operation — 1960.  
(Source: British Columbia Archives NA-19796)

British Columbia authorities reached the same conclusions as their Ontario counterparts following their first season of aerial fire suppression: aircraft could “play an invaluable part in the fire protection system” by taking fast action on small fires, holding the hot spots of larger blazes, and knocking down crown fires if caught in the earliest stage of their development.<sup>18</sup> Corporate interests took action the following year to make a dramatic contribution to air-tanker technology. Four of the largest Vancouver Island-based firms — MacMillan Bloedel, B.C. Forest Products, Western Forest Industries, and the Tahsis Company — jointly purchased four huge Martin Mars flying boats, which had originally been built by Glenn L. Martin for long-range bombing and patrol missions. Engineering began in 1938; the first aircraft entered testing in 1942; and the Martin company went on to build a total of five planes, which the U.S. Navy operated as transports on flights between San Francisco and Honolulu. One of the planes was destroyed in a fire, and the rest were mothballed in the 1950s.

MacMillan Bloedel’s McIvor became interested in the conversion of a large aircraft, after learning that Ontario had had greater success with the Otter than with the smaller Beaver. He obtained approval to inspect the planes, recently acquired by a San Francisco scrap-dealer, and proposed that the firm buy one or all for use as water-bombers. Canadian aviation authority and MacMillan Bloedel director Leigh Stevenson declared that the Martin Mars were “ideally suited for water-bombing

purposes,” contrasting their anticipated 26,000-litre (7,000-gallon) capacity to that of existing aircraft. MacMillan Bloedel took an option to purchase the aircraft, but wanted support in financing the venture. Negotiations produced an agreement between that firm and the three other participants, leading to the July 1959 organization of Forest Industries Flying Tankers (FIFT), to purchase and operate four Mars water-bombers. U.S. Navy crews flew them to the Patricia Bay seaplane base near Victoria, where Fairey Aviation undertook conversion of the Marianas Mars for water-bombing, at a reported cost of \$150,000. Principal modifications involved the installation of a 22,700-litre (6,000-gallon) tank made of Douglas fir plywood, which was partitioned into four sections to permit the entire load either to be dropped all at once or in sequence. Two hydraulically operated scoops filled the tank while the aircraft skimmed the water: a process completed in only twenty seconds.<sup>19</sup>

At a length of 36.5 metres (120 feet), with a wing span of 61 metres (200 feet), the Mars ranked as the world’s largest operational flying boat. Powered by four 2,500-horsepower Wright Cyclone engines, it had a cruising speed of 257 kilometres (160 miles) per hour, and its load capacity equalled that of 88 Beavers or ten Grumman Avengers. Following a series of flight tests in the spring of 1960, FIFT stationed the first Mars at its Sproat Lake base on central Vancouver Island, where there was a hangar, cookhouse, bunkhouse, and communications centre. The aircraft responded to six fires that season, dropping 480,750 litres (127,000 gallons) of water, despite experiencing some mechanical problems. MacMillan Bloedel’s W.B. Gayle reported at the season’s conclusion that the Mars was “stable, seaworthy, and remarkably manoeuvrable for an aircraft of its size.” Able to be airborne within 20 minutes of a call, and able to travel at an average rate of one minute per kilometre (1.5 minutes per mile) of distance between water source and drop zone, the Mars was well suited to operate from the many large lakes in the coastal region.<sup>20</sup>

Disaster struck the following June, however, when the Marianas Mars crashed into a mountainside while fighting a fire near Parksville, killing the pilot, co-pilot, flight engineer, and mechanic. An investigation attributed the crash to pilot error, and FIFT immediately contracted with Fairey Aviation to convert the Phillipine Mars for water-bombing use. That aircraft went into service in 1962, now aided by a “bird-dog” plane to guide bombing runs and maintain radio contact with ground crews. Mechanical problems curtailed the plane’s effectiveness that summer, and one of the remaining Mars was destroyed by high winds.<sup>21</sup>

Performance improved greatly during the 1963 season, and FIFT decided to proceed with conversion of the Hawaii Mars that winter. A new water-storage

arrangement, utilizing the original hull fuel tanks and 22 hydraulically operated doors on the bottom of the keel, provided a more effective drop pattern. Both planes were equipped with Gelguard™ injection systems: a Dow Chemical retardant that further improved drop characteristics by increasing water viscosity. Another firm, the Pacific Logging Company, joined FIFT in 1964 due to the addition of a second aircraft. Experience gained over subsequent years contributed to efficiency gains, consolidating the Mars's place in West Coast forest protection. After fighting 23 fires during the severe 1965 season, making a total of 314 drops containing over 5.7 million litres (1.5 million gallons) of water and 3,010 kilograms (6,636 pounds) of Gelguard™, FIFT officials considered the planes "the most important weapon in our fire control arsenal." They remain in service today, having dropped over 150 million litres (40 million gallons) of water over the years.<sup>22</sup>

Protection organizations devoted considerable attention to chemical retardants for use by land-based aircraft during the late 1950s, especially in the far West where dense forests and heavy fuel loads placed a premium on enhancing the suppressive quality of water drops, which tended to vaporize once released. The U.S. Forest Service addressed this problem during Operation Firestop, resulting in the development of Firebrake®, a sodium calcium borate compound that created a "slurry" when mixed with water. The U.S. Borax and Chemical Company product underwent testing in 1958 on Vancouver Island, and its potential also caught the attention of eastern Canadian protection authorities. A proposed demonstration evolved into a major forest-fire research conference in 1958 at Charlo, New Brunswick, sponsored by the Canadian Pulp and Paper Association.<sup>23</sup>

The high cost, toxicity, and handling problems of Firebrake® limited its use in British Columbia, but the list of less-expensive chemical retardants grew quickly during the early 1960s. Sodium alginate, made from refined seaweed, increased the wetting effect of water, and the addition of a small amount of calcium chloride produced a gel that achieved even better results. Bentonite, another thickening agent, became the most widely used short-term retardant in the British Columbia interior during the early 1960s. The Forest Service established stations at interior airports for mixing the products and loading tankers, then turned to more efficient long-term retardants by the end of the decade. Phos-Chek®, a Monsanto product, and Fire-Trol®, manufactured by Chemonics Industries of Arizona, were the most widely used retardants in North America. These salt-based materials gave off ammonium gas when heated, robbing the air of oxygen and slowing combustion even after the water itself had dried up. "The saving of timber compared to probable loss if only water is used is inestimable," declared one B.C. Forest Service official.<sup>24</sup>

British Columbia's aerial attack organization grew in sophistication over the 1960s. Fixed-wing tankers flew over 1,000 hours in 1961, and the following year government funds provided for the establishment of interior bases at Prince George, Kamloops, Smithers, and Cranbrook. Skyways Air Services of Langley secured its first government standby contract, maintaining three Avengers on a lease basis at the Cranbrook airport, each with a 1,890-litre (500-gallon) capacity. The B.C. Forest Service maintained a 38,000-litre (10,000-gallon) bentonite mixing pit at Prince George for the Avengers, and built smaller plywood tanks at other interior airports. Other commercial providers operated a variety of aircraft. Pacific Western Airlines had six Beavers and a single Otter, the latter based in Prince George. West Coast Air Services operated an unknown number of Beavers, and National Air Tankers, a subsidiary of Cal-Air Services of Calgary, purchased six former RCAF search-and-rescue Canso aircraft in 1962. Field Aviation fitted one or two of the planes with a pair of 1,500-litre (400-gallon) tanks, and the Cansos immediately went into service in the northern forest districts. Hourly rental rates ranged from \$87 for the Beaver, to \$450 for the Canso.<sup>25</sup>



**Figure 51** Consolidated Canso flying boat CF-NLT making a practice forest fire water-bombing run, Prince George, B.C. — 1966.

(Source: Library and Archives Canada/PA-124230)

Skyways quickly became the province's leading air-tanker service, winning a \$200,000 contract for the 1963 fire season. According to manager Art Sellers, the firm's fleet of 12 Avengers and six bird-dog planes was the world's largest bomber fleet of its kind. The firm relocated its headquarters to Abbotsford in 1965, coinciding with its first trials with long-term retardants. When these additives became operational in 1966 "water-bombing with the Avenger really came into its own," Skyways' Les Kerr declared. "It finally dawned on many people that, if given a fair chance, we really could do a lot towards controlling a forest fire." Reorganization of Skyways in 1969 created Conair Aviation Ltd., to conduct its air-tanker business, with Avengers remaining the "old reliable" of the fleet.<sup>26</sup>

British Columbia's tanker fleet expanded as aerial suppression gained credibility, with converted military and passenger planes assuming a larger role. Weldwood of Canada operated an Avenger. Flying Firemen established a base at Sydney for three Cansos, and acquired three former RCAF Lockheed P2V7 Neptunes in 1972. Conair added larger planes to its roster, purchasing several Douglas A26 Invaders in 1969 or 1970, and equipping the bombers with 3,800-litre (1,000-gallon) tanks for work in the Interior. A couple of years later, the firm converted a former Pacific Western Air Lines Douglas DC6, its 11,000-litre (3,000-gallon) capacity making it second only to the Martin Mars in size. During this period, tankers served in support of ground forces on 12 to 18 per cent of the province's forest fires.<sup>27</sup>

The prairie provinces employed a wide variety of tanker aircraft. During the early 1960s, land-based Stearmans and Avengers dropped bentonite and Gelguard™ retardant in Alberta. Later in the decade, Canso amphibious aircraft, converted by Field Aviation, came into service for transportation and water-bombing. By 1970, the province had leased or chartered six Cansos, seven Snow Commanders, two B25s, and four B26s, all equipped to drop fire retardants. The B26's 3,800-litre (1,000-gallon) capacity and long range made it a primary weapon, although the shortage of long, hard-surface runways dictated a heavy reliance on smaller, slower aircraft.<sup>28</sup>

Floatplanes dominated in Manitoba, where budgetary constraints and an abundance of lakes encouraged reliance on water-dropping, rather than the chemical retardants utilized increasingly by land-based aircraft. The province chartered an amphibious Canso aircraft in 1963; as late as 1970, however, the Forest Service was still relying upon only two government-owned Otters, and an equal number of chartered Cansos for direct fire suppression. Manitoba's Air Service also operated a number of Beavers in a transportation role.<sup>29</sup>

Outside of Ontario, Cansos carrying the Field Aviation technology became the tanker of choice during the early

1960s in eastern Canada. Able to scoop water from a lake, or carry fire-retardants from airstrips in their two 1,500-litre (400-gallon) hull-mounted tanks, the Canso combined a relatively large capacity with manoeuvrability, in an affordable package. Ontario tested one of the first Field Aviation conversions in 1960, and the Quebec government operated a fleet of seven similar planes. Newfoundland purchased two Cansos after they proved "tremendously effective" during the 1961 fire season. By 1970, Atlantic Aviation of Canada operated five Field Aviation-modified Cansos, under a contract with the Newfoundland government.<sup>30</sup>

New Brunswick experimented with a chartered Beaver in the early 1950s, and with a float-equipped Stearman about a decade later. Two Avengers were also tested during the early 1960s, but the lack of suitable airstrips limited their usefulness. The provincial government then chartered two Cansos from Ontario, and borrowed two others from Quebec during the severe 1965 fire season. The Cansos made a valuable contribution, but most of the province's inland lakes proved too small for the amphibious aircraft. Confronted with this dilemma, New Brunswick investigated the potential of small aircraft designed primarily for crop-dusting. Two Snow Commanders and two Grumman AG-Cats, limited in capacity to under 1,135 litres (300 gallons) but able to operate from short airstrips, served well on a chartered basis during 1969.<sup>31</sup>

By the mid-1960s, then, aerial tankers had become "integral and indispensable tools" for many fire-protection organizations. Over 150 aircraft were engaged in water-bombing across the country, but the age of these fleets concerned some officials. Spare parts for machines such as the Canso, last manufactured in 1945, were becoming difficult to obtain, and operators faced rising maintenance costs. In 1963, NRC's Associate Committee on Forest Fire Protection discussed the need for a new aircraft designed specifically for Canadian firefighting conditions. Canadair of Montreal immediately worked up several designs, settling on a twin-engine amphibious flying boat following consultation with provincial forestry departments.<sup>32</sup>

The first aircraft designed specifically for water-bombing, Canadair's CL-215 entered production in 1966, with federal government assistance to fill an order of 20 aircraft for Quebec and ten for France. Powered by two Pratt and Whitney R-2800 engines, the plane could scoop up 4,500 litres (1,200 gallons) of water in 22 seconds, while skimming the surface of a lake at 129 kilometres per hour (80 miles per hour) and make low-altitude drops at 95 knots. Flight-testing began in 1967, and the firm made its first deliveries two years later. When Quebec cut its order to 15, France, Greece, and Spain took the surplus aircraft. Production ceased after the company





**Figure 60** CL-215 water-bomber making a water-drop — Quebec Government, 1981.  
(Source: Canada Aviation Museum)

filled the initial order, but resumed a couple of years later, when France and Spain requested 20 additional planes. Canadair demonstrated the CL-215 in Ontario, Alberta, Manitoba and British Columbia, but the high cost limited provincial purchases. Manitoba bought a single CL-215 in 1978, and Ontario eventually put five into service, but as late as 1983 only 20 were in operation in Canada.<sup>33</sup>

Air-tankers became the “glamour weapon” in Canadian forest protection, but analysts cautioned that they were “not the complete answer to the fire-suppression problem.” Effective when used in the early stages of a fire’s development, they had much less impact on large blazes. “If we get a fire burning on a large enough front, I don’t think there’s a fleet of air tankers in the country, or perhaps in the world, that can completely extinguish that fire from the air,” Herbert Beall observed in 1969. Cost had also become an increasingly important issue, and the

Forest Fire Research Institute evaluated the performance of both water-bombing aircraft and chemical retardants to assist organizations in making informed purchases.<sup>34</sup>

As fire-suppression costs mounted during the late 1960s, industry and the provinces began pressing the federal government to establish a national tanker fleet. The Forest Fire Research Institute undertook a feasibility study into the creation of an interprovincial fleet under a central agency in 1969. Canadair proposed that Ottawa purchase 25 CL-215s for provincial use. An alternative plan would have seen a number of Tracker aircraft, recently retired from submarine patrol service on the aircraft carrier *H.M.C.S. Bonaventure*, converted to this purpose. The Associate Committee on Fire Protection served as liaison between Ontario and the Department of National Defence in modification and testing of one of the planes, which De Havilland had built under licence from Grumman, its developer. Tests by Ontario’s Air Service

Section at Sault Ste. Marie revealed the Tracker's suitability; however, the Treasury Board rejected the proposal for a federally financed fleet. The Tracker would later become a useful tanker as the Firecat, and a national tanker fleet became a reality in the 1980s, but an opportunity had been lost.<sup>35</sup>

Transportation and detection remained fundamental, if less newsworthy, fire-control functions performed by aircraft during the postwar decades. Provincial agencies used Beavers, Otters and other planes to move crews and equipment as close as possible to fires, although Saskatchewan attracted the greatest attention with its smokejumping program. The relative lack of large lakes and rivers in parts of the province's forest zone meant that suppression crews faced a long trek from landing areas, prompting the Department of Natural Resources to consider parachuting men directly to fire sites after the war.

In 1947, Saskatchewan's Director of Forests E.J. Marshall and forester A.O. Aschim travelled to the U.S. Forest Service's smokejumping training centre at Missoula, Montana, returning enthusiastic about the method's potential in Saskatchewan. Marshall called in Owen Hargreaves of Edmonton, who had been trained at Missoula, to organize a school at the Prince Albert airport that summer. Eight recruits, chosen for their fitness, forestry experience and firefighting ability, received training in gymnastics, fire-control, first aid, and the theory of parachute-jumping before taking to the air.<sup>36</sup>

They made the seven training jumps required to graduate from a Norseman floatplane, exiting the plane by means of a chute which extended from the doorway to one of the pontoons. Wearing a padded suit and crash helmet with mask, the smokejumper carried only a sheaf knife, compass, first-aid kit, 27-metre (90-foot) "let-down" rope in the event he landed in a tree, a shorter rope to aid in escaping from the parachute harness, and two signal streamers to advise the pilot of a safe landing. Equipment packs dropped from the Norseman contained maps, crosscut saws, shovels, bedrolls, water bags, pruning saws, pulaski tools, axes, backpacks, mess kits, bottles of mosquito repellent, lights, pumps, and a small radio.<sup>37</sup>

The program went into operation in 1948, and by the mid-1950s Saskatchewan had two Norseman aircraft adapted to smokejumping. By that time, the original chute arrangement had been discarded in favour of an exit in the belly of the plane, which allowed parachutists to drop between the floats. The four crews, each consisting of four men, spent the spring and early summer training at Prince Albert, before moving north to Lac La Ronge, where they remained on constant alert during periods of high hazard. Responding to smoke



**Figure 53** Smokejumpers — 1959.

(Source: Saskatchewan Archives Board/R-A11473-5)

alerts from lookouts or aerial patrols, they could be airborne within 30 minutes, providing a rapid initial attack force that remained on the scene until the arrival of other crews. The smokejumpers then packed up their equipment and hiked to the nearest suitable lake for retrieval.<sup>38</sup> Saskatchewan alone opted for the smokejumping method of transportation; other provinces gave the subject some consideration, but apparently concluded that the air-tanker represented the most cost-efficient initial attack option during this period.

From the 1970s to the mid-1990s, smokejumpers operated in the Yukon and Northwest Territories, and the B.C. Forest Service called upon Yukon personnel to fight fires when their involvement in the Territories was terminated during the nineties. That led to the introduction of the agency's Smithers-based "parattack" programme in 1998, later moved to Fort St. John. Twenty-one jumpers operate from that point in Canada's sole remaining smokejumping initiative, flying to fires in the DHC-6 Twin Otter.<sup>39</sup>

Early detection remained of paramount importance, however, and protection authorities debated the relative merits of stationary lookouts and aerial patrols during the postwar decades. Most decided that a combination of towers and aircraft achieved the most complete coverage, the choice depending upon funding and local conditions. Ontario's system of steel towers numbered 329 by 1960, and their observers were considered the "backbone of the forestry service." Beaver aircraft patrolled large areas of the province where the risk to timber values did not justify the expense of continuous observation. Lookouts remained the "mainstay of British Columbia's detection system," where newer stations were



**Figure 54** Yukon smokejumpers exiting a DC3 aircraft on a practice jump at McConnell Lake, Yukon — ca. 1994.  
(Source: Photo courtesy of Pete Laing)

pre-fabricated and moved into position in sections by helicopter. “No other form of detection can replace the constant observation provided by a conscientious, reliable lookoutman,” an agency official remarked in 1963. A few chartered Beavers patrolled after the war, later replaced by Piper Super Cubs. The B.C. Forest Service operated 125 lookout stations in the mid-1950s, but required at least another 200 to achieve “even sketchy coverage.” The total reached 160 in 1970, still far short of provincial requirements.<sup>40</sup>

Postwar Prairie detection practices featured a similar pattern of lookouts and aerial patrols. Saskatchewan maintained 80 towers in 1956, occupying 50 of them continuously during the fire season. The Department of Natural Resources also leased five aircraft from Saskatchewan Government Airways. Manitoba’s Air Service made Beaver and Otter aircraft available to the province’s Forest Service, which manned 97 steel lookouts built by a Winnipeg firm. Alberta, too, employed both approaches in its endeavour to achieve a “balanced detection system.”<sup>41</sup>

By the mid-1960s, the roster of aircraft utilized in a detection capacity included the Super Cub, Cessna, Helio



**Figure 55** B.C. parattack crew descending into a drop-zone during a practice jump in Smithers, B.C. — ca. 1999.  
(Source: Photo courtesy of Pete Laing)

Courier, Dornier, Centaur, Beaver, Turbo-Beaver, and Otter. The availability of suitable aircraft, rising wages for observers, the cost of replacing obsolete structures, and the ability of aerial patrols to provide more complete information on fire location, extent, and behaviour prompted many North American organizations to curtail lookout construction programs and to deactivate stations during the 1960s. The number of operating lookouts in the United States peaked at 5,000 in the 1950s, then fell as aircraft detection increased. The U.S. Forest Service began shutting down stations in the Pacific Northwest, and by 1980 fewer than 500 remained operational in that country.<sup>42</sup>

Herbert Beall estimated the number of lookouts in Canada at over 1,200 in 1955; during the following decades, however, protection organizations in eastern regions placed their faith increasingly on less expensive aerial patrols. Quebec’s Gatineau Forest Protective Association phased out 65 of its 79 towers between 1960 and 1966, planning patrols with 12 light aircraft on the basis of fire-weather forecasts. The Gatineau venture was unique, becoming the only organization in Canada to place the entire detection burden on aircraft by the end

of the decade, although other agencies soon came to similar conclusions and moved along the same path.<sup>43</sup>

Studies conducted during the 1960s by the Ontario Department of Lands and Forests indicated that aerial coverage provided substantial savings with no loss of efficiency. This provided the rationale for a gradual shift from “a tower system supplemented by aircraft to an aircraft system supplemented by towers.” The 1972 dismantling of 15 of the 19 lookouts, built in the Kenora district between 1931 and 1950, symbolized the agency’s commitment to aerial detection. In 1973, Forest Fire Research Institute Director D.E. Williams reported that “the fixed lookout tower as a detection device has all but disappeared,” replaced entirely by patrol aircraft in some regions, and curtailed substantially in others. “The old system of grizzled veterans manning remote fire towers is gone,” noted a 1981 report on fire protection in Quebec.<sup>44</sup>

Some of the enthusiasm for aerial patrols lay in the development of thermal infrared heat-scanners: a by-product of military experiments in missile-tracking. The U.S. Forest Service’s Firescan project began research on infrared detection in 1962, in cooperation with the Department of Defense, and introduced its airborne scanning system in 1966. The Ontario Department of Lands and Forests initiated trials with infrared technology during the early 1960s, and in 1965 the federal Department of Forestry coordinated tests of a device designed by Computing Devices of Canada on patrol aircraft operated by Ontario and Quebec. Able to detect slight differences in ground temperature, and to record the location of hot spots through smoke but not clouds, infrared scanning systems came into limited use during the 1970s. The B.C. Forest Service found the Hughes Probeye scanner valuable in detecting smouldering slash fires, and some provinces used the technology to plot the boundaries of major fires through dense smoke.<sup>45</sup>

While fixed-wing aircraft usurped traditional methods of fire detection and became fundamental to fire suppression strategies, protection organizations also exploited the helicopter’s unique abilities in a variety of ways. The supervisor of the Los Padres National Forest in California used an “autogiro” for fire reconnaissance as early as 1922, but it wasn’t until after the Second World War that the U.S. Forest Service began to test the technology’s role in fire control. The *British Columbia Lumberman* anticipated future developments in 1943, suggesting that the helicopter would provide a safer platform for dropping firefighters to the ground than the airplane: if confronted with dense growth, men could simply transfer to the branch of a convenient tree and climb down.<sup>46</sup>

The Ontario Department of Lands and Forests made the first recorded use of a helicopter in North American

fire-control on June 26, 1946, flying reconnaissance missions with a Bell 47B near Sudbury. Later that summer, a Sikorsky helicopter performed a similar function over the Angeles National Forest in California. The U.S. Forest Service demonstrated the helicopter’s value as a limited-payload “logistical vehicle” the following August, when a Bell 47B transported crews and freight, evacuated injured firefighters, and made reconnaissance flights on a fire in that state. Operation Firestop explored numerous helicopter applications during the mid-1950s, including hose-laying, water-dropping, and heli-jumping. As a result of these trials, the U.S. Forest Service contracted a Bell 47-6-Z in 1957 and assigned its first operational crew to the craft.<sup>47</sup>

Canadian protection organizations made some use of helicopters during the 1950s, although their limited availability, expense, and restricted carrying capacity preventing more general adoption. Ontario used an RCAF helicopter to move crews and equipment around a Sudbury-area fire in 1950, while also developing an auxiliary pumping apparatus for spraying small fires from above, and experimenting in laying hose-lines. By the end of the decade, the Ontario Department of Lands and Forests had one helicopter for year-round use, and leased five others during the fire season. The B.C. Forest Service tried “bombing” a fire with water-filled waxed-paper bags from an Okanagan Air Services machine in 1956. Both provinces found that airlifting lookout station components to elevated points saved time and expense. Alberta also purchased a Bell helicopter for fire reconnaissance and transportation work in 1958.<sup>48</sup>

The development of larger helicopters during the early 1960s broadened their forestry applications. The U.S. Forest Service’s heli-jumpers leapt to the ground from a maximum height of ten feet to attack many fires in the West. In British Columbia, Okanagan Helicopters introduced a “hover-fill” bucket system for accurate water-bombing in 1962, using a Sikorsky S-58 helicopter to pick up 1.5 tonnes (1.5 tons) of water in a suspended tank while hovering over a lake, before dumping the load by means of an electronic release. The system was soon adopted throughout North America, and Okanagan’s Jim Grady and Henry Stevensen of Nelson secured a patent on their 170-litre (45-gallon) “Monsoon” bucket. The arrival of more powerful helicopters spawned larger buckets, such as the 435-litre (115-gallon) American-made “Rainmaker” tank, which was tested by the B.C. Forest Service in 1969. Eventually, containers capable of holding 1,890 litres (500 gallons) of water or retardant went into service.<sup>49</sup>

The B.C. Forest Service contracted use of Okanagan’s Sikorsky — as well as smaller Bell and Hiller helicopters from bases at Kamloops, Fort St. John, Prince George and Nelson — which used the suspended drum, both for

its intended purpose, and to carry equipment for firefighters who jumped from the helicopter as it hovered above the ground. Pacific Helicopters had as many as six Bell and Hiller helicopters in service during the 1961 fire season, ferrying men and equipment to and from fires. Vancouver Island Helicopters and Northern Helicopters leased their Hiller and Bell 47G2 aircraft to government and corporate clients that season. Okanagan retained its identity after a 1964 merger with Pacific, readying 17 of its 55 helicopters for fire duty that summer.<sup>50</sup>

Transportation of crews and equipment to remote areas remained the primary use of helicopters in British Columbia, with minor use of the helibucket system where fires in rugged locations ruled against water-bombing by fixed-wing aircraft. The effect of low altitude rotor-blade backwash in spreading flames was a persistent problem, but western protection agencies added a new wrinkle to the transportation function during the early 1970s, by rappelling firefighters to the ground. The U.S. Forest Service began the practice in the Pacific Northwest in 1972, at about the same time that University of British Columbia forestry professor Bob Henderson and Tony Richardson of the B.C. Institute of Technology collaborated to bring the technique to the province.<sup>51</sup>

According to one account, Richardson developed a descent-control device while lowering himself from the rafters of a warehouse when he lived in Campbell River. He and Henderson organized International Fire Fighting Systems Ltd. in 1971 to promote acceptance of their "Sky Genie" helicopter rappelling system. First utilized during the 1973 season in the Nelson-Kamloops area — then in Banff, Jasper, and Glacier National Parks — the technique permitted safe deployment of an initial attack crew much closer to fires than the traditional helijack, saving precious time formerly consumed in walking from the nearest landing site. Ranger Jim Dunlop organized the first B.C. Forest Service rappelling unit at Lower Post on the Alaska Highway in the late 1970s, and the agency went on to develop a highly respected "Rapattack" program.<sup>52</sup>

During the late 1970s, the number of fixed-wing air-tankers operating in Canada stabilized at about 150, with the Turbo Beaver, Canso, Douglas A26, and the Canadair CL-215 accounting for about 70 per cent of the total. An average of 100 helicopters performed an air-tanker role, their use increasing relative to fixed-wing aircraft. Together, the 250 tankers flew about 12,000 hours a year, dropping an average of 83 million litres (22 million gallons) of water and 18 million litres (five million gallons) of retardant. They absorbed between 10 and 12 per cent of the annual Canadian expenditure on fire control, making air-tanker operation "one of the largest, if not the largest single expenditure in the fire management budget."<sup>53</sup>

Aerial firefighting has continued to grow in sophistication over recent decades. Conair Aviation developed a more precise helicopter water-dropping system in the early 1980s, fitting a 1,135-litre (300-gallon) retardant tank to the fuselage of its Bell 205 helicopters. This technology, coupled with the firm's rappelling system, allowed pilots to transport and lower crews to fires, before proceeding directly to the nearest water source for drops in support of the ground party. The firm began modernizing its aging fixed-wing fleet with the purchase and conversion of eleven Grumman Trackers to its Firecat design. The addition of a Fokker F27 in 1986 initiated Conair's transition to higher speed turboprop aircraft.<sup>54</sup>

The technology of wildfire detection also advanced during the 1980s, with the introduction of lightning location devices, originally designed to detect lightning storms around satellite launch stations in the United States. The Bureau of Land Management funded research into the development of such a system at the University of Arizona in 1975, with the objective of reducing the cost of aircraft patrols after lightning storms. The B.C. Forest Service purchased three of the locators produced by the study in 1980, at a cost of \$225,000: the first step in the creation of a computerized lightning location system capable of plotting strikes on a map for rapid deployment of aircraft and crews. Alberta invested in this "space-age technology", strategically placing seven direction-finders which flashed signals via telephone lines to a computer in Edmonton. Infrared camera patrols complemented Alberta's detection system, finding ground fires burning below the surface of muskeg in the northern part of the province. Ontario, Quebec, Saskatchewan, and the Northwest Territories employed similar technology to protect against fires caused by lightning.<sup>55</sup>

Canadians have also been important innovators in the field of lightning-detection technology. In the early 1970s, Dr. Peter Kourtz of Canada's Forest Fire Research Institute developed a system capable of detecting lightning over a 32-kilometre (20 mile) range. Manufactured by Quality Electronics in Ottawa, these "Mushroom" detectors underwent tests in several provinces before being deployed in Ontario, Manitoba and the Yukon. Some 300 of the devices had come into use across Canada by 1977, but in subsequent years the American-designed Lightning Location and Prediction system found increasing favour with protection agencies. Despite its high initial cost, that system's long range and precision in locating strikes made it an attractive alternative to the Mushrooms, which nevertheless remained in service for a time in southwestern Quebec, thanks to an advantageous combination of low maintenance costs and short-range accuracy.<sup>56</sup>

Ongoing federal research on fuel moisture and fire behaviour complemented this array of detection and suppression technologies. Carrying on in the tradition of



**Figure 56** “Mushroom” lightning detector made by Quality Technology Ltd. of Ottawa, Ontario — ca. 1970–1979.  
(Source: CSTM, cat. no. 960486)

Wright and Beall, fire scientists brought new consistency to danger forecasts in 1970, with the introduction of the Canadian Fire Weather Index System. Soon adopted by all management agencies in the country, the system relied on centralized computer data-processing to determine danger ratings from weather observations provided by field officers and new automated weather stations. During the 1970s, computer-based fire-weather information systems were established in several provinces, greatly increasing the speed with which calculations could be made, and the resulting information placed in the hands of authorities for decisions on the allocation of patrol aircraft, the issuance of burning and travel permits, forest closures, and the strength of standby fire crews.<sup>57</sup>

Postwar progress in the development of “scientific methods of forest protection” reduced the time required to bring fires under control and, over the same period, prescribed burning grew in importance as a management tool. Defined by two authorities as “the knowledgeable application of fire to a special land area to accomplish predetermined forest management . . . objectives,” prescribed burning — which reduced the hazard from logging slash — was most widely used in British Columbia. 1938 legislation in that province gave the Forest Service the authority to compel coastal operators to burn their slash: a policy given province-wide application in 1967. Ontario made a half-hearted attempt to introduce fire management in 1962, but another decade passed before the policy had a measurable impact. Alberta, New Brunswick, Newfoundland, and Quebec also made limited use of prescribed fire. British Columbia still stands first today in exploiting the silvicultural benefits of fire, while other provinces rely mainly on the mechanical preparation of cutover sites, in anticipation of natural or artificial regeneration.<sup>58</sup>

Increasing use of prescribed fire in the West during the 1970s stimulated researchers at the PFRC to develop a

novel approach to slash-burning, at that time a slow and risky business conducted with hand-held drip-torches. Seeking to make this procedure safer and less costly, the Centre’s John Muraro was inspired to develop the “flying drip-torch” system early that decade. The concept, involving the suspension of a larger torch from a helicopter, was first used in the Prince George area in 1973, and the “helitorch” system quickly became a standard practice in the province. Australian foresters, meanwhile, developed another aerial approach to burning the massive buildup of debris in the country’s eucalyptus forests. The Australians injected chemicals into cylindrical pharmaceutical vials by hand, mixing the ingredients in proportions that ignited 30 seconds after they were dropped from fixed-wing aircraft. Subsequent PFRC efforts in aerial ignition followed this model, first using plastic vials injected with a thermal chemical for delayed ignition. Eventually, researchers there designed a lightweight machine for injecting and dispensing small plastic balls from low altitudes. This system, manufactured by Premo Plastics Engineering of Victoria, went into extensive use in Canada, the United States, and Australia as a means of conducting safe, inexpensive slash-burning and wildfire-suppression operations.<sup>59</sup>



**Figure 58** Prescribed burn using a drip torch, English Township, Timmins, Ontario — August 25, 1983.  
(Source: Courtesy Canadian Forest Service)

During the 1970s, then, a new emphasis on fire management complemented the impressive array of prediction, detection, and suppression technologies forestry organizations had at their disposal. In the United States, the Park Service revised its traditional policy of prompt suppression in 1968, allowing some wildfires to burn, and introducing prescribed burns to “restore and maintain natural environmental conditions in the parks.” A decade later, the U.S. Forest Service followed suit in the country’s national forests, managing fire for “predetermined beneficial purposes,” rather than controlling all outbreaks as quickly as possible. The Canadian Parks Service adopted a similar policy in 1979, “recognizing fire as a natural phenomenon and as a force that should be incorporated in ecosystem development.” The agency proceeded cautiously, initiating several fire ecology studies before implementing the strategy. However, fire management has proven to be a difficult and controversial concept on both sides of the border. Escaped prescribed burns that threatened lives and property, and the disastrous 1988 Yellowstone fires, have ensured that fire control remains a priority even where ecosystem integrity is an objective.<sup>60</sup>

Wildfires remained a destructive, and increasingly expensive, force in the Canadian forest, the average annual bill exceeding \$50 million for damage and control in the 1970s. Then, over the 1979–1981 period, drought conditions put the country’s fire-control structure under unprecedented stress. Between four and five million hectares (10 and 13 million acres) burned each season, and the cost of suppressing over 9,000 fires, in 1980 alone, amounted to over \$100 million. Agencies in central and western Canada experienced severe aircraft and equipment shortages, generating provincial pressure for the creation of a national organization to facilitate mutual sharing of firefighters, equipment, and aircraft.<sup>61</sup>

The idea gained rapid acceptance, resulting in the establishment of the Canadian Interagency Forest Fire Centre (CIFFC) in Winnipeg on June 2, 1982. Jointly funded by the Canadian Forestry Service, two territories and nine provinces, the CIFFC operates as a non-profit corporation with a mandate to “gather, analyze, and disseminate fire management information to ensure a cost-effective sharing of resources” under the Canadian Interagency Mutual Aid Resources Sharing Agreement. The following year, six provinces and

the federal government signed a Cooperative Supply Agreement to purchase 29 Canadair CL-215s. Thirteen of these aircraft are currently operated by the provinces as a national air-tanker fleet, requests for their services outweighing all others in importance in the CIFFC operation.<sup>62</sup>

By this time, the CL-215 had proven itself an excellent water-bomber, but its cost in comparison to depreciated aircraft gave it limited acceptance in North America. With further production in doubt, the agreement came as a godsend to Canadair’s faltering CL-215 program. Completion of the delivery program in 1988 brought the number of CL-215s operating in Canada to 49, and Canadair’s turboprop CL-415 entered production in 1991. Equipped with a computer-controlled drop system, and four tanks that carry 15 per cent more water than its predecessor, the CL-415 is also faster and more manoeuvrable. Canadair sold 51 of the planes by early 1999, including nine to Ontario and eight to Quebec. France, Italy, Greece, and Croatia are the firm’s international clients.<sup>63</sup>

The investment of some \$250 million in new water-bombers and computer-linked lightning location systems, along with significant increases to protection budgets, brought annual losses down to acceptable levels, but the return of drought conditions in 1989 unleashed the most destructive fire season since before the Second World War. More recently, government budget-cutting and research into climate changes which may raise the



**Figure 52** CL-415 water-bomber making a water-drop.

(Source: Bernard Vallée, Secrétariat du Conseil du trésor)

possibility of longer, more severe fire seasons, has created concern about the adequacy of modern fire-control structures. Technological sophistication across the entire spectrum of fire-protection functions has increased the speed with which most fires can be discovered, attacked, and brought under control, but recent history provides

ample evidence of Nature's capacity to overwhelm even the best-organized and -equipped force. Moreover, some wonder if the fire management concept's appeal to governments rests more on the legitimacy it affords reduced protection appropriations, than a commitment to ecologically based forest practice.<sup>64</sup>

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## CONCLUSION

# Reflections on Federal Forestry in Modern Times

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The modern story of federal forestry in Canada is one of decline, resurgence, and decline again, in keeping with the institution's unsettled history. Without a consistent national policy upon which to anchor its development, the organization has drifted with the currents of Ottawa's shifting commitment to forestry. Following a decade and a half of weak federal initiative, cooperation with the provinces in forest renewal during the 1980s brought new vitality. But the tide turned again in the 1990s, leaving Petawawa a casualty of the most recent cutbacks.

Federal forestry's status and influence began to slip during the last half of the 1960s, as a consequence of organizational shuffling, withdrawal from shared-cost programs, and budget-cutting. In 1966, the Department of Forestry's independent existence ceased abruptly after six years, when it became part of a new Department of Forestry and Rural Development. Liberal Minister Maurice Sauvé "viewed forestry as just another tool to be used in combatting poverty through agricultural rehabilitation," industry spokesperson Pat Carney charged, but the most damaging blow came later that year with Finance Minister Mitchell Sharp's announcement that his government would not renew the federal-provincial forestry agreements when they ended in 1967. The need for federal involvement had passed, Sharp declared, although Ottawa would continue to promote sound forest management and industry welfare "within the framework of the federal jurisdiction and responsibility."<sup>1</sup>

The decision left Canada without a national forestry policy, damaged provincial programs that had benefitted from almost \$64 million in federal funds since passage of the *Canada Forestry Act*, and drew withering criticism from foresters. CIF president D.I. Crossley deplored "the lack of statesmanship that results in our Government initiating and servicing vote-getting social welfare legislation at the expense of . . . a fundamental, revenue-producing basic resource so vital to the welfare of our country." The CIF's executive committee gained no satisfaction from a late 1967 meeting with Sauvé. Their plea for a new national policy to meet projected wood demands went unheeded, prompting Crossley to denounce the government's "proclivity to hide behind its constitutional skirts" in retreating again to the research field.<sup>2</sup>

The Forestry Branch found itself in yet another new home the following year, when the newly elected government of Pierre Elliott Trudeau created the Department

of Fisheries and Forestry under Jack Davis. Preoccupied with the fisheries component of his portfolio, Davis pledged to gear forestry research to promoting greater industry efficiency and productivity. The establishment of a logging development task force to reduce harvesting costs under Ross Silversides reflected this emphasis on "operational programs that can directly benefit large sectors of the Canadian forest economy." But a 1968 personnel freeze did not bode well for the organization, which was renamed the Canadian Forestry Service in 1969.<sup>3</sup>

The general restraint policy announced that summer required the Forestry Service to hold its budget at the existing \$22 million level for the 1970–1971 fiscal year, forcing layoffs that included many career research foresters. The organization suffered the hardest hit on the Prairies, where the cuts involved closure of the Winnipeg Forest Research Laboratory, and a merger of the Manitoba-Saskatchewan and Alberta-Territories Regional Establishments into the Northern Forest Research Centre at Edmonton. Morale declined in the wake of these cutbacks, which signalled the end of the industry's postwar expansion.<sup>4</sup>

With the creation of Environment Canada in 1971, the Canadian Forestry Service found itself a minor player in a huge new ministry devoted to pollution and natural resource matters. Foresters interpreted a further administrative reorganization within Environment Canada in 1973 as yet another sign of the lack of federal support for forestry. "Continual re-organization, re-definition, re-naming and re-evaluation over the years has been at the expense of good scientific endeavour," the CIF suggested. Realizing that a restoration of full departmental status was most unlikely, some called for a transfer from Environment to the Department of Agriculture, where forestry's potential contribution to economic development would be recognized.<sup>5</sup>

The opening of the Great Lakes Forest Research Centre at Sault Ste. Marie in 1976 brightened the outlook temporarily, but two years later the fiscal axe fell again when Ottawa announced its intention of privatizing the Vancouver and Ottawa forest products laboratories, slashing the research budget, and closing several facilities. The forestry community rallied sufficient public pressure to save the Petawawa Forest Experiment Station, although consolidation of the Ottawa-based

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Forest Fire Research Institute and Forest Management Institute at Petawawa was not accomplished without “serious personnel disruptions.” Overall, Canadian Forestry Service employment dropped from 2,400 to 1,000 in the decade after 1968.<sup>6</sup>

Left “moribund and demoralized” by this latest blow, the Canadian Forest Service carried on with a reduced research capability as the federal government’s Department of Regional Economic Expansion (DREE) began investing millions of dollars in industry infrastructure through agreements with the provinces. Regeneration and silviculture received less funding under the DREE grants than road-construction programs designed to open northern timber to exploitation, thus perpetuating the dominant theme of Canadian forest history. Meanwhile, evidence of a forthcoming wood supply crisis mounted. Gordon Weetman summarized provincial status reports at a 1977 CFA conference on forest renewal, painting a bleak picture of overcutting, and a rapidly expanding legacy of non-satisfactorily restocked land (NSR). Nova Scotia and New Brunswick faced softwood shortages, and only DREE support enabled the Atlantic provinces to reforest a fraction of their cutover areas. Quebec logged 243,000 hectares (600,000 acres) annually, treating only about 20 per cent of this acreage, and had amassed almost 2.4 million hectares (six million acres) of understocked land in the previous two decades. Ontario regenerated about 67 per cent of its annual 160,000-hectare (400,000-acre) cut, and faced a large backlog of NSR land. Cutting outpaced reforestation in the prairie provinces, and British Columbia planted only 48,500 hectares (120,000 acres) of the 202,000 hectares (500,000 acres) harvested each year. Nationally, Weetman estimated the presence of 28 million hectares (70 million acres) of cutover and burned-over land awaiting treatment.<sup>7</sup>

The publication of such findings fed mounting criticism of clear-cutting practices, lax provincial regulations, and the absence of a national forest policy. A 1978 report by F.L.C. Reed highlighted the need for increased funding to support more intensive forest management. Governments invested only 5.5 cents in forest renewal and stand improvement for every dollar generated in taxes, Reed pointed out, reserving harsh criticism for the federal government’s negligible contribution. Foresters had become “unwitting victims” of the myth of inexhaustibility and the slogan of sustained yield management, he later remarked. Provincial inventory practices that served as the basis for allowable cut calculations were inadequate, foresters now admitted, and silvicultural practices remained in “a primitive state of implementation.” A 1983 study by the Science Council of Canada depicted Canada’s wood supply prospects in stark terms: one-eighth of the country’s productive forest area had “deteriorated to the point where huge tracts lie devastated,” with

logging, fire, and disease adding up to 400,000 hectares (988,000 acres) each year to the total.<sup>8</sup>

A series of national conferences set the stage for discussion of reforms. The Canadian Pulp and Paper Association and International Woodworkers of America sponsored a Canadian Forestry Congress in 1980, leading to another gathering the following year at Banff, which was organized by the Canadian Forestry Service. That workshop resulted in the adoption of a Forest Sector Strategy for Canada, which pledged federal government participation in forestry training, expanded research and development, and the introduction of forest renewal agreements with the provinces.<sup>9</sup>

The commitment to forest renewal represented the strategy’s most significant element, increasing funding of regeneration and stand improvement from \$200 million in 1980 to over \$600 million in 1987. The timing of this program proved very opportune, coinciding with deep economic recession that severely curtailed provincial reforestation efforts during the early 1980s. The dawning of a new era of federal-provincial cooperation encouraged F.L.C. Reed to predict that the 1980s would be regarded as “the decade of forest renewal in Canada.” The first round of five-year Forest Resource Development Agreements (FRDA), introduced in 1983, channeled over \$1.1 billion to the support of provincial reforestation projects to reduce the backlog of NSR lands. Corporations assumed more of the planting burden under forest management agreements signed with provincial governments, and reforestation rates soared across the country. In 1985, up to 320 million seedlings were planted, comparing favourably to the 1960 figure of ten million. Between 1986 and 1989, the increase in Canada’s forest stock was 47 per cent higher than the volume harvested, according to government reports.<sup>10</sup>

Federal forestry’s ascension continued during the initial years of Brian Mulroney’s Conservative Government, which increased Canadian Forestry Service funding and appointed a Minister of State for Forestry after taking power in 1984. Two years later, the Tories turned over administration of forests in the Northwest Territories to the territorial government, but restored the Canadian Forestry Service to full departmental status in 1989 with the creation of Forestry Canada. The early 1990s, however, saw both the agency and the principle of federal-provincial cooperation, which had fuelled the gains of the previous decade, fall out of favour.<sup>11</sup>

Forestry’s vulnerability to changing economic conditions and policy priorities manifested itself in 1993, when the Tories announced that the FRDA agreements would not be renewed. Provincial and private-sector activities had “matured to the point where more limited federal government involvement is warranted,” in what was,

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after all, an area of provincial jurisdiction. At the same time, government downsizing cost forestry its cabinet presence: a loss of status inflicted through a merger with the Department of Energy, Mines and Resources to form Natural Resources Canada.<sup>12</sup>

The Liberals held to the decision to discontinue the FRDA agreements after their election, and implemented budget cuts that forced a reduction in Forestry Service staff from 1,230 to 820. District offices in Truro, Rimouski, Winnipeg, Prince Albert, Prince George, Charlottown, and Whitehorse were closed, along with the St. John's research station. But the loss felt most deeply by the country's scientific establishment was that of the Petawawa National Forestry Institute, which was closed after 75 years of service.<sup>13</sup>

The story of the Petawawa facility's development and ultimate demise captures in microcosm the changing fortunes of federal forestry in Canada. Established in 1918 as the first permanent research facility in the country, it served as a seasonal field station for many years. There were only four buildings — two of them “dilapidated and worn” — on the site when Ken Fensom arrived at Petawawa in 1927, and it lacked a permanent research staff. The transfer of natural resources to the western provinces in 1930 confined the Forestry Service to a research role, and expansion continued under the Depression-era relief projects. By the Second World War, the station had a small year-round staff and new offices, service buildings, residences, and bunkhouses for the researchers who arrived each spring from Ottawa. Although most research projects ground to a halt for the duration, “enemy aliens” and Alternative Service Workers contributed their forced labour to station development.

Passage of the *Canada Forestry Act* in 1949 secured the agency's research mandate, brought increasing numbers of students to the facility, and touched off a major building program during the 1950s. With the opening of a laboratory in 1956, Petawawa matured into a research centre of international stature. Amalgamation of the Forestry Service and the Division of Forest Biology, following the 1960 *Department of Forestry Act*, created the impetus for a doubling of the staff to 25 scientists and 27 technicians in 1967.

During the “decade of gloom” that followed, Petawawa and its parent organization floundered as part of Environment Canada. Only an outpouring of protest from the Upper Ottawa Valley saved the station from extinction in 1978, but its new life as the Petawawa National Forestry Institute was not achieved without personnel losses and long-term damage to the Forestry Service's research performance. A shortage of space and facilities created difficulties, as surviving staff from

the defunct Forest Fire Research Institute and Forest Management Institute arrived, and Petawawa went on to host a diverse research program through the 1980s. A renewal of federal-provincial cooperation in response to the sorry state of Canada's forests allowed reforestation programs to flourish, then decline in the mid-1990s when the FRDA expired. Petawawa was a casualty of the same round of cutbacks, closing an important chapter in our forest history.<sup>14</sup>

The Canadian Forest Service carries on under fiscal restraint, the philosophy of sustainable development providing a focus for research in support of international trade, environmental regulation, and forest science technology. Indeed, critics charge that the federal government now acts “principally as a propaganda arm of Canada's forest industry,” protecting its products against international protest by fostering an image of responsible stewardship.<sup>15</sup>

The validity of this claim awaits the judgement of future historians, but what is clear from this account is the tenuous nature of the federal role in Canadian forestry. Historically, provincial regimes dependent upon forest revenues have promoted expansion with little regard for the condition of cutover areas. Even sustained yield practices served to perpetuate this “exploitive ethic”, providing little in the way of meaningful regulation to offset industry's relentless drive for fresh timber supplies. The federal government, left without direct involvement in the management of commercially important forestlands after 1930, has treated the Canadian forest in the same way. Content to support industry through a relatively minor role in science while raking in tax revenues, Ottawa has only reluctantly accepted the need for forestry investments, and these often subordinated conservation to the development imperative. Only when the backlog of understocked cutover land reached crisis proportions in the 1980s were federal funds devoted principally to reforestation, although the flow ceased abruptly after a decade of progress.<sup>16</sup>

Cooperation between stakeholders with a vested interest in maintaining the flow of corporate and government revenues from the forest has been strongest in the area of forest protection. Jurisdictional issues divided federal and provincial levels of government, and industry resisted any infringement on its access to the resource and harvesting regulations; however, all could agree upon the wisdom of protecting mature timber from the threat of fire. Although this consensus vanished when it came to assigning fiscal responsibility, the issue provided the glue for the conservation movement of the early twentieth century, as well as the inspiration for an impressive record of innovation in the science and technology of fire management. It remains central to policy debates as foresters contemplate the prospect of global warming.



**Figure 57** Operational prescribed burn, English Township, Timmins, Ontario — August 25, 1983.

(Source : Courtesy Canadian Forest Service)

The evolution of forest-fire protection practices has been central to this account. A source of corporate profits, wages, and government revenues, forests have also provided a foundation for scores of hinterland communities. From the invention of the earliest powered pumps, to research into fire danger rating, to the Canadian Forest Service's Forest Fire Behaviour Prediction System, to the recent creation of a national air-tanker fleet, Canadians have participated in a dynamic process of adaptation and innovation. Foresters can detect fires, reach them, and attack them in ways that would have astounded their early-twentieth-century predecessors. The development of modern container reforestation systems since the 1970s has brought a corresponding increase in their capacity to renew denuded lands, even if planting remains a primarily manual operation.



**Figure 59** Experimental burn at one of the white pine understory research plots, north of Thessalon, Ontario — June 1996.

(Source: Courtesy Canadian Forest Service)

Forest management has long since ceased to be a matter of surveying timberlands, putting out fires and planting seedlings. New, more complex challenges have arisen with the emergence of the environmental movement, and it remains to be seen whether or not Canadian forestry's embrace of the sustainable development concept is adequate to the needs of timber-dependent communities, or to a new conservation agenda which elevates biological diversity and ecosystem integrity over timber production and protection.

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