Forest Resources Research Policies: U.S.A. and U.K.¹

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"...research must be closely related to the problems of forest management, and as the problems change in character so must the program of research vary in its scope and emphasis."

Politiques de recherches touchant les ressources forestières aux Etats-Unis et au Royaume-Uni

Résumé

Le Royaume-Uni et les Etats-Unis offrent des conditions de recherche très différentes. L'état de la forêt et la Foresterie propre à chacun des pays sont discutés et les différentes philosophies qui animent la recherche sont décrites. La nature des problèmes auxquels les services de recherche britanniques tentent d'apporter des solutions est significative. En effet, on y aborde des problèmes concrets mettant à contribution la compétence d'un personnel forestier entraîné.

L'auteur identifie les principaux services de recherche reliés à la forêt et donne les caractéristiques particulières de la recherche au Royaume-Uni.

Leur façon d'agencer les moyens dont ils disposent et leur haut rendement des fonds engagés, constituent une source intéressante d'information dans une éventuelle orientation de la recherche canadienne vers des problèmes concrets au niveau des ressources forestières.

Abstract

The U.K. and U.S. present very different research situations. Forest conditions and forestry in each country are discussed and the differing research philosophies described. Particularly significant are the problem solving nature of U.K. in-service research, closely linked with practice, and the contribution of technically trained foresters. The principle forest-related British research agencies are identified and the special characteristics of U.K. research are described. Its methods of deployment of resources and the high return for funds invested provide several indications for possible development of problem-solving, developmental oriented forest resources research in Canada that can make a major impact on practice.

¹ A revision of an invited paper presented at the National Conference on Forest Resources Problems, sponsored by the Science Council of Canada, and held in Ottawa, June 23-24, 1969.

The scale of American research — its scope, problems in geographic diversity, etc. is such that a description in worthwhile detail can hardly be given within the limits of this submission. Fortunately two recent American documents are available². These supplement and update Kaufert and Cummings' earlier report³. These three studies present an impressive picture of a highly organized research endeavour and a massive commitment of resources.

This conference is surely familiar with the American scene so I intend rather to discuss British attitudes and refer to the American situation only insofar as is necessary to illustrate significant differences.

The Forestry Environment

Clearly Great Britain, with one quarter the population concentrated on a land surface one thirtieth of that of the United States, with all the resulting pressures, presents a very different situation from the U. S., notwithstanding that considerable areas in northern and western Britain have a lower population density than perhaps any other country in western Europe.

It is salutary to realize that, despite current expressions of concern for the environment, forests still occupy one-third of the American land area and that after more than three centuries of settlement the eastern states are still heavily wooded. The American forest comprises an area ten times that of the total British land surface. Nearly three-fourths of this forest is suitable and available for growing timber, and supplies more than ten billion cubic feet of wood a year.

Three hundred and twenty-four million acres or 24 percent of the total forest lands are in Federal ownership, of which over half is in National Forests

² These are **A National Program of Research in Forestry** 73 pp., prepared by a Forestry Task Force for the Agricultural Research Planning Committee of the U.S. Department of Agriculture and the State Universities and Land Grant Colleges, July 1967 and **Progress Report of Research: The Forest Service**: 250 pp., U.S.D.A., Wash. D. C., July 1968.

³ F. H. Kaufert and W. H. Cummings, **Forestry and Related Research in North America**, 280 pp. Society of American Foresters, Washington, D.C., 1955.

administered by the U. S. Forest Service, but more than half of the commercial forest is on small owner-ships averaging less than 60 acres in size. Other forest values are highly significant. Nearly 245 million acres are in forest and related range lands supporting one half of the American beef herd and three-fourths of the sheep. A much greater acreage is browsed by game. The headwaters of the major continental river systems are forested. These lands are also of concern for outdoor recreation.

In contrast, in the United Kingdom the primeval forest has long gone. The heaths, heather moors and grassy uplands, once forest, that form the natural grazings are of no direct concern to the forester except as potential sites for his plantations. Exceptions only are mountain tops taken in with plantable land and which, together with forest plantations, are developed as multi-purpose Forest Parks and Nature Reserves. In the lowlands the original broad-leaf cover has long been replaced by rich farmlands and densely populated urban areas. Forest comprises only eight percent of the land area and is almost the smallest percentage woodland cover in Europe. Only Holland, Ireland, and Iceland have less. Home grown timber forms barely ten percent of the total consumption and Britain has the unenviable distinction of being the world's largest timber importer. The Forestry Commission, the state forest authority, now holds 2,855,000 acres of land, 1,705,000 acres under tree crops. Of the remainder 840,000 acres comprise land unsuitable for afforestation. Only some 60,000 acres of state woodlands date from the beginning of the century. The bulk have been established since 1919 and particularly since the Second World War. Fifty-five thousand acres are planted a year with a like area of fresh land acquired. The Forestry Commission has responsibilities to provide public access and recreation and to improve the beauty of the landscape.

Woodlands under private ownership cover approximately 2,888,000 acres. Twenty-five thousand acres of new private woodlands are planted annually. Large private-owned woods are rare. Individual holdings vary from over 10,000 acres to less than 5 acres. A feature of the landscape is the prevalence of small woods, often established primarily for game management or amenity, and of hedgerow timber trees. In 1950 these latter comprised some 20 percent of the standing volume. Four thousand private estates comprising 1,200,000 acres or twenty-five percent of the total woodland area are managed under approved management plans and receive grant aid. In many private holdings game and amenity rank high⁴.

The proportionate effort devoted to forestry research and the areas of concentration in the United States, where forestry endeavour has involved the gradual obtaining of silvical control over extensive forests by a new profession far removed from its

European origins, without a background of traditional husbandry, and with no fund of knowledge of the forest environment or of forest management, obviously has little relationship to the scale or nature of research in Britain where, as a specific decision of national policy, major effort has been directed to the development of a plantation estate, often on sites previously considered unplantable, and with strong dependence on exotics, and where the need has been to revive a forestry tradition. British foresters are heir to the silvicultural and management experience of their overseas forestry. They also have the ineffable advantage of being close to the European heartlands of scientific forestry, yet, in consequence of the 19th century hiatus, freed from the weight of tradition of many of these lands.

In North America, research has, until recent times, been conducted in almost the complete absence of a planned silviculture but there are many other commitments, and the definition of what comprises "forestry" and "forestry" research is wide. Although the U. S. Forest Service is strong in research there is a multiplicity of other agencies. The influence of formal post-baccalaureate study is strong and there is considerable concern for underlying principles. Knowledge is far ahead of practice. The researcher is identified as a scientist.

In Britain there is intensive management such as to necessitate one forest worker to every hundred acres of woodland. The researcher is operating within a framework of practice. Research is done on problems that arise in the field and emphasis is strongly on silviculture. The bulk of the research is in-service and applied. Its purpose is to facilitate the implementation of the National Forest Policy.

Much that is considered appropriate grist to the American forest researcher in Britain is the concern of other disciplines and not within the province of forestry, although increasing the corpus of forest-related knowledge.

In both countries there is considerable research effort, but overall the difference could hardly be greater.

It is sometimes suggested that the reason for the different approaches is that the American forester has been faced with a wilderness about which there was little biological knowledge and with little interest by scientists in research in the forest environment. Thus the forester has had to find out the basics for himself. But this situation is far from unique. Tropical foresters, especially, have worked "on the frontier" under very difficult and extremely extensive conditions without supporting facilities. World-wide an applied empirical approach has led to the development of advanced techniques.

Bailey and Spoehr in their early but authoritative study of American forestry research needs⁵ set forth the relation of research in the fundamental sciences, to forestry, thusly:

"Even in those regions e.g., Europe and Japan,

⁴ H. L. Edlin's *Forestry in Great Britain: a review of progress to 1968*, 27 pp. Forestry Commission London, 1968, presents an excellent, concise description of British forestry and the forest environment.

⁵ W. Bailey and H. A. S. Spoehr — *The role of research in the development of forestry in North America*. American National Academy of Science. 1929.

where silviculture is most intensively practiced, it has developed almost entirely through an efficiently systemized empiricism. Thus the extension of silvicultural management over the earth's vast areas of wild forest land must be preceded by a comprehensive descriptive survey and analysis of wildly fluctuating natural and economic variables, and by an intelligently formulated program of empirical experimentation . . . Forestry cannot now wait for ultimate explanations of the extremely intricate biological phenomena of silviculture, which must be supplied through exact and time consuming research in the basic experimental sciences."

More recently Haig and his associates⁶ drew American attention to the relatively simple information on which silvicultural practices have been based in tropical forestry, with very considerable success, while the success of forestry operations in Britain provides a modern object lesson in what can be done through applied silviculture.

The British experience suggests that the key to success in this type of applied research program lies in organization, the provision of ample supporting staff, and close contact with the field.

A contributing factor in the development of the American format may well have been the rewards, both financial and in terms of job congeniality, of specialist advanced academic degrees, as compared to the possible lack of intellectual challenge and questionable professional level of the typical "first job" of North American forestry. In this the contrast with the firmly professional nature of the field responsibilities and status of the new U.K. graduate is striking.

British Research Agencies

There are five main agencies concerned in forest resources research, viz. the Forest Products Research Laboratory, the Forestry Commission Research Division, the Nature Conservancy, the Agricultural and Soil Research Institutes, and the Universities. Each of these has a distinctive role.

The Forest Products Laboratory at Princes Risborough is part of the Ministry of Technology. A large amount of time is spent on Commonwealth problems, and in the past it has been concerned largely with imported timber, but it is now devoting an increasing amount of attention to the properties and processing of home grown wood in close collaboration with the Forestry Commission.

The Forestry Commission Research Division is responsible for applied research and development, and also for some objective basic research and advisory services to both public and private forestry. The main research station is at Alice Holt Lodge near Farnham, Surrey in southern England with a northern research office located in Scotland at Edinburgh and a new northern research station in course of construction. The Division is organized on the basis

of functional sections i.e. silviculture, soils, ecology, physiology, genetics, seeds, pathology, entomology, utilization. There are also the Planning and Economics Section (working plans, inventory, mensuration, thinning studies and sample plots, growth and yield, economics) and Work Studies Section (including machinery research and development) that are an integral part of the research station, although part of the Management Services Division. There is a central library and documentation bureau, a photographic section and a statistics section with computer services.

There are twenty-two small field stations and a considerable number of field parties that move about the country as necessary. The field stations and parties are staffed by technically trained foresters⁷.

There are 44 graduate foresters⁸ and scientists in the Research Division with a supporting staff of 105 technically trained foresters and 26 technicians, and 32 graduate foresters or equivalent and 70 technical foresters in the two associated sections. Additional are administrative, computational and clerical staff.

This structure provides an efficient team for laboratory work and for the planning, control and execution of a large program of field experimentation dispersed over the country, principally though not exclusively in state forests and nurseries.

The Nature Conservancy's role lies in the conduct of objective basic and applied research and advisory services for the conservation of wildlife and the management of Nature Reserves. It is under the Department of Education and Science and its research is financed by the Natural Environment Research Council. Forest related activities are based on its Merlwood Woodland Research Station. This program is oriented to providing scientific advice on the management of natural woodlands and Nature Reserves, and to monitoring changes taking place in woodlands as a result of industrial exploitation, commercial forestry and agricultural practice and to devising ways in which wild life conservation may be combined with the efficient use of woodland reserves.

The Research Institutes are financed by various Research Councils, Government Departments and Industry. Four principal Research Institutes are engaged in part in research relevant to forestry: the Rothamstead Research Station in England and the Macaulay Soil Research Institute in Scotland working on forest soils and tree nutrition problems, the Tree and Bush Fruit Research Establishments at East Malling and Long Ashton, the Fire Research Station and the Forest Products Laboratory. The forestry role of these institutes lies in the conduct of objective basic and applied research on trees and wood for the Forestry Commission and wood-using industry. In addition some research is done on the

⁶ I. T. Haig, M. A. Huberman, and U. Aung Din, **Tropical silviculture**. Proceedings, American Society of Foresters. 1959.

⁷ By technically trained foresters is meant men who have had two years of training in the Forestry Commission Forester Training Schools.

⁸ i.e. with University degrees in forestry.

development of machinery and chemicals for forestry use by several industrial research establishments.

The Universities are responsible for pure and objective basic research on trees, forests and woodlands. This research is financed by the national University Grants Committee, by the Natural Environment Research Council, the Agricultural Research Council, the Science Research Council, the Forestry Commission, by Industry and by other grant giving bodies. Research is done at about 20 universities but particularly at Aberdeen, Bangor, Edinburgh and Oxford which each have departments dealing with forestry.

The Natural Environmental Research Council co-ordinates the long term basic research of Nature Conservancy staff with the activities of other agencies. N. E. R. C. will also embrace the proposed new Forest Research Institute that is to be established near the Forestry Commission's Northern Research Station at Edinburgh. The main fields of research of this new institute remain to be defined in detail but will be concerned with basic research in the fields of tree physiology and genetics.

The Forestry Commission has an Advisory Committee on Forest Research formed of eminent scientists — representatives of other experimental stations, and representatives of the universities, who meet periodically to discuss the Commission's research program. Thus the applied program is exposed to scientific opinion and liaison is provided for.

The total forest related research effort of the other agencies is very much less than that of the Forestry Commission Research Division although in recent years there has been a considerable increase in activity consequent on the establishment of N. E. R. C.

Details of the Forestry Commission's programs are given in the annual research report⁹ which also includes records of research undertaken for the Commission at universities and other institutions.

Characteristics of Forestry Research in the United Kingdom

- 1. The organization of research as an integral part of the state agency charged with the management of the state forest estate and the implementation of national forest policy, and all that flows from this circumstance.**

From the outset it has been accepted that the research must be closely related to the problems of forest management, and as the problems change in character so must the program of research vary in its scope and emphasis. When large scale activity started in 1919 the new Authority was faced with a lack of technical information. Forestry education was directed towards the needs of overseas, and largely Indian forestry. Hitherto home forestry had been practiced on private estates or in the limited

areas of Crown Forest. Knowledge was localized and personal. The few textbooks were mostly translations of doubtful applicability to the new plantation enterprise. Much of the accumulated knowledge was of slight application to the conditions under which the Forestry Commission had to operate. There was, however, considerable experience with exotics mainly in the arboreta and parks and gardens of country houses which featured prominently the introductions of plant collectors. The Forestry Act of 1919 empowered the Commission to "Make or aid in making such inquiries, experiments and research, and collect or aid in collecting such information as they may think important for the purpose of promoting forestry, and the teaching of forestry, and to publish or research, and to disseminate such information" . . . The duties of the Commissioners in respect to research on a) timber and other forest products, and b) "the deeper reactions which trees have in common with other organisms", were largely determined by two Committees appointed to consider coordination of government research. These recommended that a Research Institution be set up under the Forestry Commission to deal with "problems connected with the growing crop" but that "for any fundamental research other than that directed to an immediately economic result in relation to forestry, reference should be made in the first instance to an appropriate authority in whom is vested control of the research upon the subject under discussion"¹⁰. A small research branch was organized in 1919 to work on silviculture, crop production, pests and diseases but the proposal to establish a research institute remained unimplemented until the post-world War II expansion. The formation of a central research station was one of the Forestry Commission's recommendations on post war forest policy and this was put into effect in 1946 with the opening of Alice Holt Lodge. The initial concept of research oriented to the problems of the forestry enterprise has been closely adhered to, though this has not excluded the conduct of long term studies. While grant-aided research has been supported to an extent, this has played a relatively small part in the overall effort and there has been little or no interest in the accumulation of knowledge for knowledge's sake. This has been so even when problems have not been amenable to experimental solution but have required a continuing fundamental approach over a period of many years. "Ultimately the results of all research have been judged by the improvement in efficiency and economy of operations"¹¹.

The practice has been to leave the more fundamental aspects to the Universities and other agencies. "When such enquiries are necessary for a practical outcome of some importance to forestry activities the policy is for these to be carried out by

⁹ Report on Forest Research for the year ending....., Forestry Commission, London. The abbreviated title given in the FAO/IUFRO World List (Oxford/Forestry Abstract symbols) is Rep. For. Res. For. Comm. London.

¹⁰ Report of the Agriculture Sub-Committee of a Cabinet Committee appointed to consider the coordination of research carried out by Government Departments, 1920.

¹¹ M. V. Laurie. Planning a forestry research programme.. 7th British Commonwealth Forestry Conference Paper. U.K. Forestry Commission.

individuals attached to these institutions and supported on a grant from the Forestry Fund. If a study is not essential to operations then responsibility for financing is not considered to rest with the Forest Authority". The Commission's own research staff is concerned mainly with the more technical aspects of forestry, "the more immediate practical experimentation and investigation, and with the practical problems arising", this to provide a basis for the necessarily empirical methods of the executive staff¹². Emphasis is on strictly controlled field experimentation and crop observation and assessment. As the forests grow emphasis is shifting towards problems of management and utilization.

2. The close relationship that exists between research and practice, the interchangeability of staff, the extension function of the research staff, the problem-solving nature of much of the research undertaken, and the feedback of problems and information from the conservancies to the research branch.

The view is that research foresters should be close to their colleagues who are running the forests. As deliberate policy the Forestry Commission established the headquarters and principal research station of its expanded research branch in a rural setting rather than in a university environment. Research personnel identify with their field colleagues. They look upon themselves as foresters and their concern is with the professional area. There is a common recruitment and research foresters are drawn from the general cadre. All silvicultural research is conducted by district forest officers posted to the Research Division. The thinking is that this approach keeps the research practical and results-oriented. While some men may spend all, or the greater proportion of their careers in the Research Division and there is obviously operational specialization there is considerable interchangeability of staff at all levels including section heads. Exceptions only are in the case of the ancillary specialists who may not be foresters. The present Director of Research, after some fourteen years in silvicultural research, spent seven years in a field conservancy before returning as Director. The Chief Silviculturist came to this position after service as a ranking field forester. Conversely one of the five full time Forestry Commissioners spent most of his prior career as a research officer; so also with other senior administrators. This contrasts with American practice where many Forest Service research establishments are situated at universities and there is emphasis on the career recruitment of specialist forest scientists with advanced degrees.

The British view is that any loss in research efficiency is more than compensated for by the greater awareness of forest realities that is brought by men transferred from the conservancies, and the sympathy for research objectives that is taken to the oper-

ational situation by men transferred from research. A factor in the success of this policy is the intensity of management and essentially technical nature of the duties of the field administration. Considerable though often informal mechanisms are adopted to ensure close relationships. The functional and territorial staffs can influence the development of the research program and senior research foresters make a point of visiting forests in each conservancy each year with conservancy foresters. In this way significant problems for subsequent investigation are often identified. Research foresters frequently advise on field situations — for example nursery fertilizer applications are prescribed by the Research Division¹³ while the advice of conservancy foresters is sought on research problems. Research staffs participate in in-service training programs as students and instructors on the same basis as field staff. There is a research liaison section to facilitate the translation of research findings into field practice. There are one week courses for field officers where work of the Research Division is described and discussed. These sessions give district foresters a working knowledge of the latest findings and an introduction to current projects. It also gives the Research staff a chance to learn of developing problems in the field and lets them know how their work is being received by field staff.

It is an article of faith that research only receives justification in practice, that good forestry is dependent upon good field practice and that the purpose of the research effort is to facilitate this. In consequence of these measures and attitudes there is a constant interchange of information and much personal contact between forest and research. The communication gap, at least by North American standards, is non-existent.

3. The relatively minor attention that is directed to basic or more fundamental studies, and the considerably lesser part played by the universities, both in faculty research and research undertaken in the course of graduate study and the relatively insignificant role of thesis research.

By comparison with the American situation there is much lesser attention given to basic research. This is not to say that such research has not been undertaken but that much of the research considered as appropriate to "Forestry" in America is done by workers in other disciplines and reported as such. Thus research in forest soils will be done by soil scientists, on forest insects or animals by entomologists and zoologists, in many aspects of recreation by sociologists and psychologists, and will be recorded in the appropriate journals rather than in the forestry literature. There have been notable contributions over the years by scientists working in association with the Forestry Commission, but essentially forestry research as such has been directed strictly to the practical outcome. Forestry itself has remained within its original professional frame. The view point is well put by Dr.

¹² Research policy was stated quite specifically in **Post War Forest Policy** H.M.S. O. London. Cmmd. 6447, 1943 and in **Annual Report of the Forestry Commissioners, 1949.**

¹³ 1,500 acres, 100 million transplants annual production.

F. C. Hummel, U. K. Forestry Commissioner¹⁴ "some of us believe, and I am one of them, that there is no such thing as basic research in forestry. The basic research takes place in scientific disciplines such as genetics, physiology, biochemistry, entomology, soil science upon which applied research in forestry, and indeed the practice of forestry itself is founded". While in recent years university participation has increased this is small by comparison with the United States. The university forestry schools have been mainly concerned with undergraduate teaching, with the notable exception of the Commonwealth Forestry Institute, Oxford, which has long provided the post-graduate training of Colonial Forest Officers. With notable exceptions faculty, most often men with prior careers in the field, and frequently with considerable research experience, have not been overly concerned in the conduct of research. This has been particularly so in the main areas of professional forestry. With greater availability of grant aid, the situation is changing rapidly but the American concept of the university forestry school as a major research centre with a strong faculty research commitment has not yet been generally accepted by any means. In this the little emphasis on advanced degrees and formal graduate study in British forestry plays a major part. Thesis research has an insignificant role in the overall situation. Yet university professors have status and are frequently consulted as to research and field policies. The lesser research emphasis has also been because the number of undergraduates studying Forestry has been quite small. As a result the number of staff that can be employed is also small, and their teaching load correspondingly large, though the student/teacher ratio may be very reasonable, so that the time left for research is very limited.

4. The lesser significance attached to formal graduate training and advanced degrees as qualification for research appointments, and the major part played by vocationally trained foresters.

The cult of the doctorate has yet to hit British forestry. While there is general agreement that forestry research should be carried out by specialist staff there is considerable difference between British and American approaches in this regard. The American attitude is well illustrated by the 1967 Task Force Report.

This accepted the Ph.D. or equivalent qualifications as the essential hallmark for research leaders in all interest fields. In the United States considerable incentives exist for formal post-B.S.F. education through increased congeniality of available employment and enhanced career and financial prospects. Agencies provide facilities through suitable postings and financial support for mid-career graduate education.

The British view has been that, while advanced degrees are applicable and even desirable in the ancillary sciences, the outlook, approaches and methodologies of applied research can be learned

on the job. Few Forestry Commission research personnel, or for that matter university teaching staff other than those recruited for specialist positions, have had advanced degrees, and career or financial benefits have not accrued from such qualification. Up to the present no preference in Forestry Commission recruitment has derived from the possession of a higher degree and in the recruitment processes qualities other than purely academic have weighed much. In part this reflects the different content and standing of the European and American first degree but it also has arisen out of a belief that while in the sciences the best preparation is usually through graduation in, and full identity with the basic discipline, in that research in these areas demands a knowledge of science rather than of forestry, and a command of scientific method rather than of silvicultural technique, for the main areas of forestry a broad training in silviculture and management, soundly based on the underlying sciences, is desirable. This contrasts with the American pattern of practitioner training followed by specialization through graduate study. The fact that British policy is to look outside professional ranks for the conduct of fundamental investigations relates. The different types of background of researchers in the two countries is reflected in the approach to research problems and methodologies adopted.

Current greater interest in advanced degrees among young British graduates arises rather from contracting employment prospects in British and Commonwealth forestry for foresters of U.K. origin than from any re-orientation in basic education or professional philosophy.

A highly significant characteristic is the major role played by technically trained foresters. The proportion of graduate to technical foresters varies in different fields but in those areas where considerable field experimentation or survey is required the functional sections may have a ratio of six technical foresters to one graduate, while in no case is there a lesser ratio than two to one.

If necessary for the conduct of a project a graduate forester can call upon the services of an almost unlimited number of field men.

A discussion of this policy states: "It has been found that the progress and success of the work depend very considerably on the maintenance of a proper balance between the graduate staff planning and analyzing experiments and the research foresters responsible for their layout, supervision and assessment in the field. There is no doubt that the existence of this body of skilled foresters provides a vital link in forestry research, which is lacking, or at any rate insufficient, in some forest research organizations, even in countries where more money is available¹⁵". The different functions of the graduate and technical foresters are clearly recognized and the young graduate does not serve an apprenticeship as a field assistant but operates at the professional level from the outset. Indeed he prob-

¹⁴ Personal communication.

¹⁵ Forestry Commission Research Station. *Nature* **185** (4709): 281-282, 1960.

ably would be without the competences necessary for work at the lower level. University and technical forestry education are directed to quite distinct end products that complement rather than duplicate.

There is considerable turnover at the junior field assistant level, particularly in less specialized areas. Coming directly to research after the completion of technical training these men may be employed in such tasks as sample plot measurement and nursery assessment and supervision and as assistants to the technical foresters. After a few years they are frequently transferred to the Territorial staff. Some with special inclinations will be retained in the Research Division. In this way a man is not retained after his enthusiasm has begun to wane or when family responsibilities may decrease his mobility. The short-term view might be that such men are lost to research at a stage when they are becoming of real value. But it is held that it is to the advantage of both the research division and the service generally for this turn-over to take place. The conservancies benefit from the habits of accuracy which have been inculcated, and possibly special skills gained, while the research division gains from the understanding and cooperation of ex-research personnel in the field.

To facilitate the operation of this system extensive use is made of standard mensurational procedures and silvicultural experiment record and assessment forms. Technically trained research foresters in the field are placed in charge of groups of projects with responsibility for maintenance and measurement.

There is also a group of technical foresters who have developed specialist skills and competences and who may, in their own sphere, have higher levels of scientific or technical expertise than the graduates with whom they work.

Emphasis is on the research team, but the concept is not one of a group of scientists working on a common problem under a research leader, but rather of a research forester with access to well trained supporting staff and with facilities for specialist consultation.

In contrast in American research the graduate forester tends to give much of his time to a limited number of experiments which he conducts himself in considerable depth, possibly with the assistance of one or two aides, or operates as one of a group of specialists each working on aspects of a common problem. If without an advanced degree he may well be operating at least in part at the level of the U.K. technical forester, or even below this, but without his practical training and background.

In the U.S., although there is increasing use of aides and technicians the Forest Service has not developed a technical forestry cadre comparable to that of the British "school"-trained or working-forester.

Another aspect that receives considerable attention in the U.K. is the belief that important for any constructive research effort is that young research workers are given plenty of scope and responsibility.

A large proportion of the main results obtained by the Forestry Commission Research Branch have been achieved by research workers well under 40 and some by men under 30 years.

5. The extensive nature of much of the research in consequence of the last.

Very large programs of field experimentation are possible because of the availability of supporting staff. The Forestry Commission maintains a larger number of mensurational sample and thinning plots than any other European forest service. This is reflected in the excellence of their studies of growth and yield. In silviculture, the principle subject of research, trials and experiments will be replicated throughout the country as necessary for the project. Their success is reflected in new technology and the extension of forestry onto sites previously considered unsuited.

The difference in the American staff structure is reflected in the deeper treatment and reporting that is often given to individual investigations by individual research foresters in the U.S., while the academic research training is reflected in, an often, thesis-like approach to the problem under investigation.

6. The very different attitude toward research publication and complete absence of the "publish or perish philosophy" in the assessment of research staff.

There is a striking lack of interest in publication among British research foresters. Staff but rarely write solely for other research workers or for a scientific or specialist clientele. Progress is made known through the Forestry Commission Annual Research Report. This is a major research publication. Bulletins and shorter papers are issued at very irregular intervals, and contributions are made to the scientific journals but to a much lesser extent than elsewhere. This might be disputed by British research foresters but the evidence lies in the content of the journals and the publication lists of individual researchers. What publication there is is mainly directed to the practitioner. In Britain the publication list plays no part in professional advancement. It is part of the research forester's function to interpret his results through positive recommendations that take full account of working realities so that practice and technique may be modified in the light of scientific advance. Reference to experimental results are selective rather than exhaustive.

The contrast with the American circumstance is great. An official statement of the U.S. Forest Service¹⁶ states that "productivity in this respect (publications) is an important consideration in judging the capabilities of officers", and there is strong support for the view that "the earliest possible publication of research findings is an obligation assumed by public agencies engaged in research"¹⁷ and that full experimental details should be published.

¹⁶ Research publications, policy and procedure. U.S. Forest Service.

¹⁷ F. H. Kaufert and W. H. Cummings.

In the U.S. Forest Service a tentative decision is made regarding the form of publication at the problem analysis stage and as partial justification for the study before investigational work is started. Characteristically many papers present the results of individual projects or even experiments, and early publication, even of partial results, is encouraged.

The American research forester is identified as a research scientist. He is a member of a considerable community. The esteem of his co-workers is one of his chief incentives. His prestige is not greatly enhanced by writing for non-specialists, thus he tends to write for other research specialists, his language is often technical and his papers assume a background knowledge few practitioners have. On occasion it would seem that the purpose of research is publication. There is a considerable communication gap. A policy of early publication is adopted to ensure recognition of contributions and to encourage a creative atmosphere. A great deal of time is spent in research writing.

In Britain, as the research forester identifies not only with the scientist but also with his fellow foresters he feels less incentive to obtain scientific esteem. Contributions are directed to a closely knit profession rather than to a limited circle of specialists. Much research remains unpublished, although influencing practice through departmental action. In the absence of pressure for publication less time is given to writing and more is thus available for project planning, development and control. The greater cohesiveness within the profession, smaller numbers, fewer agencies, more restricted range of research projects, narrower field of professional commitment, and greater possibilities for personal contact play a part.

But even when allowance is made for these factors it is clear that publication assumes a different place in the two countries. On the one hand there are long backlogs of scientific papers for publication and difficulties in placing papers. On the other forestry journals have found it necessary to solicit articles. American papers tend to be impersonal and even institutionalized, British contributions to be descriptive and to bear the imprint of individual style. Apart from the annual report, the principle papers prepared by British in-service researchers for publication are perhaps those that result from the presentation of invited papers at professional meetings. These characteristically are of a survey or general nature rather than a report on a specific project. The difference in orientation is quite apparent if one scans the titles of papers typically presented by British and American foresters at professional symposia or considers the content of the journals of the two countries.

On the one hand there is almost certainly over- and on the other, under-publication. In American practice significant contributions may be lost sight of, and the individual research worker, and more particularly the practicing forester, may have difficulty in keeping abreast of current development through sheer volume of published materials. In the British system much work may never see the light

of day and there is little doubt but that much valuable material remains unknown outside the home circle. The U.K. contribution is often unknown to the foreign researcher accustomed to journal publication, for the literature is no real guide to progress, or even of the present state of knowledge, while the Annual Research Report may be unseen. Yet there is the paradox that the principle world forestry documentation service, Forestry Abstracts, is provided by the United Kingdom, while the most extensive forestry library in the world is at the Commonwealth Forestry Institute, Oxford.

7. The tendency to supply specialist services rather than to expect personal expertise in individual research personnel.

Just as technical and graduate foresters each perform a specific function on the research team so in the provision of specialist services. Typically the U.K. research forester will seek the advice of the statistician in the design of this experiments and computing staff will undertake the detailed work of computation on the conclusion of the work, leaving the matter of interpretation to the research forester, again in consultation with the biometrician. Similar situations prevail, for example, in the provision of photographic services and soil and ecological descriptions, which may well be made by a technical forester specialized in this work. The concept is that the professional forester should know sufficient to consult the specialist rather than have the diverse competences himself.

8. The essentially down to earth pragmatic approach.

Perhaps in all, this is the strongest characteristic of the U.K. research. The motivation is the facilitating of practice and the resolution of problems not amenable to empirical solution. If an *ad hoc* approach provides a working solution to a particular problem then an *ad hoc* approach will be adopted alongside the more sophisticated methodologies found necessary for the solution of other problems. The work is by foresters, for foresters. Much of the research is of a long-term nature but it is still pursued only to that extent and depth necessary for a practical outcome.

As to the success of these policies:

This is reflected in the high level of research productivity and the contribution made to practice, and through technological advance to the implementation of the national forest policy. British forestry, during the relatively short period since its resurgence, has shown considerable adaptability to changing circumstances and a high level of professional competence. The consensus is that the F. C. Research Division has more than paid for itself.

The research program demonstrates that success in the adoption of an empirical pragmatism lies in the provision of a well trained professional staff with strong supporting personnel, in close contact with, and an integral part of, the authority charged with the management of the forest estate, through with its own administrative structure, and with a strong commitment to the improvement of practice

through the implementation of research findings. The British research commitment amounts to \$1,820,000 or three percent of Forestry Commission expenditures, in personnel it amounts to some 15 percent of the graduate staff and 5 percent of the technical. Additional are the costs and staffing (comprising an additional 5 percent of the graduate and 5 percent of the technical staff) of the two Management Services Division sections, and of the forest related efforts of the other research agencies that would in the United States be undertaken by foresters.

As to the exportability of the organizational structures and policies, each country has its own special circumstances and the pattern of research that evolves must reflect national needs. Similarly in regard to the scale and orientation of the program. American research is of a high calibre and its extent impressive. It may be presumed to have developed to its present form in response to national require-

ments. Its methods of deployment of resources for research into the basic relationships and the close connections between the U.S.F.S. and University research are worthy of study in the development of a Canadian solution.

Nevertheless the British method of deployment of considerably lesser resources and the high return for the research dollar invested would seem to provide several indications for possible development of a problem-solving, developmental oriented Canadian forest resources research, that can make a major impact on practice through answering those questions that are of concern to the practitioner.

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The Physical and Mechanical Properties of Whitebark Pine

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"Knowledge of the basic physical and mechanical properties of whitebark pine is needed to determine its potential use and proper classification in the lumber market."

Abstract

The results of physical and mechanical tests on samples from five whitebark pines (Pinus albicaulis Engelm.) clearly indicate that this species should be classed as soft pine.

Les propriétés physiques et mécaniques du Pin à blanche écorce (Pinus albicaulis Engelm.)

Résumé

Les résultats obtenus à la suite d'essais sur les propriétés physiques et mécaniques d'échantillons de cinq individus du pin à blanche écorce (Pinus albicaulis Engelm.) montrent clairement que cette espèce forestière devrait être classée dans la catégorie des pins à bois mou.

Introduction

Paul (5) indicated that whitebark pine belongs to the soft pine group which includes western white pine (*Pinus monticola* Dougl.), eastern white pine (*Pinus strobus* L.) and sugar pine (*Pinus lambertiana* Dougl.), but he does not present physical evidence other than botanical classification and

visual observation to support his position. Because there is no basic information on the physical and mechanical properties available for whitebark pine, the lumber from this species is being marketed as lodgepole pine (3).

Knowledge of the basic physical and mechanical properties of whitebark pine is needed to determine its potential use and proper classification in the lumber market.

Methods

An area in the Crowsnest Forest, in southwestern Alberta, (Latitude 49° 48' and Longitude 114° 35') was selected for sampling whitebark pine (3). The five trees selected according to A.S.T.M. standard D-143-52 (1965) (1) averaged 16.1 inches in diameter outside bark, 73 feet in total height, 53 feet in merchantable height, 47.3 cubic feet in gross volume and 303 years of age.

One 8-foot butt log was taken from each of five whitebark pine trees selected to be used for mechanical-property tests. The samples were marked out on the logs according to A.S.T.M. Standard D-143-52 (1965) (1). The logs were sawn into 2½-inch planks at a local sawmill. The planks were further reduced to obtain required dimensions for mechanical-property tests. The tests conducted were on static bending, compression parallel and perpendicular to the grain, and shear.