THE PACIFIC NORTHWEST AND BEYOND: ESSAYS IN HONOR OF HOWARD J. CRITCHFIELD

edited by

James W. Scott

Center for Pacific Northwest Studies
Western Washington University

Occasional Paper #14

THE PACIFIC NORTHWEST AND BEYOND:

ESSAYS IN HONOR OF HOWARD J. CRITCHFIELD

Figure 1. Howard J. Critchfield: A Formal Portrait

THE PACIFIC NORTHWEST AND BEYOND:
ESSAYS IN HONOR OF
HOWARD J. CRITCHFIELD

edited by

James W. Scott

Occasional Paper #14

Center for Northwest Studies

Western Washington University

1980

Center For Pacific Northwest Studies

Western Washington University

Bellingham, WA 98225

September 1980

PREFACE

This volume of essays specially written in honor of Dr. Howard J. Critchfield, one of Western Washington University's most distinguished scholars, is the successful culmination of an idea that surfaced during a leisurely conversation I had one day about eighteen months ago with another of my colleagues, Dr. Robert Monahan. The conversation had shifted to the topic of scholarly research and almost inevitably to Critchfield's contribution to geographical and climatological research—a steady contribution made over a thirty-year period. Knowing that his sixtieth birthday was not too far ahead, we got round to thinking about what we might do to celebrate this, and we wondered whether a Festschrift might not be the most appropriate thing. American universities have usually honored their distinguished faculty at the time of their retirement, very often by Festschriften, but why not for some other event like a sixtieth birthday? Mulling over the idea for about a week, we decided it was the thing to do, and we proceeded to move ahead with it, coopting Dr. Robert Teshera as our "business manager."

Approximately thirty scholars—colleagues and students, both past and present—were invited to submit papers for inclusion in the Festschrift. It is gratifying to report that eighteen of the persons approached responded positively, and that all but two of them have been able to meet our deadline for submission. One other scholar, Dr. Harold Bockemuehl was forced to withdraw his offer because of a pending operation from which he is now rapidly recovering.

The original aim was to prepare a volume with a tightly-knit theme concerning the Circum-Pacific world that Dr. Critchfield knows so well. This proved rather more difficult to attain than we had expected. Hence the papers presented here are more than usually diverse and wide-ranging. They have been grouped into five sets—Pacific Northwest Themes; Canadian-American Themes; Canadian Themes; Overseas Themes; and General Themes. Preceding them is a fine personal tribute—trenchant and witty—to Howard Critchfield by Dr. Samuel P. Kelly, Dean for Graduate Affairs and Research at Western Washington University. The other contributors include one of our currently-enrolled graduate students—Patrick S. Grant; four former students—Theodore R. Boss, Ralph E. Lewis, Daniel E. Turbeville and H. L. Zietsman; three former colleagues—William J. Brockie, Michael P. McIntyre and George A. Rheumer; and nine present colleagues—James Bosch, Charles J. Flora, Eugene A. Hoerauf, Robert L. Monahan, Debnath Mookherjee, Maurice Schwartz, Herbert C. Taylor, Thomas A. Terich and James W. Scott. Of the eighteen contributors, thirteen are geographers of various persuasions—among the sub-fields of the discipline represented are Cultural Geography, Biogeography, Cartography and Urban Geography. The remaining five contributors include a Higher Education specialist, a coastal geomorphologist, two anthropologists and a marine biologist. Six universities are represented, including one in South Africa and one in New Zealand.

We have succeeded, I believe, in touching on a good many, if not all, of the topics with which "Critch" has been concerned in his own research and teaching. Only a small handful are somewhat removed from his principal interests. The essays are tokens of the high esteem in which we hold him. As scholar and teacher he has earned a high place in the pantheon of learning.

James W. Scott

CONTENTS

IV

Canadian Themes

V

Overseas Themes

VI

Some General Themes

Appendices

LIST OF ILLUSTRATIONS*

Note: The illustrations that accompany many of the papers are not listed here.

ACKNOWLEDGMENTS

During the past eighteen months the volume has been in the making I have incurred many debts. Help has come from many sources and has been given unstintingly. Especially would I like to thank the following persons.

- The more than 120 sponsors who have helped make this volume a reality.
- The authors who have met their deadlines admirably and contributed some excellent scholarly papers.
- Robert L. Monahan for his help in launching the project.
- Robert W. Teshera for his effort in organizing finances.
- Eugene Hoerauf for his many cartographic contributions and his preparation of photographs, including the cover.
- Eileen Smith and Mary Ellin Robinson for their help in typing letters and helping prepare the preliminary drafts of articles.
- Ken Anderson, University Printer, for his cooperation and expert advice.
- Jeannie Cyr of the Public Information Office for searching out the Critchfield photographs.
- and most of all to Jane Clark, Director of the Bureau for Faculty Research for her ever-willing cooperation, and especially for her preparation of the final, typeset copy.

August 19, 1980. J.W.S.

I

HOWARD CRITCHFIELD: COLLEAGUE AND NEIGHBOR

Samuel P. Kelly

Several months ago Jim Scott, chairman of our department of Geography and Regional Planning, asked me to contribute to a Festschrift that would mark Howard Critchfield's sixtieth birthday. I accepted gladly and received this assignment: compose a somewhat informal, personal envoi to be added to the collection of professional papers which will reflect many of Dr. Critchfield's interests—climate, agriculture, settlement, economic geography and other topics, especially within the circum-Pacific areas where he has traveled, taught and conducted research.

Now, where to begin? There is Critchfield the geographer, Critchfield the faculty member, Critchfield the person, and several other Critchfields as well, including Critchfield my neighbor since 1966 when we bought the house adjacent to his. I've seen him often and in varied settings, heard him likewise, read some of the things he has written, and I've formed opinions--mainly respectful ones—of the man. Let me move through several of the Critchfields for a few pages, relying on fact, impression, hearsay and speculation. (I'll bet that he is properly wary at this point.)

First some facts. Here I rely mostly on the files of WWU's Bureau for Faculty Research, particularly on the collection of faculty vita. Critchfield's, fortunately, is relatively up-to-date. Thumbing through it I uncover considerable information about this quinquagenarian.

Howard John Critchfield (alias "Critch") was born in Vernon, Colorado, a part of the United States where there's just a whole lot of geography, up and down and in every direction. The early record is a bit vague; we pick him up again when he graduated from high school in metropolitan Bonners Ferry, Idaho, with honors—the other senior that year was merely average. Bonners Ferry also is surrounded by geography, and Critchfield's future professional interests are being molded, though he may not have recognized this. After high school came a two-year teacher's course from the Lewiston (Idaho) State Normal School—again with special honors—followed by two years as an elementary school teacher back in Bonners Ferry.

Then, induction into the U.S. Army. Service schools in Texas and North Carolina in weather observation and pre-meteorology; "Flexible Gunnery School" in Florida (of great assistance in later years when he became a departmental chairman and when he served on the Faculty Senate); Arctic Training School in Colorado; and the School of Arctic Climatology in Montana. Next, duty with the Air Force Weather Service in Alaska and Canada, including assignment at Nome. (Up to now, he probably had seen more quadrupeds during his life than bipeds. It's a wonder he didn't become a zoologist.) He was discharged--as from high school and normal school, honorably—in 1946, after a period of thawing out. (It is easy to understand why he spent so much time in the South Pacific during his later years.)

On to higher education; a B.A. in Geography in 1946 from the University of Washington, followed by an M.A. the next year in Geography and Climatology. Then came a period at Washington State University for further

study and an instructorship in Geography, and in 1952 a Ph.D. from the University of Washington. His continuous professional career began in 1951 when he joined the faculty of Western Washington University and moved through the ranks to full professor, with service as departmental chairman included.

The folder also shows visiting lectureships or exchanges with various institutions: The Ohio State University, the University of Colorado, the University of Canterbury, New Zealand, the University of Waikato, New Zealand, and the University of Stellenbosch, South Africa. Mixed in was travel to Australia, South Asia (which he noted as more densely populated than Vernon or Bonners Ferry), Europe, Japan, India and Nepal (back to the mountains). Attached to much of this travel were grants from Carnegie, Fulbright, the National Academy of Sciences, the New Zealand Department of Internal Affairs, and from other sources.

What else does this file disclose? Well, there is considerable information about his academic career. There's a long listing of publications dating from about 1950 to the present. I find books (e.g., General Climatology published by Prentice-Hall and now in its third edition; it is also published by Prentice-Hall of India); dozens of articles (in, for example, Encyclopedia Americana, Americana Annual, Professional Geographer, Economic Botany, Economic Geography, Bulletin of the American Meteorological Society); contributions to collections of essays and articles; contributions to annuals and proceedings; reviews and monographs, and still more. There is also editorial consultancy to Prentice-Hall and to the Journal of Quaternary Research.

His multiple interests are disclosed by the number and variety of publications and presentations: water, erosion, conservation, climate, economic and applied geography, the interaction of climate; and in such settings as the South Pacific, New Zealand, the United States and Canada. Professional memberships have accompanied these interests: The Association of American Geographers, The American Association for the Advancement of Science, The American Geographical Society, The American Meteorological Scoeity, the New Zealand Geographical Society, among others.

Recently, Critchfield has given much time to the study and application of climatology. He is the official State Climatologist of Washington, through appointment by the Governor. As such, he organizes reports and prepares special materials for business and government agencies, and this on top of his regular teaching assignment. In 1979, he served as the president of the American Association of State Climatologists. He was a member of the 1979 Climate Research Board summer study project at Woods Hole, Maine, at the invitation of the Research Council of the National Academy of Sciences. (His folder also contains a copy of a letter of commendation from the Director of the (U.S.) National Weather Service—an item over which my wife would raise a protest, since she has been singularly unsuccessful in ever obtaining an accurate weekend weather forecast from her neighbor. She refuses to accept the necessary and protective distinction between the history of climate and her plans about what to do next Saturday and Sunday. "You'd think by now he'd know something about weather, wouldn't you?")

I've just pulled from Critchfield's file a 12-year-old note from our research bureau to a faculty member in Psychology whose surname also begins with "C." No wonder we've never received the budget report we requested in 1968. Better stop right here. Surely sufficient evidence has been provided to establish the professional talents and credentials of our subject, Dr. Critchfield.

What records or files don't display clearly are the personal, more impressionistic things. What about Critchfield the person? the faculty member? the

neighbor? For you readers who haven't seen him, here's how you'd recognize the man. Medium build, blue eyes, thinning hair, clean-shaven. (Of course, that also describes Frank Sinatra.) And a clear calm gaze at the world around him. (That gaze may be slightly color-blind, though there may be alternative explanations of why he drives an orange-and-white Chevrolet.) In an age of general inattention on American campuses to attire, he is noticeable through wearing suits, jackets, shirts, ties and enclosed shoes; and not at all diffidently. Despite his origins in the remote mountain ranges of Colorado and Idaho, he has acquired gentle habits. He speaks softly and clearly, listens attentively, uses knife and fork with near elegance, and drinks coffee and tea quietly and inconspicuously, especially during committee meetings.

Values and character are harder to see but they can be inferred from actions and commitments. For instance, several years ago I served with Critchfield on the university's Faculty Council. Meetings began at 4 p.m. and often lasted until 6 p.m. or later. Yet consistently at 5 p.m. he would rise from his chair and quietly leave the meeting room. I puzzled over this; he didn't have a 5 p.m. class, he wasn't addicted to jogging in the late afternoon, and so far as I knew his kidneys were in fine shape. Then I noticed something: by the time I arrived home after these meetings, the noise of his typewriter was clearly audible through the open window of his study. Finally, I asked him the obvious question. He replied that if a committee which met weekly couldn't transact its major business in an hour, he would not encourage its bad habits at the price of a delayed dinner and lost time for writing. That seemed so compelling and righteous to me that I decided to accompany him on his timely exits until I recalled that, unlike Critchfield, I was not yet a full professor.

Another illustration of character and commitment: a month or so ago I mentioned to him that the cover on the current issue of National Geographic was a fascinating photo of an erupting moon of Jupiter, taken by one of the U.S. space probes. He said he hadn't seen that particular cover. I was startled, for I expected that he'd been a lifetime subscriber. He explained rather patiently that he'd quit reading the Geographic when it quit including articles on geography. Now that is really living to one's creed and commitment.

To make the profile more complete, there should be some comments about his hobbies, his socializing and like matters. Fortunately this isn't a biography; otherwise, that particular section would be a short and disappointing one. I've lived next door to him for 15 years. To my knowledge--uncertain knowledge perhaps--he doesn't golf, jog, swim, cycle, bowl, gamble or subscribe to plain-brown-wrapped magazines published in Hollywood. I have drunk a beer or two with him and have been at several parties where he was enjoyably present and always decorous. I've never seen him insist on being served health food; in fact, I think he uses gravy on his potatoes. He's kind to his cat--and to ours. He served for several years on the city Planning Commission, during which time he was a considerable disappointment to his immediate neighbors who expected his first official activity would lead to repavement of our alley, but no.... This paragraph is becoming frustrating to write. Maybe before the publishing date for this collection of papers the FBI will investigate Critchfield and I can add some juicy details. Who really knows his neighbor?

Now that I think of it there is one thing that diminishes him in my mind: his considerable luck in raising vegetables, which he arrogates to skill, especially with cucumbers. I know luck when I see it in action, even when it's near incessant. My vegetable garden is not more than 100 feet from his. It faces the same way, slopes at about the same angle, is planted and weeded with equal care, is watered even more bountifully, and is a relative failure. He recognizes this and

smugly brings over prize-winning cucumbers and other vegetables, claiming that he was going to throw these particular culls away but thought that I might be able to use them until my garden showed some promise. This is, on the surface of things, a report of generous actions by a neighbor, but if you were there to see the sly smile that accompanies these gifts from the soil, you'd know what I mean. Just as soon as my garden's luck turns for the better, I'm going to refuse his largesse—probably about 1990.

In the meantime, carry on, Critch. This collection of essays demonstrates the regard in which your colleagues, at WWU and elsewhere, hold you. The prosperity of universities requires productive scholars, even at the price of an overloaded work schedule. Also required are faculty willing to serve competently and constructively on the councils and committees of the institution. A primary requirement is good teaching. I'm sure you know by now that your students consider you well prepared, highly informed about what you teach, rather demanding (a compliment, I think), and fair in judgment and evaluation. Put all these things together and they constitute a good reason for a Festschrift. Since you show no signs of slowing down, there'll probably be Festschrift II in another ten years. If so, by then I promise to have more detailed information to include in that volume, so if you see me watching you closely, you'll know why. Meanwhile, have a good year as the 80's encounter you in the 60's. And since I'm having a difficult time raising sweet peppers, I wonder if you'd . . . (That's the least you can do in return for the earlier kindly words, "thinning hair.")

II

PACIFIC NORTHWEST THEMES

DAILY NEWSPAPER CIRCULATION IN THE PACIFIC NORTHWEST: AN ANALYSIS OF AREAL DISTRIBUTION

Patrick S. Grant

The role of the regional newspaper is American society's principal means of acquiring a comprehensive understanding of the world around them. Most importantly, perhaps, newspapers are a major source of information about the market. Through newspaper advertising, businesses can effectively inform large numbers of people about the products or services they have to offer, and conversely, consumers can better assess the merits of what each business is marketing. Furthermore, newspapers exert a considerable political influence through editorial columns and by their editors' decisions about which stories to emphasize in the newspaper layout.[1]

The purpose of this paper is to examine the patterns of daily newspaper circulation in the greater Pacific Northwest (Oregon, Washington, Idaho, and western Montana). From these patterns interpretations can be drawn about political and economic spheres of influence, and factors contributing to their evolution. In order to reach these interpretations based on newspaper circulation dominance, the following question must be posed for each community in the Northwest: what city's newspaper circulates the greatest number of copies? Obviously, the place of publication has much to do with the content of the paper. Likewise, a reader's own perceptions and thinking are oriented towards the particular city from which he receives his newspaper. Perhaps more significantly, a reader will likely choose to subscribe to a particular newspaper because of his own orientation or interest in the city of origin.[2] Thus economic patterns (mainly through advertising) and, to a lesser extent, political patterns, are substantially affected by newspaper readership patterns.

A number of geographers have used newspaper circulation areas as indicators of metropolitan dominance.[3] Circulation is a particularly useful indicator in the United States because of the importance placed by newspapers on local news and advertising. Due in part to the country's geographic extent, the U.S. has failed to produce a widely circulated national newspaper.[4] In Europe, on the other hand, national newspapers are more important. Businesses in the United States must rely more heavily on local or regional newspapers to convey market information to consumers—the newspaper is an effective means of reaching Americans since they live in more dispersed settlement patterns.

During the past several decades, the number of daily newspapers in the United States has declined.[5] In the early part of the twentieth century, many large cities had several competing daily newspapers.[6] Today, only a few major U.S. cities have more than two major dailies, and in many cities, the two newspapers are published by one firm.[7] In the Northwest, only one city, Seattle, has two competing daily newspapers. Numerous factors have contributed to this trend—among them economies of scale, caused by rapid improvements in printing technology. The increased costs of modern printing equipment have created barriers to entry in the newspaper business, discouraging potential competitors. A less significant factor is the expanding reliance on radio and television as sources of information. But these can never replace the newspaper-

-neither can be as comprehensive or specific as the newspaper, especially with local information (another explanation for the local characteristic of American dailies). Most daily newspapers publish without any competition from other dailies in their respective cities; a factor that places a burden on these newspapers to be responsible and impartial in their presentation of information.

Nonetheless, individual newspapers compete with newspapers from other cities. The competitive value of a newspaper is directly proportional to the population of the city where it is published.[8] The critical factor is total circulation, since that is an indicator of the audience which could be reached through advertising. Circulation is dependent on population. Similarly, the extent of a newspaper's circulation is dependent on the population of its place of publication. A city wields a "gravitational field," which becomes stronger if its population increases, and the city's newspaper circulation is the same as its field.[9]

A distinction can be made among daily newspapers between metropolitan dailies and regional or local dailies.[10] Metropolitan newspapers circulate much further from the place of publication, have higher total circulation, larger staffs, and higher advertising costs but more space committed to advertising. These newspapers also include a more comprehensive range of news stories. Six metropolitan newspapers are published in the Northwest: two each in Seattle, Spokane, and Portland.

A study of 1963 newspaper circulation in the Northwest was done by Preston for his application of central place theory concepts to the Northwest.[11] In this study, Preston distinguished "centrality" from "nodality." The nodality of a central place is determined by the total volume of central goods and services provided by a place, while centrality considers what proportion of these goods and services are consumed away from the central place as compared to locally.[12] The question is then, how important is a settlement as a regional center relative to other settlements? Preston used newspaper circulation dominance patterns as a major consideration in determining central place spheres of influence in the Northwest.

For this current study, most of the circultion data were provided from reports published by the Audit Bueau of Circulation (ABC), an organization founded as a self-regulatory agency for individual newspapers to report accurate circulation figures for use by advertisers. Prior to the establishment of ABC, newspapers would exaggerate circulation figures in order to attract more lucrative advertising.[13] Of the sixty-three daily newspapers with circulation dominance in the Northwest, forty-nine are members of ABC. The remaining fourteen newspapers had to be contacted individually for specific circulation information.

Using these data, the three maps (on the following pages) were drawn. Several factors, however, need to be considered in the interpretation of these maps. First, the data for each newspaper are dated anytime from late 1978 to early 1980, although nearly all the reports were taken sometime during 1979. Since newspaper circulation is unlikely to have changed markedly during this time, the data still have value for comparison. Another problem is the mapping of newspaper dominance in sparsely settled areas. Some large areas exist for which there are no circulation reports, and some smaller newspapers circulate so few newspapers that, when several newspapers circulate, no one paper is significantly dominant. Still another factor is that while circulation data are listed in reports by community, variations exist between newspapers as to the geographic scope of particular communities, making comparisons difficult. Finally, in some ABC reports, data for "ABC Primary Market Areas" are not broken down by community, making it difficult to compare circulation figures among competing

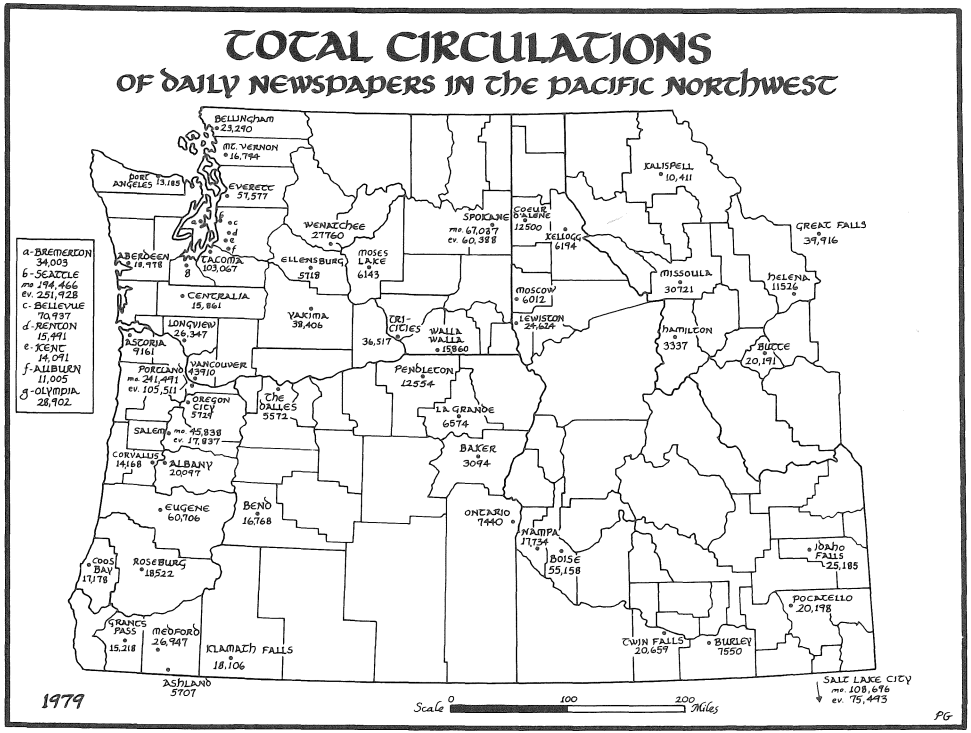


Figure 1. Total Circulations of Daily Newspapers in the Pacific Northwest

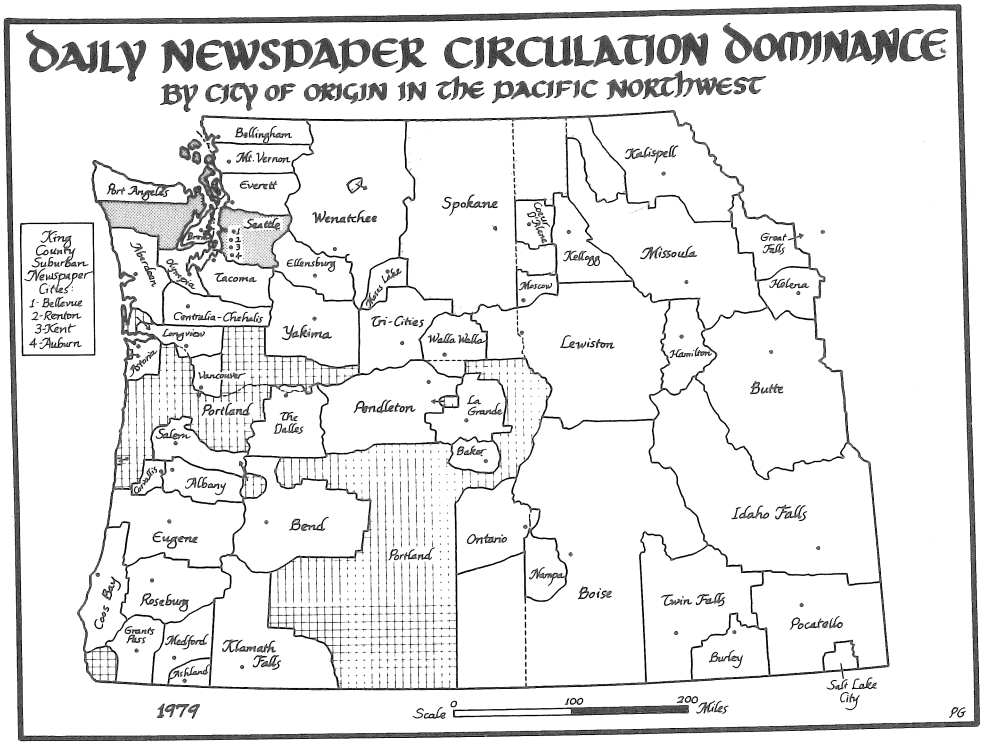


Figure 2. Daily Newspaper Circulation Dominance

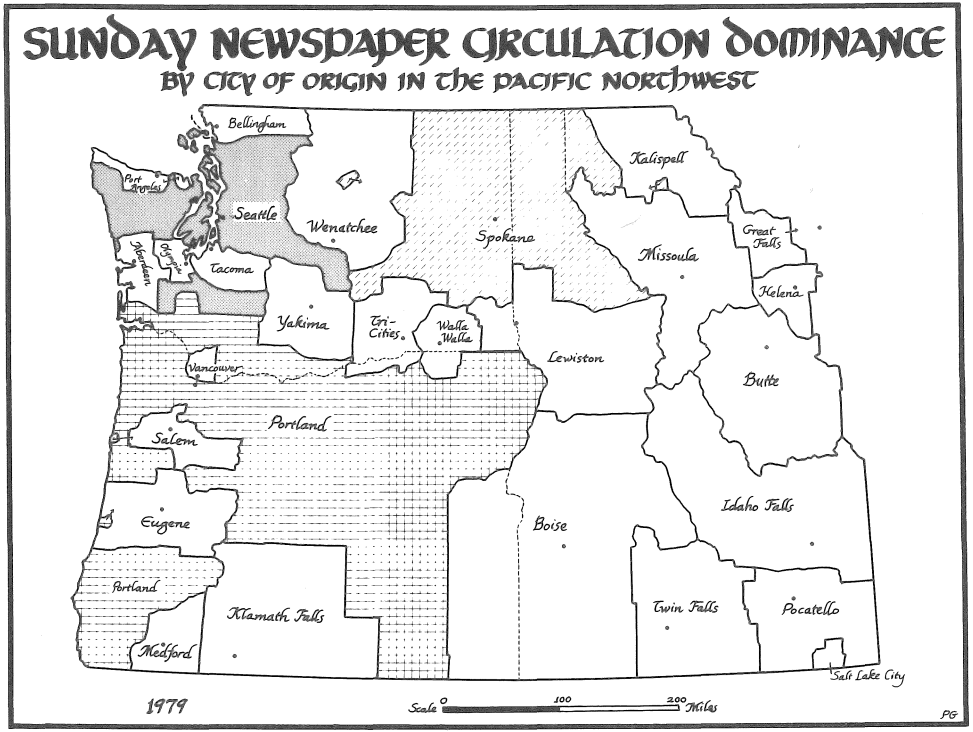


Figure 3. Sunday Newspaper Circulation Dominance

newspapers in King Co. (Wash.), southern Snohomish Co. (Wash.), and northwestern Clackamas Co. (Oregon).

These maps give a clear impression of "gravitational fields," which decrease in strength with distance, which emanate from the places of publication of newspapers. The greater the circulation—and the publishing city's population--the stronger the gravitational field.[15] The map of weekday newspaper circulation dominance shows that Portland newspapers dominate in many areas where an alternative newspaper from a closer city could be (or is) available. The Oregonian (Portland) circulates more heavily in Joseph (northeastern Oregon) than the La Grande Observer or the East Oregonian (Pendleton), and more heavily in Brookings (southwestern Oregon) than The World (Coos Bay).

Metropolitan newspapers tend to dominate distant areas with low population densities, largely because of the absence of a competing smaller city. Seattle newspapers dominate Jefferson Co., Wash., (pop. 14,200), but not Clallam Co. (pop. 46,000) or the adjacent Pierce Co. (pop. 453,900). Portland newspapers dominate Harney Co. (Oregon), but not Marion Co. (Ore.). Furthermore, the border between two newspapers from two competing cities generally conforms to the patterns which would be anticipated by laws of retail gravitation. The border dividing the extent of The Post Register (Idaho Falls) and the Idaho State Journal (Pocatello)—both newspapers have similar total circulations--is almost equidistant between Idaho Falls and Pocatello, i.e., through the middle of Bingham County. But the division between The Idaho Statesman, Boise (circ. 55,158) and the Times-News, Twin Falls (circ. 20,659) is much closer to Twin Falls.

Based on patterns of newspaper circultion, Portland seems to have a strong degree of centrality. Portland newspapers circulate nearly everywhere in Oregon; Washington, Idaho, and Montana, however, are not dominated by one city. While Portland's importance as a transportation center, resulting from its favorable position on the Willamette River is a factor, its centrality is more likely a result of its situation relative to competing centers.

The presence of metropolitan newspapers only in Washington and Oregon causes newspaper circulation patterns which are different from Idaho and western Montana. Every portion of Oregon and Washingto is served by a metropolitan newspaper from Spokane, Seattle, or Portland. In central and southern Idaho, as well as western Montana, however, the circulation areas overlap very little beyond immediate fringe areas. For example, while The Oregonian circulates throughout Oregon, The Idaho Statesman circulates very few copies outside of southwestern Idaho and Malhew Co., Ore. Likewise, The Montana Standard (Butte) circulates heavily within a portion of southwestern Montana, but very little outside of it.

Transportation routes also have a definite influence on newspaper circulation. What is not very clear from the weekday newspaper circulation map is the fact that settlements at Washington State Ferries' terminals on the west side of Puget Sound are dominated by newspapers from the opposite side of the Sound. Seattle newspapers are dominant in Kingston, Winslow, and Southworth (all ferry terminals), but nowhere else in Kitsap County. The Everett Herald is dominant in Columbia Beach, a ferry terminal with service to Mukilteo (near Everett), but nowhere else on Whidbey Island. A large proportion of the traffic travelling on the ferry routes from these terminals consist of communters to Seattle and Everett, who thus have an interest in and orientation to those places.

A particularly notable trend in the American newspaper business during the past ten or twenty years is the rise of suburban daily newspapers.[17] In the Northwest, evidence of this trend is found only in the Seattle metropolitan

area. Within the past five years, four newspapers started publishing daily (Bellevue, Renton, Kent, Auburn), with a combined circulation of over 100,000. In addition, The Everett Herald is publishing a separate Western Sun edition serving southwestern Snohomish County. The growth of suburban areas is a major factor contributing to this trend, but a very important reason is the local perspective and orientation these newspapers provide to the areas they serve. An attractive feature of the suburban daily is the very direct relationship it has with the community. Metropolitan dailies have been responding to this challenge by publishing separate editions for individual regions within the metropolitan area, featuring local news, but they cannot meet the need for local information as well as local newspapers can.

Newspaper circultion areas are highly indicative of economic trade areas, thus, analyzing the spatial arrangement of newspaper circulation dominance is an important method of determining regional economic patterns. There are, however, other features which make up these patterns, e.g., patterns of banking, telephone use, transportation, etc., which, together with newspapers, give a more complete picture of trade areas. The analysis of the spatial distribution of any services contributes to this picture, but since the information about these services is conveyed most completely through the newspaper, an analysis of newspaper circulation is very useful. In spite of competition from other media, corporate ownership, and higher printing technology costs, the newspaper will continue to play an important role in American Society because of its role in spreading local information, both news and advertising.

FOOTNOTES

[1]See Hynds, Ernest C., American Newspapers in the 1970's, N.Y.: Hastings House, 1975, for a thorough discussion of the roles of newspapers.

[2]An analysis of news "information fields," which alludes to these questions of perception was done by H. C. Kariel, and L. Rosenvall, in "Circulation of Newspaper News in Canada," Canadian Geographer, XXIII, 2, 1978, pp. 85-111.

[3]See Park, R. E., and C. Newcomb, "Newspaper Circulation and Metropolitan Regions," in R. D. McKenzie, chief author, The Metropolitan Community, N.Y.: McGraw-Hill, 1933, pp. 98-110; and Park, R. E., "Urbanization as Measured by Newspaper Circulation," American Journal of Sociology, 35 (1929), pp. 60-79; and Lueck, V., "Hierarchy and Regionalization in U.S. Sunday Newspaper Circulation," Minnesota Geographer, 21, (1968-1969), pp. 10-23; and Phillips, Phillip D., "Newspaper Circulation as a Measure of Metropolitan Influence and Dominance," Southeastern Geographer, 14, no. 1 (May 1974), pp. 17-25.

[4]The Christian Science Monitor and The Wall Street Journal could be considered exceptions, but their readership is somewhat specialized.

[5]Ayer's Directory of Publications, 1940-1979, Philadelphia: Ayer Press.

[6]Ibid.

[7]In the U.S., only New York, Philadelphia, and San Antonio hve more than two important widely circulated daily newspapers.

[8]Zipf, G. K., "On the Number, Circulation-Sizes, and Probable Purchases of Newspapers," American Journal of Psychology 61 (1948), pp. 79-89.

[9]Braunstein, Yale M., "A Gravity Model Analysis of the Demand for Mass Communication," Regional Science and Urban Economics, 6, no. 3 (1976), pp. 289-308.

[10]This distinction is made in Rivers, W. L., and Rubin, D. M., A Region's Press: Anatomy of Newspapers in the San Francisco Bay Area, Berkeley: Institute of Government Studies, UC, 1971.

[11]Preston, R. E., "The Structure of Central Place Systems," Economic Geography, 47 (1971), pp. 136-155.

[12]Preston, R. E., "The Recent Evolution of Ontario Central Place Systems in Light of Christaller's Concept of Centrality," Canadian Geographer, 23, no. 3 (1979), pp. 201-221.

[13]Bennett, Charles O., Facts Without Opinion: First Fifty Years of the Audit Bureau of Circulations, Chicago: ABC, 1965. See Preston, R. E., "Audit Bureau of Circulation Daily Newspapers Records as a Source in Studies of post-1915 Settlement Patterns in the U.S. and Canada," Historical Geography Newsletter, 7 (1977), pp. 1-12.

[14]Preston, "The Structure of Central Place Systems."

[15]Reilly, W. J., The Law of Retail Gravitation, New York: The Knickerbocker Press, 1931.

[16]Berry, B. J. L., and R. F. Lamb, "The Delineation of Urban Spheres of Influence: Evolution of an Interaction Model," Regional Studies 8, no. 2 (Aug. 1974), pp. 185-190.

[17]Bell, T. N., "The Suburban Daily: New Power in Publishing," Saturday Review, January 14, 1967, p. 118.

A GEOGRAPHIC CLASSIFICATION OF WASHINGTON'S PACIFIC COAST

Thomas Terich, Maurice Schwartz
and Eugene Hoerauf

The morphology of a coast is a product of past and present processes. Understanding the magnitude and breadth of the multitude of operating processes is necessary in order to classify the resultant morphology. Geomorphic classifications have been prepared by many investigators over the last half century. Among the first in this country was D. W. Johnson (1919). He established a classification system that showed the relative long-term nature of land and water movements. Coastal areas were classified as submergent, emergent, neutral or compound. Submergent shorelines are produced when sea level rises relative to the land, whereas when the land rises relative to the sea an emergnt shoreline is created. Neutral shorelines show little long-term relative movement between land and sea. The compound classification is assigned when the shore is a product of many relative movements. This genetic classification of coasts has persisted for many decades and is found in many contemporary physical geography and geology texts.

Numerous authors since Johnson have classified the coastlines of the world. Some are classified on the basis of form (morphology) and others on genesis. A new genetic classification scheme has been introduced by Inman and Nordstrom (1971). They applied plate tectonics theory to the development of worldwide coastlines. They have shown that the gross morphology of a coast can be explained by its relative position on one of the major coastal plates. The large-scale features fall into three general classes, depending on their position relative to the moving plates. The "collision edge," "trailing edge," or "continental side of a marginal sea formed by an island arc." This classification has introduced a worldwide genetic explanation for coasts but, on a smaller scale, tectonic and erosional conditions prevail to produce local differences in morphology.

The work presented here is an attempt to classify the local geomorphology of the Pacific Coast of the state of Washington. This coast has been surprisingly neglected by researchers. It is hoped that this work will provide both a regional view of the state's coast and stimulate additional study.

The Pacific Coast of Washington can be divided into three distinct geomorphic regions: southern (I), central (II), and northern (III), as shown in Figure 1. The southern and northern regions clearly differ from one another. The central region, itself distinctive, blends some of the physical characteristics of both the northern and southern regions.

Southern Coastal Region (I)

The southern region of Washington's Pacific Coast extends from the mouth of the Columbia River, which separates the states of Washington and Oregon, north to the Copalis River (Figure 2). The beaches of this region are

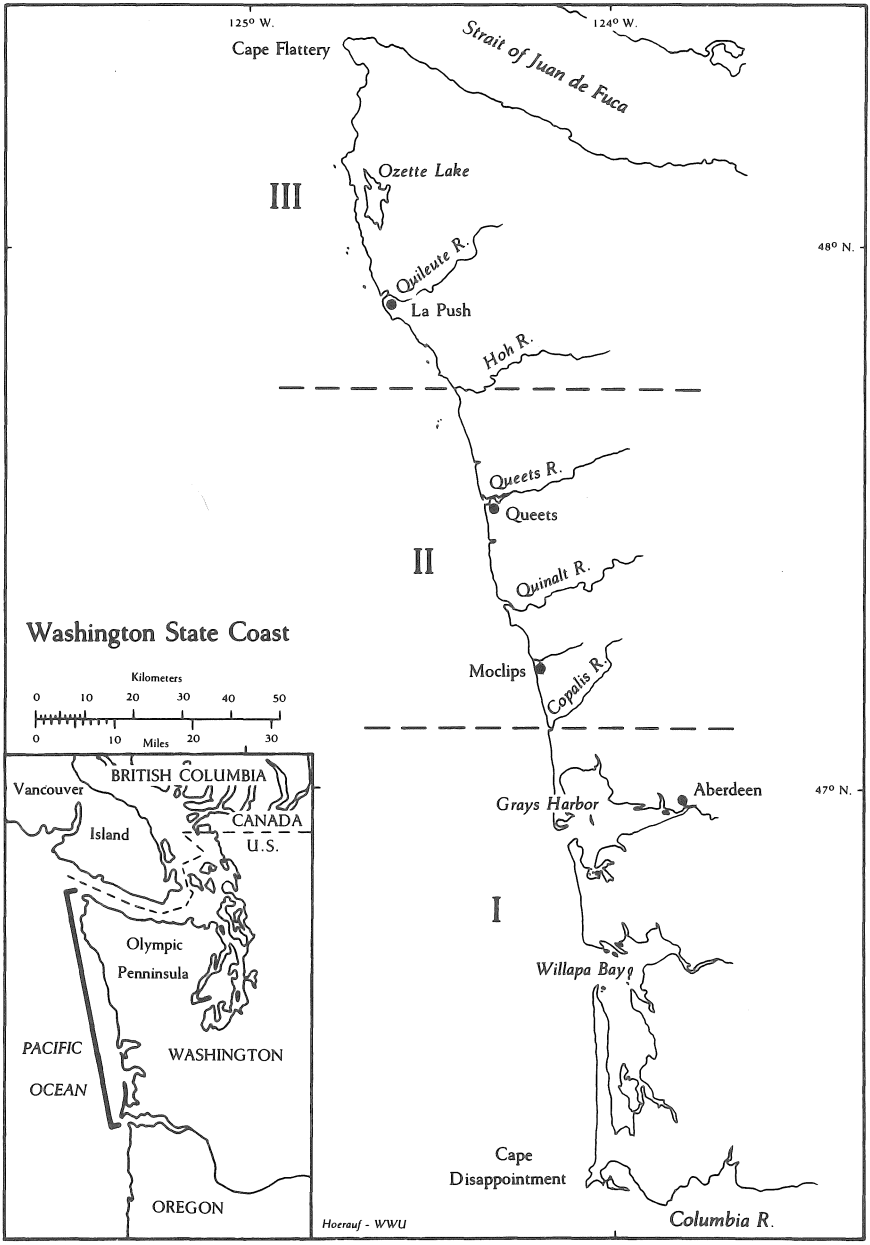


Figure 1. Washington State Coast

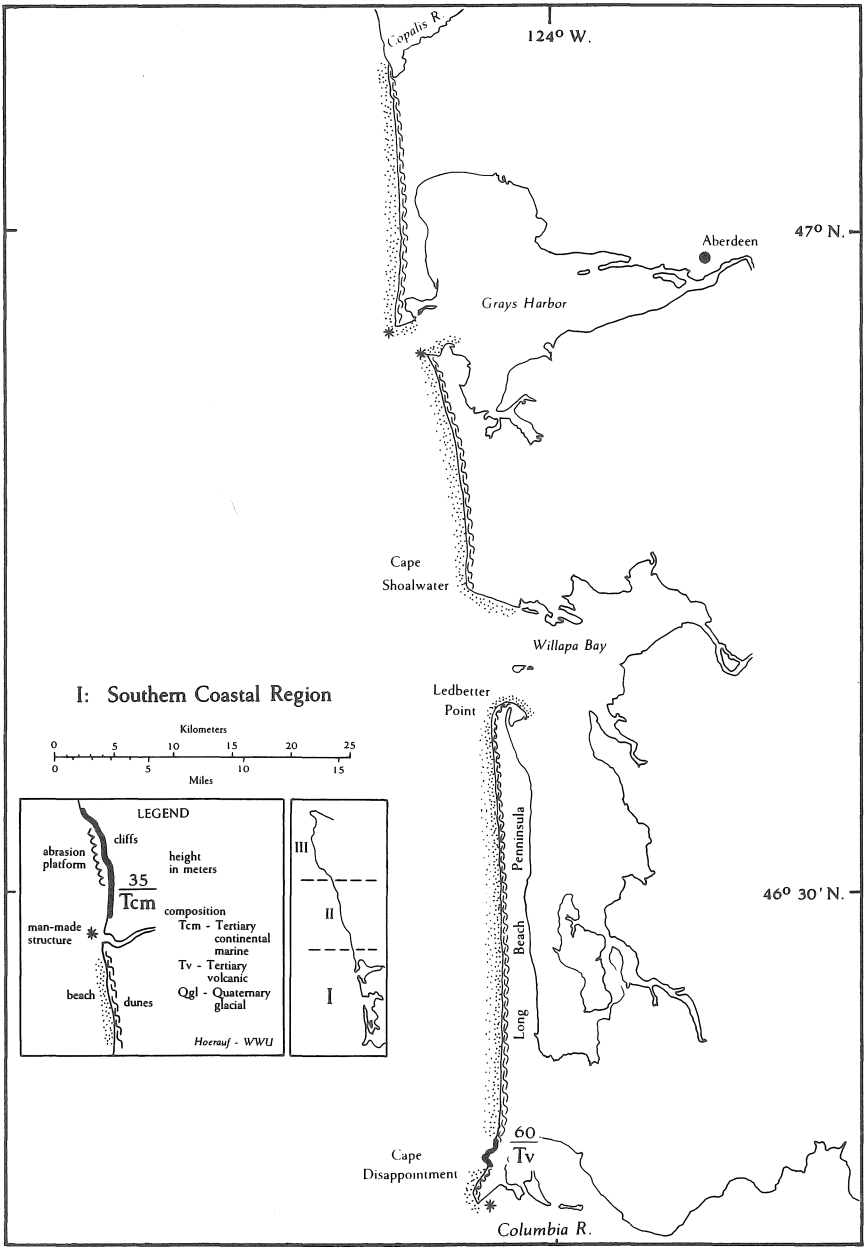


Figure 2. Southern Coastal Region (I)

strikingly uniform. They are composed of wide, fine-sand intertidal zones, backed by low-lying parallel dune ridges and troughs heavily covered with dune vegetation (Figure 5a). Two very large estuaries, Willapa Bay and Gray's Harbor, interrupt the linearity of the coast. Both are protected from large ocean waves by sandspits. Long Beach Peninsula, the longest spit, extends north from Cape Disappointment near the Columbia River, 30 km. It has grown from large volumes of sediment delivered to the coast by the Columbia River (Ballard 1964). The beaches of this entire southern region owe their existence to sediment delivered from the Columbia River and transported with a northern net littoral drift (Phipps 1978). The volume of sand movement to the north diminishes by entrapment in the two large estuaries, accretion on the beaches, and loss down submarine canyons that intersect the continental shelf (Phipps and Smith 1978).

The beaches of this region are generally accretional with a steady supply of sediment from the Columbia River. Adjustments, both natural and man-made are occurring to the shoreline of the region. The most noticeable changes are found on the north and south entrances to Willapa Bay. Phipps and Smith (1978) have shown Ledbetter Point, the north tip of the Long Beach Peninsula, to have gone through periods of rapid northward advance and southward recession since the late 1800s. The most dramatic erosion found anywhere on the Pacific Coast of the United States is at Cape Shoalwater, on the north side of the entrance to Willapa Bay. The shoreline has receded northward about 4,000 meters since 1887 (U.S. Army Corps of Engineers 1971). The present erosion rate averages about 50 meters per year and is expected to continue. The erosion has destroyed valuable recreational beaches, public highways, and a school; forced the relocation of a coast guard lighthouse and a cemetary; and cost the lives of many residents. The cause of the erosion is not fully known, but it is believed to be related to the slowly northward migrating channel entrance to Willapa Bay.

The wide sandy beaches of this southern region are again broken at the mouth of Gray's Harbor, an important shipping port. Twin jetties have been built at the entrance to the harbor. The jetties have caused local realignment of the shoreline with periods of jetty construction, deterioration, and reconstruction (U.S. Army Corps of Engineers 1975). The north jetty traps a great deal of littoral drift and the beach to the north has very high accretion rates, up to 16 meters per year (Phipps and Smith 1978). Progressively to the north, the accretion rates and wide sandy beaches, characteristic of the southern region, diminish until the Copalis River is reached. This river marks the boundary of the southern coastal region (I).

Central Coastal Region (II)

North of the Copalis River the physical form of the coast changes (Figure 3). The central region (II) presents a blend of linear beaches and steep sea-cliffs, singularly representative of the southern (I) and northern (III) regions, respectively (Figure 5b).

The contribution of Columbia River sediment to the beaches of this region significantly diminishes, but a plentiful supply is available from the five rivers that open to the shore and the active sea-cliff erosion of this central region.

The physical character of the beaches change from wide, fine- to medium-sand beaches between the Copalis and Moclips Rivers to steep, narrow, variable fine- to coarse-grain beaches along the remainder of the region. The variability of beach sediment is attributed to the geological differences in sea-cliffs which supply much of the eroded sediment.

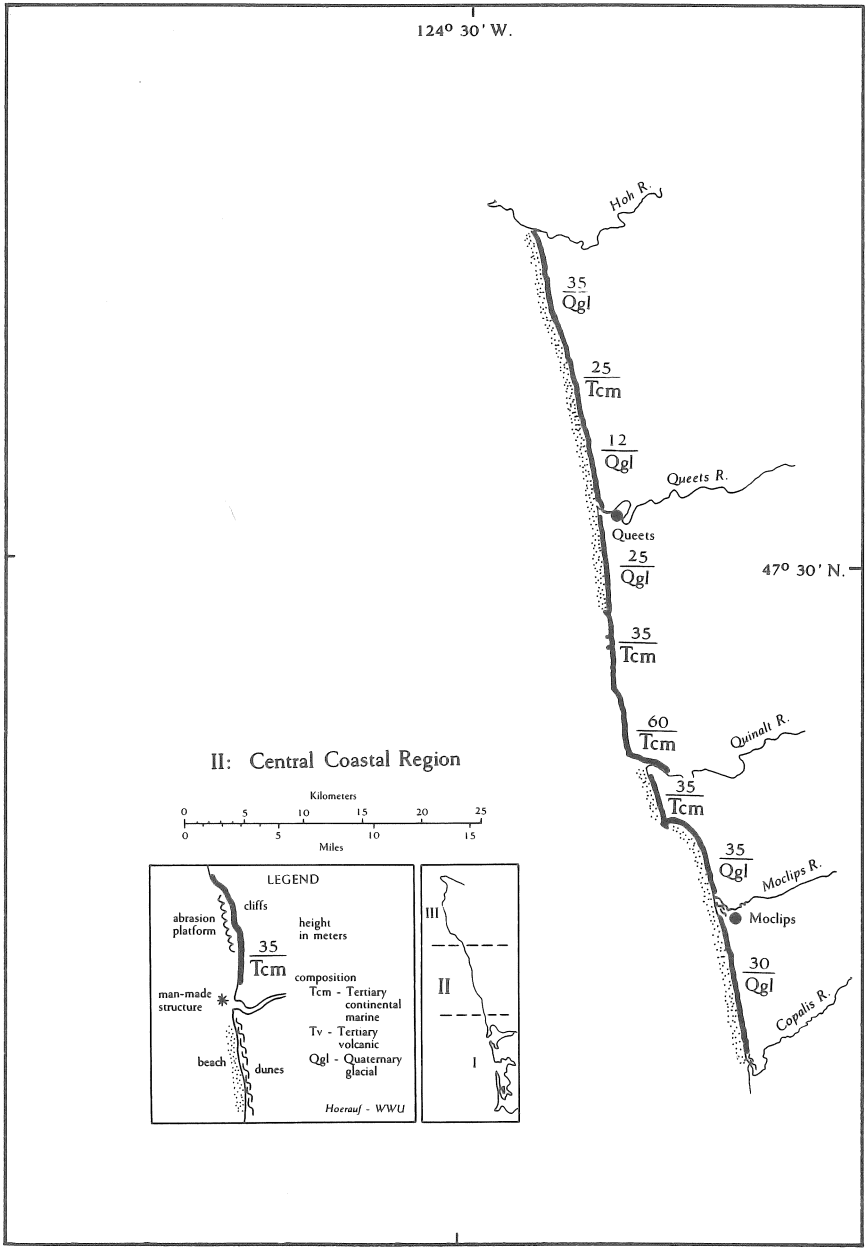


Figure 3. Central Coastal Region (II)

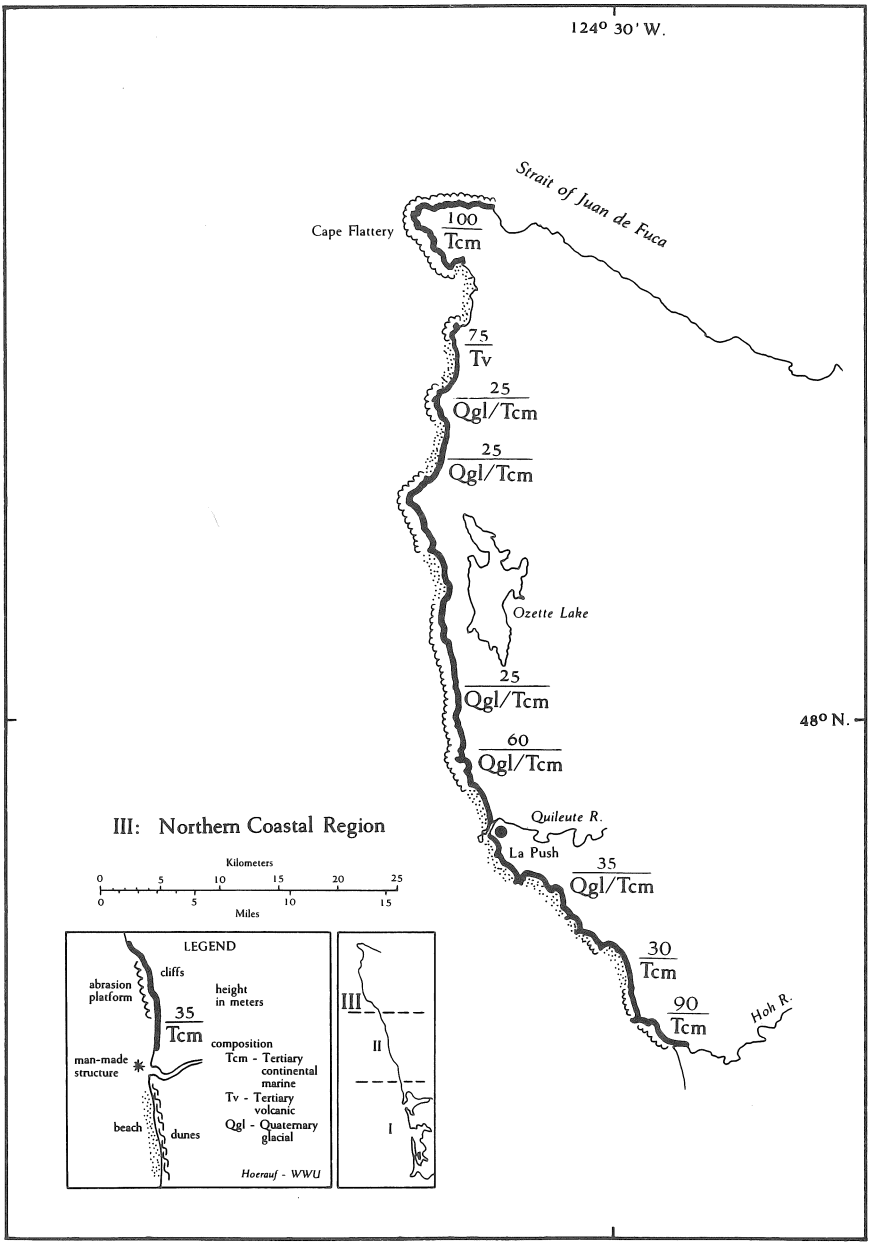


Figure 4. Northern Coastal Region (III)

The prominent sea-cliffs of the central region (II) reveal some of the dramatic geologic history of the Olympic Peninsula. Race (1973) has provided a detailed investigation of the coastal geology. He has divided the rocks into two major groups; the Hoh rock assemblage, and a second group referred to as "tectonic melange." The Hoh rock assemblage is a group of highly folded, steeply titled sandstone and siltstone sequences. The other major group, tectonic melange, is a "chaotic assemblage of siltstone, sandstone, conglomerate and volcanic materials" (Race 1973). Both of these major rock groups have been displayed on the map (Figure 3) as Tertiary continental-marine (Tcm). Superimposed upon these two major rock groups are younger glacial sand and gravel deposits (Ogl).

The complexity of the coastal geology is a product of the subduction of the Juan de Fuca plate beneath western Washington resulting in the formation of the Olympic Mountains and the complex Hoh rock assemblage. The results are dramatically displayed in steeply dipping strata, hogbacks, and sandstone sea-stacks. Race (1973) also notes of significance in this central region, elevated wave-cut platforms up to 40 meters above present sea level. Clam borings, formed 70,000 years ago, are still preserved in some of these elevated rocks.

Northern Coastal Region (III)

The impressive complexity and beauty of the central coastal region (II) is equalled and surpassed by the northern coastal region (III). This region is most noted for its scenic beauty consisting of numerous offshore sea-stacks, high sea-cliffs, broad hard rock wave-cut platforms and isolated pocket (Figure 5c) beaches (Figure 4). The small isolated pocket beaches of the northern region (III) are products of local sea-cliff erosion. These small beaches generally have a steep profile and are composed of pebbles and cobbles eroded out of the nearby cliffs. Bounding these small beaches are steep sea-cliffs with resistant rock promontories rimmed by broad flat wave-cut platforms. They are indicative of slow, yet inexhaustible, wave erosion of the land. The products of headland erosion—coarse sands, gravels, pebbles, and cobbles—are driven toward relatively quieter inlets and hollows along the coast forming small isolated pocket beaches.

The geology of the sea-cliffs of this region is a complexity of inter-fingered sandstones and conglomerates of continental and marine origin (Tcm). Tertiary volcanics (Tv) penetrate the sandstones and conglomerates forming resistant points along the coast. A blanket of Quaternary glacial sands and gravels overlies many of the lower harder rock assemblages, providing evidence of the former glaciation of the Olympic Peninsula.

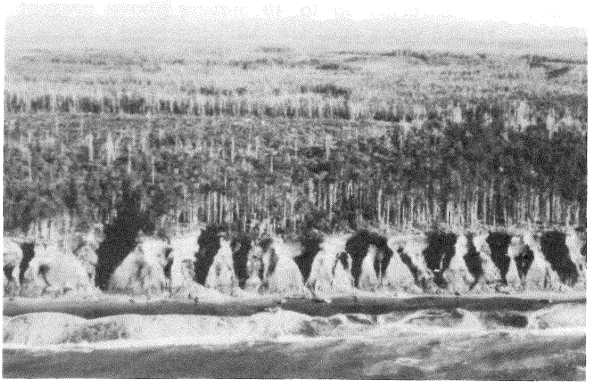
The highest cliffs along the entire Washington coast are found at Cape Flattery, the northern most promontory along the coast. The entire Cape is surrounded by wave-cut platforms that attest to the unceasing wave attack. Cape Flattery marks the end of Washington State's open exposure to the Pacific Ocean. Beyond the Cape the coast turns toward the southeast into the relatively quieter waters of the Strait of Juan de Fuca.

Summary

The Pacific Coast of Washington State is extremely complex in form and composition. A close look reveals three major morphologic regions, each distinctive, yet common to all are the same shore processes. While the gross morphology of the coastline fits a "collision edge" as identified by Inman and Nordstrom (1971), it is clear that smaller scale tectonic and erosional conditions

(a) Southern region coastline

(b) Central region coastline



(c) Northern region coastline

Figure 5

have produced local differences in the morphology of Washington's Pacific Coast.

REFERENCES

Ballard, R. L. (1964). "Distribution of Beach Sediment Near the Columbia River." Department of Oceanography M.S. Thesis, University of Washington.

Inman, D. L. and C. E. Nordstrom (1971). "On the Tectonic and Morphologic Classification of Coasts," The Journal of Geology, Vol. 79, No. 1, pp. 1-21.

Johnson, D. W. (1919). Shore Processes and Shoreline Development. John Wiley and Sons, Inc., New York.

Phipps, J. B. and John Smith (1978). Coastal Accretion and Erosion in Southwest Washington. Department of Ecology, State of Washington.

Race, Weldon (1973). Geology of the Washington Coast. Department of Natural Resources, State of Washington.

U.S. Army Corps of Engineers (1971). National Shoreline Study: Inventory Report, Columbia-North Pacific Region, Washington and Oregon. North Pacific Division, Portland, Oregon.

U.S. Army Corps of Engineers (1975). Grays Harbor and Chehalis River Navigation: Project Operation and Maintenance. Final Environmental Impact Statement, Seattle, Washington.

Figure 2. The Young Professor

THE MAKAH WHALERS[1]

Herbert Taylor and James Bosch

> What the buffalo is to the Indians on the plain, the whale is to the Makah. (H. H. Webster, Makah Indian Agent, 1865)

The Makah were the northwesternmost tribe in what is now the continental United States. In aboriginal times they occupied five villages clustered about Cape Flattery and stretching south to the village of the Ozette on Cape Alava.

> The Makah are Wakashan in linguistic stock, Nootkan in linguistic family and central Northwest Coast in cultural tradition. The Makah are, therefore, the most easily delineated of any of the western Washington tribes. (Taylor, 1974, p. 77)

The linguistic and cultural relatives of the Makah are the Nitinat, Clayoquot and Nootka proper of western Vancouver Island. Evidently, the Makah pushed south across the Strait of Juan de Fuca in aboriginal times and, in occupying the Cape Flattery area, split the Chemakuan- and Salish-speaking peoples, driving some east and others south (Irvine, 1921). How long ago this invasion occurred is not clear although Dr. Richard Daugherty's excavations at Ozette will probably go far toward answering the question. Currently available radiocarbon dates of excavated houses at Ozette show 450 B.P. (1528 A.D. with perhaps a 6 percent margin of error) and an underlying house probably dating to 800 B.P. (Kirk and Daugherty, 1978, p. 45; Taylor, 1974, pp. 75 and 76). However, much work remains to be done at Ozette, and Makah occupation of the area may well prove to extend back thousands of years. In any event, the Makah were in possession of the Cape Flattery area centuries before the coming of the white man.

The Nootkan-speaking peoples on the open Pacific side of Vancouver Island are whalers. So are the Quileute and Quinault to the immediate south of the Makah. The Quileute evidently acquired their knowledge of whaling from the Makah, and the Quinault picked it up from their northern neighbors, the Quileute. The Quinault, the southernmost of the whaling tribes of the Northwest Coast, probably adopted cetacean chasing only within the last two or three centuries (see Singh, 1977, p. 48; Olson, 1926, p. 44; Taylor, 1978, p. 40).

Thus there were three groups on western Vancouver Island and three on the west coast of Washington's Olympic Peninsula who comprised the entirety of whale hunters on the aboriginal Northwest Coast (this reckoning includes the Ozette with the Makah, the Hoh with the Quileute and the Queets with the Quinault). Of these six groups, however, ethnologists are agreed that the Makah were the whalers par excellence (Curtis, 1913, Vol. IX, p. 145; Taylor, 1974, p. 68).

The Makah and Ozette were the only Northwest Coast Indians who relied upon the whale as their primary food source (see chart). Partly this was because the Makah territory lacked major salmon streams (Singh, 1966, pp. 17 and 19),

but in part because the Makah seem to have deliberately opted to occupy sites (notably Wa'atch and Ozette) which were ideal for whaling but not for fishing. The major fishing of the Makah was done on the lee sea for halibut.

THE IMPORTANCE OF FOOD RESOURCES FOR EACH INDIAN GROUP
(The number indicates order of importance)

Food Resources	Quinault	Queets	Quileute	Hoh	Ozette	Makah
1. Bluback Salmon	1					
2. Silver and King Salmon	2	1	1	1	6	7
3. Dog Salmon						11
4. Halibut					3	2
5. Steelhead		10	6			
6. Cod					11	4
7. Smelt	7	4	7			
8. Mollusk	5	9	8		7	5
9. Elk and Deer	3	2	2	2	9	10
10. Bear		3		10		
11. Whale	4		3	3	1	1
12. Fur Seal			7	7	5	6
13. Hair Seal			9	4	4	3
14. Sea Lion and Porpoise	9	8	10	8	8	8
15. Camas and Fern Roots	6	6	4	5		
16. Berries	8	5	5	6		9
17. Birds and Eggs	10	7	11	9	10	

After Singh, 1966, p. 48--as with nearly all ethnologists the importance of mollusks is underrated--partly because they relied on male information and partly because they ignored the archaeological record.

The senior author will confess at the outset that when he* was first retained by the Makah to serve as tribal anthropologist before the Indian Claims Commission that he took Indian and ethnologists' tales of whaling with more than six grains of salt. I could conceive of the Makah consuming stranded whale or even of their harpooning the rare blackfish, but I could not conceive of deep-sea expeditions in dugout canoes in successful pursuit of giant grey and sperm whales. However, in the course of the test excavation at the Makah site of Wa'atch on the open Pacific, I became a convert. The seven test pits all had layers of whale bone, particularly vertebrae, and the remains of harpoons and other whaling equipment were rapidly apparent. Now the evidence from Ozette is far more extensive and persuasive. No man lies to his garbage heap—the Makah were intensive whalers; and probably Singh was right, and their primary food source was the whale.

*To avoid confusion, first person singular refers to Taylor. First person plural refers to Bosch and Taylor.

Rudely jolted out of my preconceptions, and enlisting James Bosch, we made a study of available evidence, and the following, divided into three categories, is a brief encapsulation of what we found.

1. Makah Whaling Equipment
2. Whaling and the Spirit World
3. The Hunting of the Whale.

Makah Whaling Equipment

The Makah invariably used an eight man version of the "Nootka" or "Chinook" canoe for whaling. Generally, writers who have cut their ethnological teeth on the Lower Northwest Coast employ the term "Chinook Canoe," whereas those oriented to the Central Northwest Coast use the term "Nootka Canoe." They are referring to the same craft. The term Nootka would seem to be preferable because:

1. The best of those canoes were made on western Vancouver Island, and many were traded south.
2. The evidence suggests that this canoe originated amongst the Nootkan-speaking peoples.
3. The term "Chinook" is currently applied to a village, a tribe or sub-tribe, a language, a linguistic family, a jargon, a fish and a wind, which would seem ample nomenclatural diversity.

The Nootka canoe is distinguished from the sea-going "Northern" canoe used by the Haida, Tsimshian and Kwakiutl in several salient ways:

1. The Nootka canoe is vertical at the stern while the Northern canoe has an oblique stern.
2. The Nootka model has a sloping cutwater—the Northern is vertical.
3. The Nootka canoe was normally about 30 feet in length and only in exceptional cases reached 50 feet. The Northern canoes were sometimes over 60 feet in length.
4. The Northern canoe was usually more heavily ornamented.

The canoe was a dugout carved from a single large cedar with the exception of the stem and bow pieces which were separately carved and fitted to the craft.

There was a paucity of good cedar in Makah territory, and most of what there was was inaccessible and/or so located that it could not be rafted to the coast. The Makah, thus, were forced to rely on their Nootkan relatives on Vancouver Island. Sometimes they purchased finished canoes from them and sometimes cedar logs for canoe manufacture. The Makah also served as middlemen in trading Nootka canoes farther south.

On occasion the Makah made their canoes from cedar drift logs (Singh, 1966, p. 34). Daugherty thinks it likely that, in the more distant past, the Makah rafted cedar down the Ozette River from the banks of Lake Ozette at a time when the sea level was higher (Taylor, 1974, p. 48).

In common with several other Northwest Coast tribes, the Makah adopted the sail after the coming of the white man. The Makah whaling canoe of the post-contact period was powered by a single square sail something over 3 feet wide and over 5 feet long. The sail was made of woven cedar bark and had as a

mast a pole inserted into a socket between the forward thwarts of the canoe. A halyard of twisted sea-lion gut was used for hoisting the sail.

Prior to the development of the sail, the paddle was the sole power source for the canoe, and even after sail appeared it remained the means of maneuver in actual pursuit, harpooning and following the whale. Also, since a single square rigged sail did not allow tacking into the wind, the paddle was frequently the primary energy source on a whaling voyage until the Makah abandoned canoes for inboard engine-powered craft. The paddle was carved from yew or maple with a thin flexible blade and was lanceolate in shape.

The harpoon gear included a shaft, a projectile point or head, a lanyard, floats, sections of harpoon line and heavier line to tow the whale to shore. The harpoon shaft tapers to a point at either end and is usually 14 to 18 feet in length. It is made of two yew sections cut diagonally at the center to fit together and bound at the jointure with braided cedar-bark fiber. The harpoon head is made of two pieces of elk-antler or bone so closely fitted together that they appear to be one piece. The cutting edge was, in the pre-contact period, made from mussel shell; later a copper blade was used, and, finally, steel.

The lanyard was made of whale sinew and was attached to the base of the head by tying strands of sinew around the base and then wrapping the base in cherry-bark cord. A socket in the base of the head is designed for a snug fit of the shaft end (for a detailed diagram of the harpoon head parts see Waterman, 1920, p. 33). There was a long string of tackle attached by way of the harpoon head and the lanyard to the harpoon. A Nootka tackle arrangement consisted of 4 fathoms of sinew line attached to the harpoon head. Then there was a float made of sealskin and designed both to retard the whale after the harpoon struck and before the whale died and to keep the carcass of the whale afloat after it died. Attached to this first sealskin float was 8 fathoms of 1-1/2 inch plaited cedar line, then another sealskin float, followed by 20 fathoms of 3/4-inch cedar line, then another float attached to which was 30 fathoms of 1/2 inch line and finally another float. All of this lay neatly coiled in the prow of the canoe until it was paid out after the whale had been harpooned. Additionally, some twenty more floats, attached to harpoons and shorter lances were utilized to keep the whale afloat after its death. (By all odds the best description of Makah whaling equipment is given in Waterman, 1920, but Olson, 1927, Curtis, 1913, and Swan, 1870, should also be consulted.)

Whaling and the Spirit World

Like the Eskimo, the Makah were quite clear that the actual hunting of the whale was, while imprtant, a secondary matter. What guaranteed the success of a whaling expedition was the propitiation of the spirits through a number of rituals, coupled with vigorous observation of an intricate set of taboos. To begin with, the whaler—that is the harpooner—had to be in a singular position of rapport with the spirit world before he could even consider whaling. He had to possess something between what the anthropologists call "mana" and the Coast Salish call "toumanous."

When a whaling expedition had been decided, the leader, who in nearly all cases would also be the harpooner and would also be drawn from the upper class, began a series of observances in the winter months before the spring hunt. (The Makah hunted the whale in May and June, the Quileute in June and July and the Quinault from the end of June through July. Singh, 1977, pp. 65-67. This shift to a later season southward suggests an adaptation to the whales' migration patterns.) Early every morning during the waxing of the moon during the winter the

harpooner bathed in a freshwater pond or lake, scrubbing himself raw with hemlock twigs. Then he dived, staying under water as long as possible, and came up spouting in imitation of the whale. However, his movements must be calm and slow "so that the whale will act in the same way" (Curtis, quoted in Waterman, 1920, p. 39).

The whaler's wife sometimes accompanied the whaler upon these ablutionary devotions. When she did, she tied a rope around his waist, and the whaler then walked, with slow undulations, around her, singing whaling songs. During this performance the wife repeated again and again, "This is the way the whale will act." At night the harpooner prayed in whispers, sometimes to Sun or Daylight, sometimes directly to whale, as in this Clayoquot version:

> Whale I want you to come near me, so that I will get hold of your heart and deceive it, so that I will have strong legs and not be trembling and excited when the whale comes and I spear him. Whale you must not run out to sea when I spear you. Whale if I spear you, I want my spear to strike your heart. Harpoon when I use you, I want you to go to the heart of the whale. Whale, when I spear at you and miss you, I want you to take hold of my spear with your hands. Whale do not break my canoe, for I am going to be good to you. I am going to put eagle-down and cedar bark in your back. (Curtis, in Waterman, 1920, p. 39).

Finally, a harpooner used human corpse or skeletons in his ceremonial baths. The corpse or skeleton would be tied to the harpooner's back, and he would swim around the pond with this burden, spouting and diving in imitation of a whale. Fresh corpses were said to be the most efficacious, and according to some informants, a small boy might be killed for this purpose in aboriginal times. (In 1955 I encountered a tale of one Ozette harpooner so skilled in necromancy that he used a whaling crew of resurrected corpses.)

In addition to a variety of ritual performances, the harpooner observed a number of taboos. The whaler's wife assisted him in ceremonials, but throughout the winter before the hunt he avoided all sexual contact with her, and he must avoid even thinking of sexual matters. Neither a harpooner nor his family might eat any whale meat until after he had slain six whales (four among the Quinault and Quileute. Singh, 1966, p. 44).

The whaler's wife had a whole host of taboos to observe as well as sexual abstinence. After the whaling expedition departed, she lay on her bed unmoving until the following afternoon (if she moved about, the whale would be hard to catch), and she must not drink anything lest the whale be lean (Ganther, 1942, pp. 67 and 68).

The Hunting of the Whale

In the late winter or early spring the harpooner notified the men whom he had selected for his crew. Evidently, these positions were so sought after and prestigious that to decline such an appointment was unheard of unless the appointee knew himself to be unclean. Once notified, the eight-man crew also underwent ritual purification.

No less than seven species of whale have been identified by ethnographic informants as objects of the chase in Makah hunts:

1. Killer whale or blackfish (Orca)
2. California grey whale (Rachianectes glaucus)
3. Sperm whale (Rhyseter macrocephalus and Ziphius carrotris)
4. Right whale (Balaenoptera artifera)
5. Humpback whale (Megaptera veisibilis)
6. Finback whale (Balaenoptera davidsoni)
7. Sulphur-bottom whale (Balenoptera sulfurea)

What little archaeological evidence we have would indicate that the California grey was by some odds the most commonly taken. When the massive excavations now in progress at Ozette have been reduced to print, we should have a much clearer picture of the relative importance of these species to the Makah economy.

Normally, the Makah hunted whales with two or more canoes in company so that they might assist one another and, at need, recover survivors of a canoe crushed by a whale's tail. The whaling expedition usually stayed within sight of land. Occasionally, pursuit of a whale could take them further out to sea. More frequently, the canoe would be towed far out to sea after the whale was harpooned with the accompanying canoes trying their best to keep up. The longest whaling voyages reported by informants lasted about two weeks.

The canoe's crew consisted of the harpooner in the bow, the steersman in the stern and six paddlers. However, two of these paddlers had specialized tasks also. The man immediately aft of the harpooner needed to have extraordinarily quick reflexes and the moment the harpooner had struck the whale it was his task to throw over a float and bend it to the line. One of the paddlers needed to be a diver of great endurance whose task it was to fasten a tow line through the lower and upper jaws of the whale after it was dispatched. This not only served as a tow line but also closed the cetacean's mouth and, according to the Makah, kept the body from becoming water-logged.

As the canoe approached a whale, the harpooner stood upright in the bow, keeping his weight well forward. The steersman attempted to put the canoe upon the whale's back just before the harpooner lunged. Indeed, my informants told me that a skilled and fearless harpooner preferred to lunge into the harpoon drive with his left foot in the bow and his right resting on the whale. (I cannot find this posture mentioned in any of the ethnographic literature.)

The harpooner tried to strike the whale just as his head became submerged as it turned to go down. If the whale was struck while its tail was in the air, it was apt to knock the canoe into pieces. (If this happened, the crew used the sealskin floats as life preservers until they could be rescued by the accompanying craft. As the harpooner struck,

> he swings the harpoon up over his head, turning his body toward the right side, the palms of both hands, in which he grasps the shaft, turned outward. This does not seem to be the natural position for a lunge, until it is tried, experimentally. Ths position as a matter of fact gives much greater power, control, and freedom of effort, and enables the hunter to strike downward with all his might, and yet recover his balance quickly. (Waterman, 1920, p. 43)

The harpooner had to take great care to stand clear of the line which would zip out of the canoe as the stricken whale dived—if his foot became entangled, he might be dragged to his death. It was in the course of being towed by a struck

whale that the canoe might be towed far from land. Every time the whale surfaced, it was harpooned or lanced again to implant additional floats to retard its flight and ensure buoyancy when it died.

In a successful whale hunt, the animal would eventually be incapable of diving more than a few feet because of the retardant effect of the floats. (The actual cause of death of the whale is usually drowning and as many as twenty buoys may be required to keep it afloat.) Whilst the dead whale was being towed shoreward, songs were sung to it promising gala treatment upon beaching and assuring the whale that this was the fate it had been searchng all over earth to find. Once beached, the whale was first decorated with eagle down and feathers. The whale was, after a period of ripening, cut up by the harpooner and was presented to the members of the crew, with lesser portions to other members of the village in a form of potlatch. To the harpooner was reserved the hump section, which is richest in oil. However, the harpooner might not partake of his prize unless he had previously killed five whales, nor might any member of his immediate family. The harpooner, therefore, would sell or give away his hump section in most cases (Swan, 1870, pp. 21-22).

According to my informants, the average life of a harpooner was five years, and, since even an highly successful one would not be likely to kill so many as five whales in his first couple of novitiate years (four in a season was a record), he had only a brief period to enjoy much material benefit. As Gunther (1942, p. 69) says,

> Thus the whaler's dangerous undertaking yields him little but enhanced prestige and high esteem in his community. He and his wife are hemmed in by rigid taboos, but all success in this society involves such hardships. The spectacular character of the whaler's occupation lifts him above his fellows and makes him the target of suspicion and the object of envy—the price society usually demands for success.

Three of four whales would be sufficient to sustain a Makah village for the year, and the Makah normally had a surplus of whale meat and oil to trade down the coast and up the Columbia. After the advent of the white man a thriving trade was carried on in whale oil. Swan estimates that by 1850 the Makah were producing 30,000 gallons of whale oil annually and that most of this was sold to European vessels (Taylor, 1974, p. 68).

By 1860 the Makah were doing far less whaling and in the last decades of the nineteenth century had almost abandoned whaling for the then more profitable seal hunting (Swan, 1870, p. 22; Waterman, 1920, p. 48). From the last decade of the 19th century until 1920s there was a resurgence of whaling (Waterman, 1920, p. 48; Gunther, 1942, passim). For the last two generations the Makah have been fisherfolk though the whale lingers in their rich folklore.

NOTE

[1]The senior author wishes to express his gratitude to his principal Makah informants of the mid 1950s Henry Markistum and Pat Wilkie and to his graduate assistant Mrs. Julia Owens. For more recent assistance he is indebted to Dr. Caroll Riley, Professor of Anthropology, Southern Illinois University, his graduate assistant Mr. Joseph Cuco, and his student assistant Mr. Kenneth Pratt. For aid in manuscript preparation he would like to thank the Bureau of Faculty Research and in particular Ms. Geraldine Walker.

SELECTED BIBLIOGRAPHY

Colson, Elizabeth. 1953. The Makah Indians. University of Minnesota Press, University of Manchester Press.

Curtis, Edward S. 1913. The North American Indian, Vol. IX. Norwood Massachusetts.

Gunther, Erna. 1942. "Reminiscences of a Whaler's Wife." Pacific Northwest Quarterly, 32:65-69. Seattle.

Irvine, Albert. 1921. "How the Makah Obtained Possession of Cape Flattery." Luke Markistum, tr., Indian Notes and Monographs, Miscellaneous Series, No. 6. New York: Museum of the American Indian, Heye Foundation.

Kirk, Ruth with R. D. Daugherty. 1978. Exploring Washington Archaeology. Seattle and London: University of Washington Press.

Olson, Ronald L. 1927. Adze, Canoe and House Types of the Northwest Coast. Seattle: University of Washington Press.

_____. 1936. The Quinault Indians. Seattle: University of Washington Press.

Reagen, A. B. 1917. "Archaeological Notes of Western Washington and Adjacent British Columbia." Proceedings of the California Academy of Science, 4:8:1.

Riley, C. L. 1968. "The Makah Indians: A Study of Political and Economic Organization." Ethnohistory 15:1. Buffalo: State University of New York.

Singh, Ram Raj Prasad. 1966. Aboriginal Economic System of the Olympic Peninsula Indians, Western Washington. Sacramento: Sacramento State College.

Swan, James G. 1870. "The Indians of Cape Flattery." Smithsonian Contributions to Knowledge 220. Philadelphia.

Taylor, Herbert C. (Jr.) 1974. Anthropological Investigation of the Makah Indians. Coast Salish and Western Washington Indians III. American Indian Ethnohistory: Indians of the Northwest. New York and London: Garland Publishing.

_____, 1978. Incident at "La Punta de Los Martires." Pacific Northwest Themes: Historical Essays in Honor of Keith A. Murray. James W. Scott, editor. Bellingham, Washington: Western Washington University.

Waterman, T. T. 1920. "The Whaling Equipment of the Makah Indians," Vol. I, No. 1. University of Washington Publications in Political and Social Science. Seattle.

FLORA OF POWERLINE RIGHTS-OF WAY WHATCOM COUNTY, WASHINGTON

Theodore R. Boss

Powerline rights-of-way form a sharp discontinuity in the regional vegetation of northwestern Washington, yielding an open habitat and an edge effect suitable for a ruderal flora. Following van der Pijl (1972), a ruderal flora is defined as being composed of native and adventive plants found to a large degree in habitats created by human activity. The powerline flora is further modified by seeding efforts and herbicide treatments. These maintenance procedues provide for a low stature vegetation along the rights-of-way no matter what the pre-existing vegetation was. Although the vegetational features of rights-of-way remain the same, plant species, which together comprise the flora, may change as the powerline traverses dissimilar environments. In this paper the distribution of plant species along a powerline right-of-way complex in Whatcom County will be discussed in relation to elevation, past and present land use patterns, seeding efforts, and herbicide treatments.

Vegetation History of Whatcom County

The natural vegetation of western Whatcom County, before settlement, was dominated by coniferous tree species. Franklin and Dyrness (1973) place the western part of the county within the Puget Sound Area of the Western Hemlock Zone. Important species that comprise this area are Douglas fir, western hemlock, western red cedar, red alder, big leaf maple, vine maple, and sword fern.

The natural vegetation of western Whatcom County has been radically altered in the last 150 years. In low-lying regions with gentle topography land use has changed from logging, to agriculture, and in many places today to urban expansion. Such activities have kept the land in a state of continual disturbance, resulting in the proliferation of habitats apt for the establishment and growth of ruderal species. In higher elevations where agriculture or urbanization are not found the natural vegetation has been modified, in many cases, into a managed coniferous forest. However, many of the species in these forests are the same found in the natural vegetation. Even though the land has been manipulated for forest products, disturbance has not been as frequent or as dramatic as that which has and is occurring in the lower elevations.

Muenscher (1930) studied the ruderal flora of Whatcom County. He listed 96 plant species as ruderals or, in his terminology, weeds. Of these 96 species, five were recorded as native and the rest as adventive. Among these adventive species 41 were established before 1905, 20 between 1905 and 1910, 10 from 1910-1919, and 17 species from 1920-1930. Twenty-two more species listed by Muenscher (1941) may be regarded as ruderals.

Rights-of-way History

The Bonneville Power Administration constructed a 125 Kv line in Whatcom County in 1954. This line ran in a northwest-southeast direction between the community of Custer in Whatcom County and the city of Monroe in Snohomish County. In 1966 a 250 Kv line was completed adjacent to the 125 Kv line. Construction of a 500 Kv line next to the two existing lines began in the summer of 1973, and was completed in 1976. For all three lines the regional forested vegetation was removed. Although some species of the regional vegetation persisted along the rights-of-way, generally they declined in abundance and vigor. Procedures that have followed the clearing of the rights-of-way have maintained an open habitat in which ruderal species have spread, where once a closed forest canopy of the reginal vegetation occurred.

Although no information concerning herbicide treatments has been obtained for the 1976 line, Bonneville Power Administration records show that the right-of-way complex was sprayed with 2-4,D between 1966 and 1972. Several other herbicides were tested at specific sites along the rights-of-way. All herbicides were selectively applied at the base of fast tall-growing species such as red alder, big leaf maple, and conifers. The 1954-1966 right-of-way was also seeded with a grass-clover mixture which consisted of ruderal species, many of them adventive.

Methodology

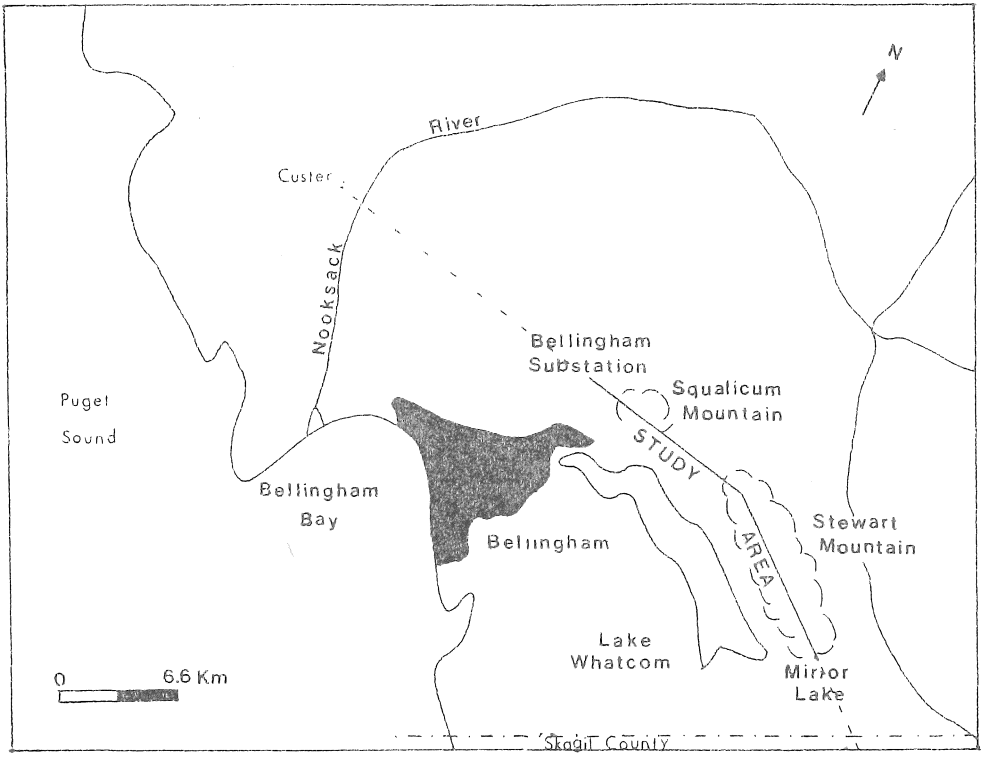
To sample the flora along the powerline rights-of-way, nine sample sites were established along a 21 Km segment of the Monroe-Custer lines in 1973. The segment chosen for study was bounded on the northwest by the Bellingham Substation and on the southeast by Mirror Lake (Fig. 1). This segment was selected because the lines intersect pastureland and woodland within the urban-rural fringe of Bellingham, pass through commercial forestland, cross various slopes with different aspects, and range from 59 meters to 864 meters in elevation. Each sample stand was 50 meters in width, with the length being adjusted so that the ends were located 15 meters within the regional vegetation on either side of the rights-of-way. This ensured that all lines of the Monroe-Custer Complex were included in each stand. By this procedure, those species composing the regional vegetation where the 500 Kv line was later placed, were noted in 1973 before construction began. The nine stands were visited at five-week intervals between May, 1973 and May, 1974; and from June, 1975 through June, 1976.

All species within the nine stands were noted at each sampling interval, and the nomenclature of Hitchcock and Cronquist (1973) followed.

Results and Discussion

Vegetation of the 1954 and 1966 Rights-of-way

A total of 149 species were identified (Appendix I). Eighty-seven species were considered to be native to northwestern Washington, 57 to be adventives, and five species of circumpolar distribution (Hitchcock and Cronquist, 1973). Thirty-four of the native species were ruderals as were all of the adventive and circumpolar species. The 52 other native species were considered as regional species (Boss, 1976).



Elevation, surrounding land use patterns, and seeding efforts have an effect on the over-all distribution of species along the rights-of-way.

With an increase in elevation, species numbers decreased from 114 in the low elevations (Stands 1-3) to 51 in the highest elevations (Stands 6-7). Adventive species dropped out as elevation increased. Comprising 47% of the flora in the lower elevations they comprised only 35% in the higher elevations. Because most adventive species are introduced at low elevations, and are adapted to more moderate climatic conditions, it seems highly plausible that as elevation increases fewer adventive species are well adapted to the change in climatic conditions. Hence the decrease of adventive species at the higher elevations. Frenkel (1974), likewise, found a decrease in the adventive flora with an increase in elevation in his study of vegetation along the Everitt Memorial Highway, Mt. Shasta, California. Generally regional species were found more often along the rights-of-way in the higher elevations, while the ruderals, especially the adventive species, prevailed in the lower elevations.

Surrounding land use patterns also influence the number of ruderal and/or adventive species found along the powerline rights-of-way. Due to the continual disturbance in the lowlands, many habitats have been created in which ruderal species have been able to establish themselves. Ruderal species therefore have been in close proximity to the rights-of-way, and have been able to take advantage of the newly-disturbed ground during and after construction of the powerlines. In the higher elevations, with disturbance not being as dramatic as in the low elevations, and with much of the vegetation surrounding the rights-of-way

being dominated by coniferous species, ruderal species have not been as successful in invading the rights-of-way. The deep shade of the reginal forest is a detriment to the establishment of ruderal species, especially adventives, for these species are shade intolerant. Therefore, habitats suitable for the establishment of ruderal species have not been as prolific in the higher elevations as in the lowlands.

The seeding efforts of the Bonnevile Power Administration has also had an effect on the rights-of-way vegetation. Most of the species used in the seeding effort were found in all nine stands. Since all these species are ruderals, and the majority adventives, the number and percentage of adventives, and ruderals as a whole, might have been even less than now found in the higher elevations.

500 Kv Line

The pre-right-of-way vegetation in the lowlands was composed of such tree species as red alder, big leaf maple, Douglas fir, flowering dogwood, black cottonwood, and grand fir. The shrub layer was comprised of Indian plum, snowberry, vine maple, salmonberry, ocean spray, red flowering current, and red elderberry. Herbs and ferns found within the regional vegetation were bleeding heart, fringecup, spring beauty, stinging nettle, wake robin, sword fern and bracken fern. In higher elevations the vegetation was either dense stands of Douglas fir, western hemlock, and western red cedar with few shrub or herb species; or a "parkland." Within the parkland shrubs and herbs found were salmonberry, red huckleberry, oval-leafed huckleberry, salal, bicolored lupine, foam flower, star flower, twin flower, and foxglove. The majority of the species found within the parkland were not considered as ruderal species.

Within a week after the initial clearing of the land for the 500 Kv line, species found germinating in the lower elevation sites were stinging nettle, spring beauty, bedstraw, mouse-eared chickweed, western bittercress, shepard's purse, and black nightshade. Five weeks after the removal of the regional forested vegetation additional species found along the 500 Kv lines were velvet grass, Kentucky blue grass, wild rye grass, tansey, Canadian thistle, St. John's wort, and white clover. All the species found within the first five weeks along the 500 Kv right-of-way are ruderals. In May, 1974, and later in 1975 and 1976 more ruderal species were found in the low elevation sites of the 500 Kv line. It may be presumed that many of these species had germinated either from a seed bank or from rhizomes that had been established within the soil before the clearing of the land instad of invading the right-of-way after clearing.

In the higher elevations species found immediately after the removal of the regional vegetation were those individuals of the regional species that had escaped removal by the construction operation. Even in the spring of 1974, nine months after the initial clearing of the land very few species were found germinating along the 500 Kv line. Species recorded were red alder, mouse-eared chickweed, foxglove, wood groundsel, and common groundsel. When the field research ended in June, 1976, several sites in the higher elevations were still basically void of plants.

All the species found on the 500 Kv right-of-way were also found on the adjacent earlier rights-of-way.

Conclusion

When man alters the natural vegetation of northwestern Washington he ensures that a ruderal flora will be introduced into the landscape. These ruderal

species will perpetuate themselves if the land is maintained in a disturbed condition. Such conditions are found along powerline rights-of-way. Many of the ruderal species may be adventives depending on environmental conditions such as found along elevation gradients, historical factors as seen in changing land use patterns, and maintenance procedures like seeding.

Bibliography

Boss, T. R. 1976. Vegetation of the Monroe-Custer Line Complex, Whatcom County, Washington: A Case Study. A report to the Bonnevile Power Administration 106 pp.

Franklin, J. and T. Dryness. 1973. The Vegetation of Oregon and Washington. Portland, Oregon. U.S.D.A. PNW Forest and Range Experiment Sttion.

Frenkel, R. E. 1974. "Floristic changes along the Everitt Memorial Highway, Mt. Shasta, California." The Wasmann Journal of Biology 32 (1): 105-136.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. Seattle: University of Washington Press.

Muenscher, W. C. 1930. "Some changes in the weed flora of Whatcom County, Washington." Torreya 30: 130-134.

Muenscher, W. C. 1941. The Flora of Whatcom County, State of Washington. Ithaca, New York: Published by author.

van der Pijl, L. 1972. Principles of Dispersal in Higher Plants. 2nd Ed. New York: Springer-Verlag.

APPENDIX I
SPECIES LIST

Scientific Name	Common Name	Stand # 1	2	3	4	5	6	7	8	9
Trees										
Abies amabilis*	Pacific Silver Fir						+			
Acer macrophyllum*	Big Leaf Maple	+	+	+	+					
Alnus rubra**	Red Alder	+	+	+	+	+	+		+	+
Pseudotsuga menziesii*	Douglas Fir	+	+	+	+	+	+	+	+	+
Salix scoulerina**	Scouler's Willow			+				+		
Thuja plicata*	Western Red Cedar				+	+		+		+
Tsuga heterophylla*	Western Hemlock				+	+	+	+		
Shrubs										
Berberis aquifolium*	Tall Oregon Grape	+	+	+	+	+	+		+	+
Cytisus scoparius**	Scotch Broom	+		+	+					
Gaultheria shallon*	Salal					+	+		+	+
Holodiscus discolor*	Ocean Spray	+	+	+	+	+			+	
Osmaronia cerasiformia*	Indian Plum	+		+						
Physiocarpos capitatus*	Pacific Ninebark	+								
Ribes lacustre*	Prickly Current		+	+	+			+	+	+
Ribes sanguineum*	Red Flowering Current		+	+	+	+	+	+	+	
Rosa nutkana**	Nootka Rose			+						
Rubus discolor***	Himalayan Blackberry	+		+						
Rubus laciniatus***	Evergreen Blackberry	+		+	+	+	+		+	+
Rubus parviflora**	Thimbleberry	+	+	+	+	+			+	
Rubus spectabilis**	Salmonberry	+			+		+	+	+	
Rubus ursinus**	Pacific Blackberry	+	+	+	+	+	+	+	+	+
Sambucus racemosa*	Red Elderberry		+	+					+	
Spirea douglasii*	Douglas' Spirea	+								
Symphoricarpos albus*	Snowberry	+	+	+						
Vaccinium ovalifolium*	Oval-leaved Huckleberry							+		
Vaccinium parvifolium*	Red Huckleberry					+	+	+		
Graminoids										
Agropyron repens***	Quack Grass	+	+	+						
Agrostis alba***	Redtop	+		+				+	+	+
Aira caryophylla***	Silver Hairgrass	+	+	+	+	+	+	+	+	+
Anthoxanthum odoratum***	Sweet Vernalgrass							+		+
Avena fatua***	Wild Oat				+					
Bromus mollis***	Soft Cheat	+	+	+						
Bromus sitchensis**	Alaska Brome					+			+	+
Carex leporina***	Hare Sedge	+		+			+		+	
Carex muricata	Muricate Sedge				+					
Carex sitchensis*	Sitka Sedge	+								
Carex stipata*	Sawbeak Sedge	+								
Dactylis glomerata***	Orchard Grass	+	+	+	+	+	+	+	+	+
Elymus glaucus**	Wild Rye Grass	+	+	+	+	+	+	+	+	+

Scientific Name	Common Name	Stand # 1	2	3	4	5	6	7	8	9
Festuca rubra***	Red Fescue	+	+	+						
Holcus lanatus***	Velvet Grass	+	+	+	+	+	+	+	+	+
Juncus effusus*	Soft Rush	+	+							
Juncus tenuis*	Slender Rush			+						+
Lolium perenne***	English Ryegrass	+	+	+	+		+	+	+	+
Luzula campestris*	Field Woodrush					+	+			
Luzula parviflora*	Small Flowered Wood-rush						+	+		
Phalaris arundinacea***	Canary Reedgrass	+			+					+
Phleum pratense***	Timothy	+	+	+	+					+
Poa compressa	Canadian Bluegrass	+								
Poa pratensis***	Kentucky Bluegrass	+	+	+	+	+		+	+	+
Scirpus microcarpus*	Small Fruited Bullrush	+								
Trisetum cernuum**	Wooding Trisetum					+				
Herbs										
Achlys triphylla*	Vanilla leaf					+				
Alisma plantago-aquatica*	American Water Plantain	+								
Anaphalis margaritacea**	Pearling Everlasting	+	+	+	+	+	+	+	+	+
Arabis glabra***	Tower Mustard			+						
Artemesia suksdorfii*	Coastal Mugwort				+	+	+	+		
Aster eatonii**	Eaton's Aster	+								
Aster subspicatus**	Douglas' Aster	+		+	+					+
Blechnum spicant*	Deer Fern				+	+	+	+	+	
Brassica nigrum***	Black Mustard				+					
Campanula scouleri*	Scouler's Bluebell								+	
Capsella bursa-pastoris***	Shepard's Purse	+	+	+	+	+				
Cardamine oligosperma**	Bittercress	+	+	+	+	+	+		+	+
Centaurium umbellatum***	Common Centuary	+		+	+					+
Centurea diffusa***	Tumble Knapweed	+	+	+	+	+			+	
Chenopodium album***	Lambsquarter	+	+							
Chrysanthemum leucanthemum***	Ox-eyed Daisy		+	+	+	+		+	+	+
Cirsium arvense***	Canadian Thistle	+	+	+	+	+	+	+	+	+
Cirsium edule**	Indian Thistle				+					
Cirsium vulgare***	Bull Thistle	+	+	+	+	+			+	+
Cornus canadensis*	Canadian Dogwood							+		
Crepis capillaris***	Smooth Hawksbeak	+	+	+	+	+			+	+
Descurinia pinnata**	Tansey Mustard	+		+					+	
Dicentra formosa*	Bleeding Heart	+	+	+	+	+		+	+	
Digitalis purpurea***	Foxglove			+	+	+	+	+	+	+
Disporum hookeri*	Hooker Fairybell								+	
Draba verna**	Spring Whitlow Grass									+
Dryopteris filix-mas*	Wood Fern	+								
Epilobium angustifolium**	Fireweed	+	+		+	+	+	+	+	+
Epilobium watsonii**	Watson's Willow Herb	+	+	+	+					+

Scientific Name	Common Name	Stand # 1	2	3	4	5	6	7	8	9
Erigeron annuus**	Annual Fleabane	+		+	+					+
Equisetum arvense**	Field Horsetail	+			+				+	
Euphrasia arctica**	Euphrasia	+								
Fragaria vesca*	Woods Strawberry						+			
Galium aparine@	Bedstraw	+	+	+	+	+	+		+	+
Geranium dissectum***	Cutleaf Geranium	+	+	+	+					+
Geranium molle***	Dovefoot Geranium		+							
Geum macrophyllum*	Large-leaved Avens	+		+	+				+	
Hieracium albiflorum*	White Flowered Hawkweed					+	+			
Hieracium aurantiacum@	Orange Hawkweed	+								
Hypericum perforatum***	St. John's Wort	+	+	+		+			+	+
Hypochaeris radicata***	Hairy Cats Ear	+		+	+	+				+
Lactuca biennis***	Blue Lettuce	+								
Lactuca muralis***	Wall Lettuce	+	+	+	+	+	+	+	+	+
Lactuca serriola***	Prickley Lettuce	+								
Lilium columbianum*	Tiger Lily			+					+	+
Linnaea borealis*	Western Twin Flower									+
Lonicera ciliosa*	Orange Honeysuckle	+		+						
Lupinus bicolor**	Two Color Lupine						+			
Madia sativa**	Coast Tarweed					+				
Matricaria matricariodes**	Pineapple Weed	+	+	+	+	+			+	+
Melilotus alba***	White Sweed Clover	+								
Mentha piperita**	Peppermint	+								+
Mimulus guttatus*	Yellow Monkey Flower	+								
Montia parviflora**	Springbeauty	+	+	+	+				+	+
Myosotis laxa@	Forget-me-not	+	+	+	+					
Oenanthe sarmentosa**	Water Parsley	+								
Parentucellia viscosa***	Yellow Weed	+	+							
Petasites frigidus*	Sweet Coltsfoot					+				
Penstomen serralutus*	Coast Penstomen					+				
Plantago lanceolata***	Ribgrass	+	+	+	+	+			+	+
Plantago major***	Common Plantain	+		+					+	
Plectritus macrocera*	White Plectritis		+							
Polystichum munitum*	Sword Fern	+	+	+	+	+	+	+	+	+
Prunella vulgaris**	Self Heal	+	+	+	+					+
Pteridium aquilinum**	Bracken Fern	+	+	+	+	+	+	+	+	+
Ranunculus acris***	Tall Buttercup	+	+	+	+				+	+
Ranunculus occidentalis**	Western Buttercup				+	+				
Ranunculus repens**	Creeping Buttercup	+								
Rumex acetosella***	Sheep Sorrel	+	+	+	+	+	+	+	+	+
Rumex crispus***	Curly Dock	+	+	+	+					+
Scutellaria lateriflora*	Mad Dog Skullcap	+								
Senecio sylvaticus***	Wood Groundsel			+						
Senecio vulgaris***	Common Groundsel	+	+	+	+	+				+
Silene cucubalanus***	Bladder Catchfly	+		+						

Scientific Name	Common Name	Stand # 1	2	3	4	5	6	7	8	9
Smilacina racemosa*	False Solomon Seal		+	+						
Solidago canadensis**	Canadian Goldenrod		+	+			+	+		
Solanum nigrum***	Black Nightshade	+	+							
Sonchus arvense***	Perennial Sowthistle	+		+	+					+
Sonchus oleraceus***	Common Sowthistle	+	+	+	+					
Stachys cooleyae*	Cooley's Hedgenettle	+		+						
Tanacetum vulgare***	Tansey	+	+	+	+			+		
Taraxacum officinale***	Dandelion	+	+	+	+		+		+	+
Tellima grandiflora*	Fringecup	+	+	+	+				+	
Tiarella trifoliata*	Foamflower						+			
Trientalis latifolia*	Western Starflower					+			+	+
Trifolium dubium***	Least Hopclover	+	+	+	+					+
Trifolium pratense***	Red Clover	+	+	+	+					
Trifolium procumbens***	Hopclover	+	+	+						
Trifolium repens***	White Clover	+	+	+	+					+
Typha latifolia**	Cattail	+								
Urtica dioca**	Stinging Nettle	+	+	+	+				+	+
Verbascum thapsus***	Common Mullein			+	+	+	+	+	+	+
Veronica americana**	American Brooklime	+						+	+	+
Veronica seryphyllifolia**	Thyme-leaved Speedwell				+					
Vicia cracca***	Bird Vetch	+	+	+	+					
Vicia tetrasperma***	Slender Vetch	+		+	+					
Viola sempervirens*	Evergreen Violet						+	+	+	+

*Native, regional species
**Native, ruderal species
***Adventive, ruderal species
@ Circumpolar species

Figure 3. Department Chairman

PRECIPITATION, PERCOLATION TIME AND DISSOLVED OXYGEN RHYTHMICITY IN A DUG WELL IN WHATCOM COUNTY, WASHINGTON

Charles J. Flora

INTRODUCTION

Much has been written concerning dissolved oxygen and its behavior in surface waters (e.g., Hutchinson , 1957; Richards, 1957; etc.) but the writer has been unable to find such for water under the ground. While the topic is of theoretical interest, dissolved oxygen fluctuation in groundwater should be of some practical significance in establishing a base against which to assess change and in understanding certain chemical and biological cycles. Thus, the behavior of iron synthesizing bacteria, a major problem in Whatcom County groundwater, is probably influenced by the dissolved oxygen concentration (Jones, 1975).

On February 22, 1976, the writer began weekly sampling of the surface water from a dug well located in northern Whatcom County (near Everson), Washington (Figure 1). It was dug in about 1947 (Wiemers, 1979) and from ground level is 34'10" to the pea gravel bottom (see Figure 2). The shaft is 36 inches in diameter and encased in concrete rings each 36 inches high. Originally used for irrigation, it was "planked over" within a pumphouse and converted to domestic use in 1971.

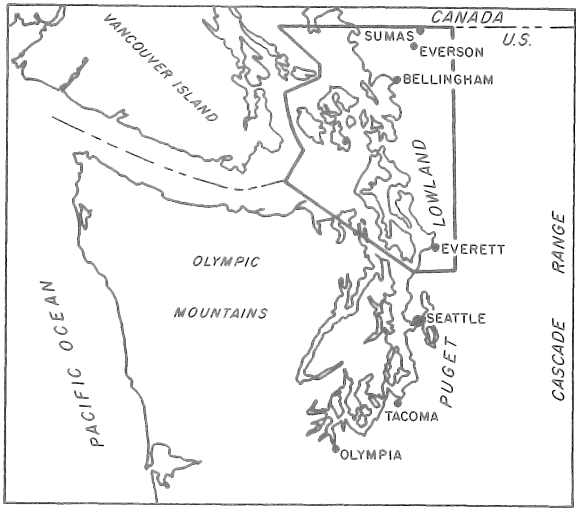


Figure 1. Map showing the Puget Lowland. This study well is very close to Everson, Washington. (from Easterbrook, 1979).

The area occupied by the well is part of the Puget Lowland (Figure 1) lying in the Puget Trough west of the Cascade Mountain Range (Easterbrook, 1969). This is an "elongate structural trough modified by Pleistocene deposition and erosion" (op. cit.). The area has felt the effects of glaciation on several occasions, most recently the Sumas Stade (a part of the Fraser glaciation) about 10,000 years ago when the southerly advancing ice stopped near the international boundary about five miles north of the well. The well is situated on a terrace of glacial outwash material produced by the Sumas Stade that covers much of northern Whatcom County (Armstrong et al, 1965). This terrace consists of mixed sand, gravel and cobble in the area of the well. The Nooksack River slices through the terrace east and north of the well. The outwash material is highly permeable (Easterbrook, 1973) at the well site, and in summer a two-week period without rain requires that crops be irrigated.

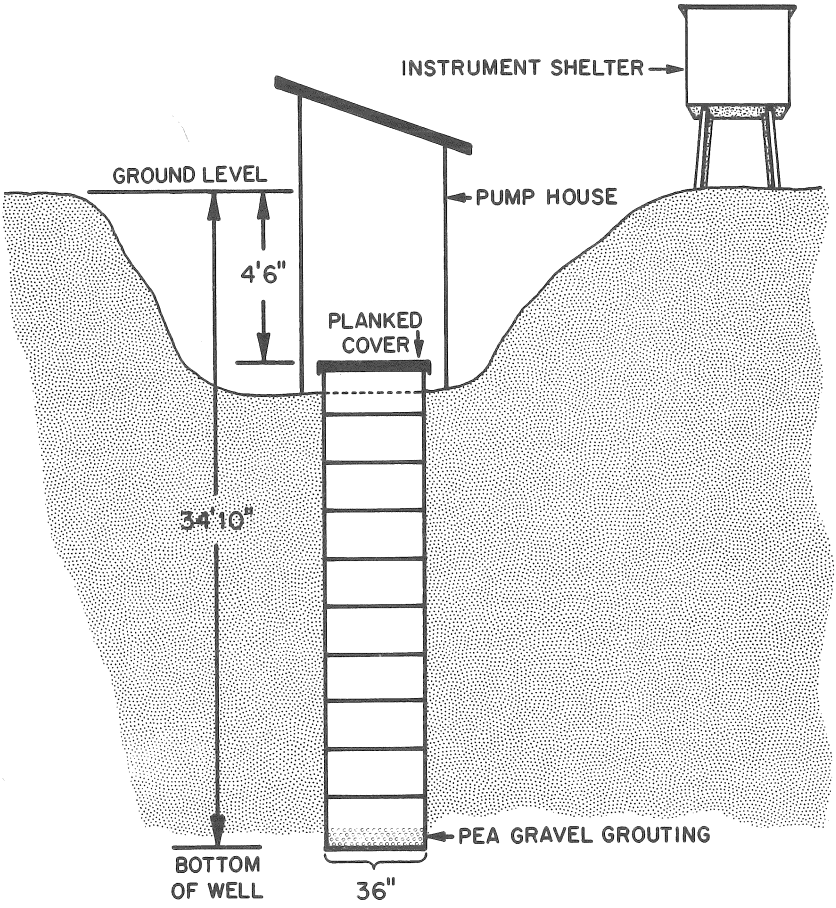


Figure 2. Lateral exposure of study well.

About one-half mile northeast of the well is Green Lake, a very small body of water with peat beneath and around it. Less than one-quarter mile southeast is a peat bog which is sometimes flooded during the heavy rains of winter.

At this writing, samples have been taken from the well surface and analyzed for dissolved oxygen on a weekly basis for four years. On a few occasions vertical samples were collected and some data were gathered from neighboring wells. Throughout, the Strickland and Parsons (1972) modification of the Winkler method was used for D.O. analyses. During the last three years, a duplicate sample was run by another worker using the azide modification as described by Standard Methods (1976). Samples were acid-fixed in the field and titrated within two hours of collection. Three years of independently-run duplicate samples produced an r of .98.

DISCUSSION AND PRESENTATION OF DATA

Because the well is covered and photosynthesis is precluded, the writer had expected its water to be consistently low in dissolved oxygen, but thought that subtle rhythms might be revealed. From February 22 till May 30, 1976, concentrations fluctuated from .5 to 1.3 mg/l. But beginning May 30, concentrations increased rapidly and continuously, reaching a high of 9.1 mg/l on June 27, 1976. The level remained high for the next six weeks and then declined rapidly to 3.0 mg/l on August 29. This was followed by a rise over three weeks to 7.4 mg/l and then a decline to the original low levels. Thus it appeared that the surface water of the well not only varied in dissolved oxygen concentration but was also cyclic—high in the middle third of the year, low in the remainder.

Three years of monthly means are illustrated in Figure 3.

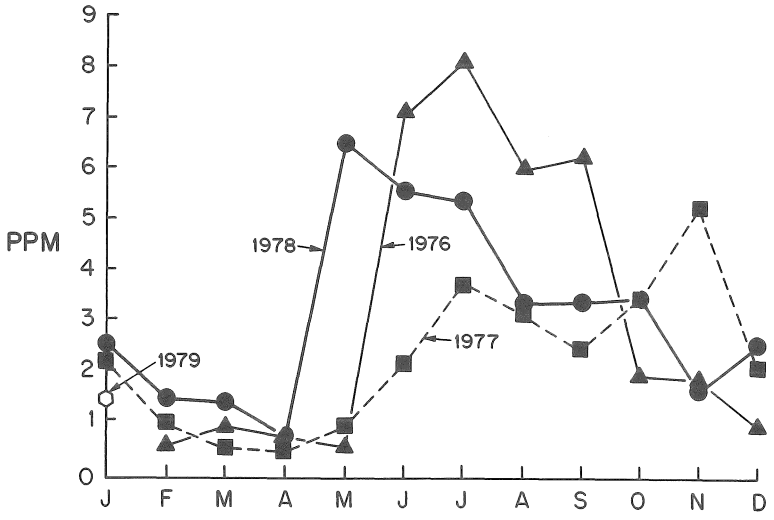


Figure 3. Dissolved oxygen (Mg/ℓ) for three years. Monthly means based on weekly data. Surface water.

pattern varies from year to year, in each a cycle is evident. In Figure 4, all data are combined by month and the standard deviation is illustrated. A July peak is prominent and a November one somewhat less so. A fourth year of data not presented here fits in with the general observation that the surface water of the well varies rhythmically in dissolved oxygen concentration.

But, is it only a surface phenomenon or does the deeper water also vary rhythmically? In Figure 5 vertical data gathered on three occasions over three years are illustrated. June 6, 1978 saw the highest surface value, but the lowest bottom reading. June 6 also had the greatest concentrations from the 26' level to the surface. The joints between the concrete rings lining the well are permeable so water can intrude at different levels. But the few available data suggest the D.O. rhythmicity is related to the upper water--not the bottom. Under conditios of mixing, modified levels could be found in subsurface water and the June 6 observation may be the result of mixing, since on that occasion turbidity was highest at about the 19' level (Figure 6) rather than at the bottom as would be expected. Mixing will be discussed later.

One wonders whether this well is unique, i.e., do other wells in the vicinity display D.O. rhythmicity? Only limited data from neighboring wells are available and these are presented in Table 1.

TABLE 1

DISSOLVED OXYGEN (mg/l) CONCENTRATIONS FOUND IN THE SURFACE WATER OF NEIGHBORING WELLS. (ALL WITHIN ONE-HALF MILE OF THE STUDY WELL)

Well Location	July 4, 1976	January 17, 1977
6589 Lunde Rd.	9.5	3.4
6763 Lunde Rd.	10.7	7.3
6610 Lunde Rd.	5.5	1.6
6618 Lunde Rd. (Study Well)	9.0	0.5

In all cases, the July values were substantially greater than in January, and, without exception, over the four years July readings were substantially higher than those of January in the study well. Thus, other wells in the vicinity appear to display a similar pattern and whatever is responsible for the rhythmicity is not peculiar to the study well.

How to account for the rhythmic fluctuations of dissolved oxygen.

The writer has considered several possible explanations:

1. Mechanical, i.e., either through physical agitation or the introduction of air into the well, the pumping system is responsible. The system functions most during summer when the garden is irrigated and livestock drink greater quantities of water and it is during summer that D.O. levels tend to be highest. Moreover, in late March, 1978, a ruptured pipe sprayed water about the pumphouse, flooded the well cover and caused the surface D.O. to increase from 1.5

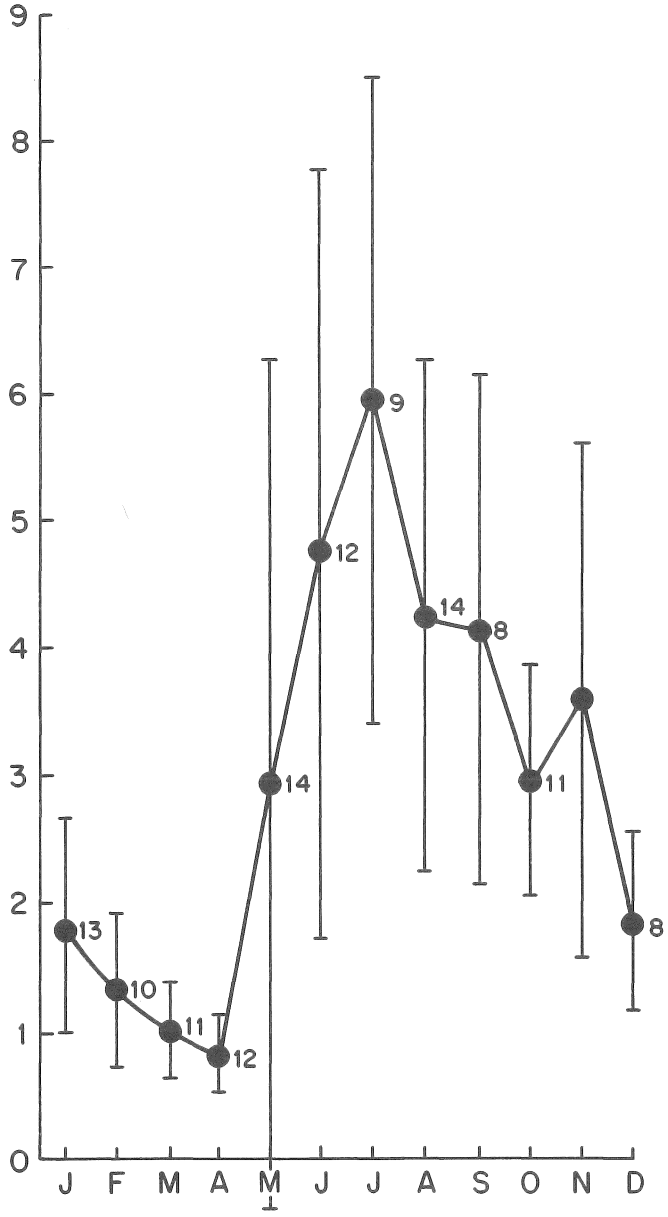


Figure 4. Combined monthly means D.O. for three years--surface water. Shown for each month is the three year mean ±, the standard deviation and the number of samples.

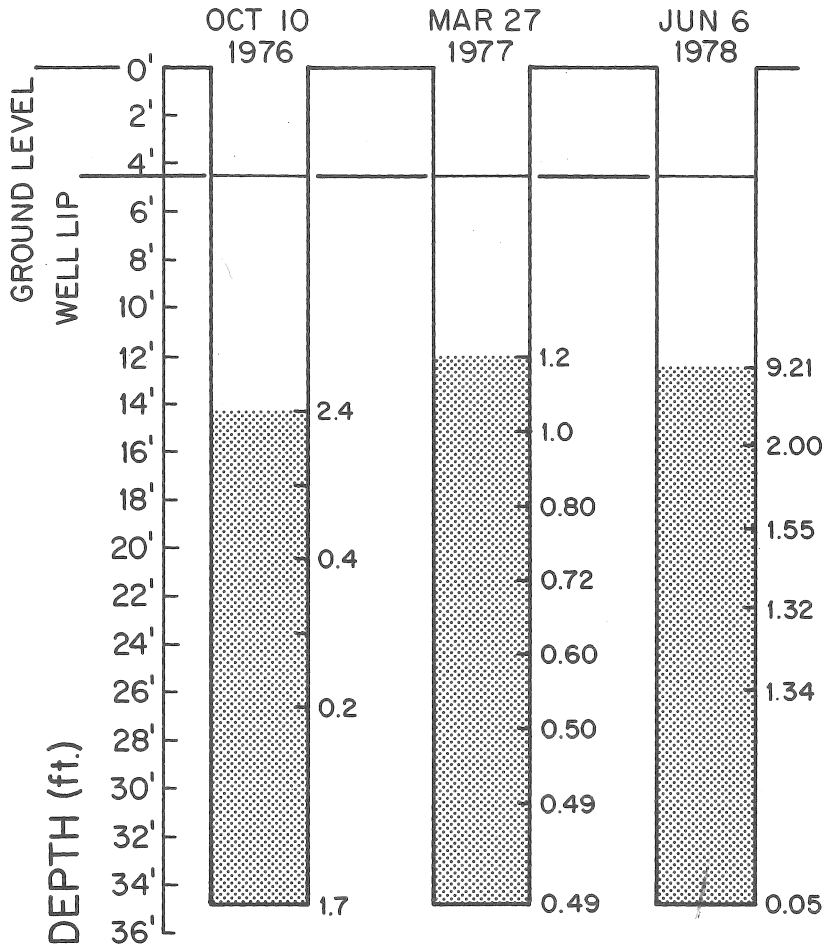


Figure 5. Dissolved oxygen (Mg/l) distribution--surface to bottom--in study well on three dates.

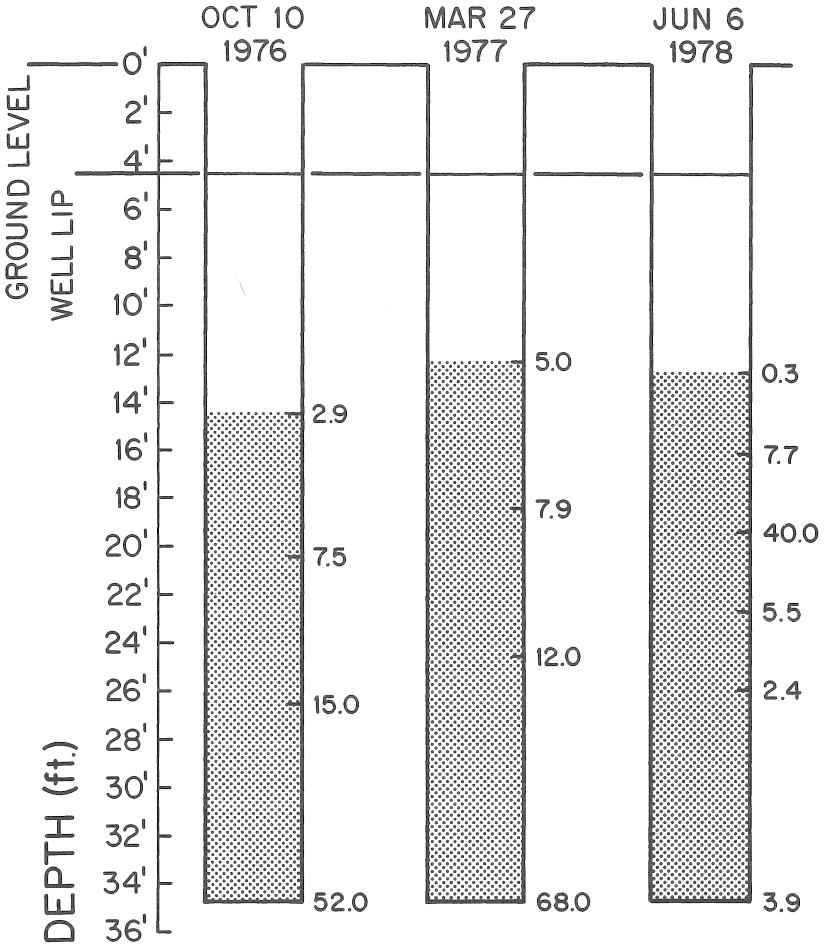


Figure 6. Turbidity (J.T.U.) distribution--surface to bottom--in study well on three dates.

to 8.7 mg/1. But mechanical explanations were rejected because the pump has a single pipe with foot valve and air is not introduced by the system. Moreover, were air introduced, it should cause greater concentrations in the lower, colder water than at the surface. Such is not the case (Figure 5).

2. Highly oxgenated water enters the water table from other sources, e.g., photosynthetic action in the summer increases the D.O. level in nearby lakes and ponds. This water would flow beneath the surface into the well causing an increase. Or perhaps summer melt from glaciers in the nearby Cascades would increase the D.O. level and this water would flow underground into the well. These possibilities were rejected because required rates of flow would be too great. Moreover, there is strong evidence that recharge in the well is directly related to local precipitation—not to inflow from such as glacial melt (Flora, 1980).

3. It is a function of time required from precipitation to pass through the mantle into the water table. This, which is labeled the "time-in-transit" hypothesis, is favored by the writer.

According to this idea, rain upon striking the ground surface is high in dissolved oxygen. It percolates through the mantle and settles on the groundwater. If percolation is slow, as when the soil is saturated (Young and Warkentin, 1975), biota in the mantle lower the D.O. more than when percolation is rapid, as when the soil layer is relatively dry. Thus, following extended periods of little or no percolation, the mantle should dry out, pore spaces should open as clay particles, etc. shrink. Then, given sufficient rainfall, water high in D.O. would quickly pass vertically through the mantle and laterally into the well via the upper joints between the concrete liners. Once the soil had become saturated, the percolation time would increase, biotic activity would be extended and the D.O. level lowered when the water entered the well.

Given this hypothesis, summer D.O. in the well surface water should be high, and in winter at lower levels; and this is the case as illustrated in Figures 3 and 4. Also, the D.O. curve should be inversely related to the soil moisture curve and this is clearly the case in Figure 7. Finally, an increased D.O. level should follow significant precipitation which follows periods of dryness. Such is illustrated in Figure 8 where, after 33 consecutive days without measurable precipitation, nearly .8 inches fell in 24 hours and a small pulse in D.O. appeared two days later. Of the next six days, rain fell in measurable quantities on four and on August 25 a pronounced peak in D.O. was observed. Figure 9 displays weekly data for D.O., soil moisture and precipitation in 1976, but it should be noted that for the week ending June 20, more than 1" of rain was recorded. On June 29, the highest D.O. level was established, and during the two weeks prior to the rain (June 20) the soil moisture level was quite low.

Unfortunately, these data are not as supportive of the hypothesis as one would like. This may be because mixing can play an important role in the apparent rhythm. Given small D.O. concentrations in bottom waters, mixing throughout the column could reduce surface concentrations. Given high surface concentrations, mixing could increase subsurface readings. Earthquakes can induce mixing (Blanchard and Byerly, 1935; DaCosta, 1964) as can atmospheric pressure (Peck, 1960; Tuinzaad, 1954). In the writer's observation, on May 16, 1976 an earthquake of 5.3 on the Richter scale with an epicenter bout 20 miles from the well produced no observable mixing at the surface but atmospheric

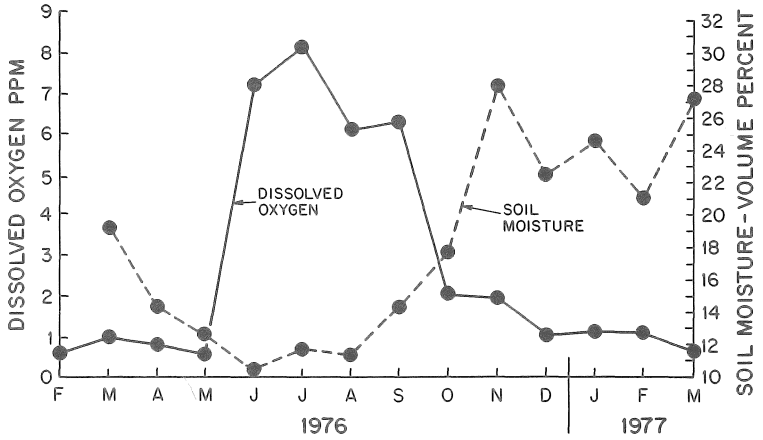


Figure 7. Dissolved oxygen (solid line) vs. soil moisture in volume percent (dashed line) -- monthly means.

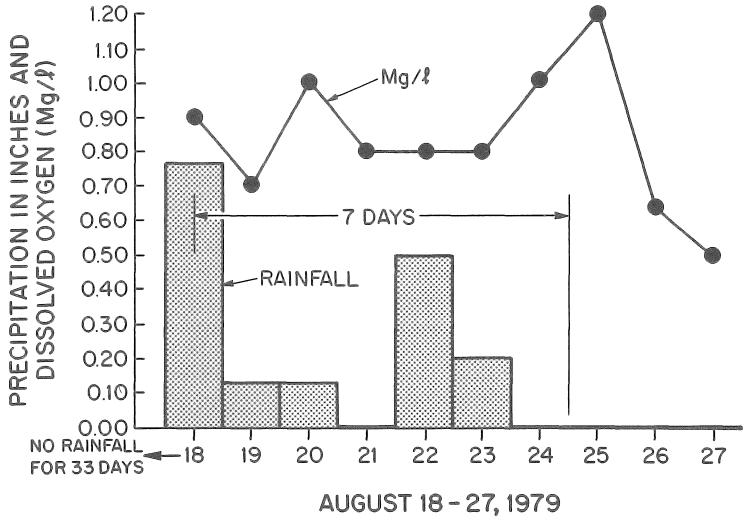


Figure 8. Relationship between dissolved oxygen (Mg/l) (upper graph and rainfall (inches) (lower bars).

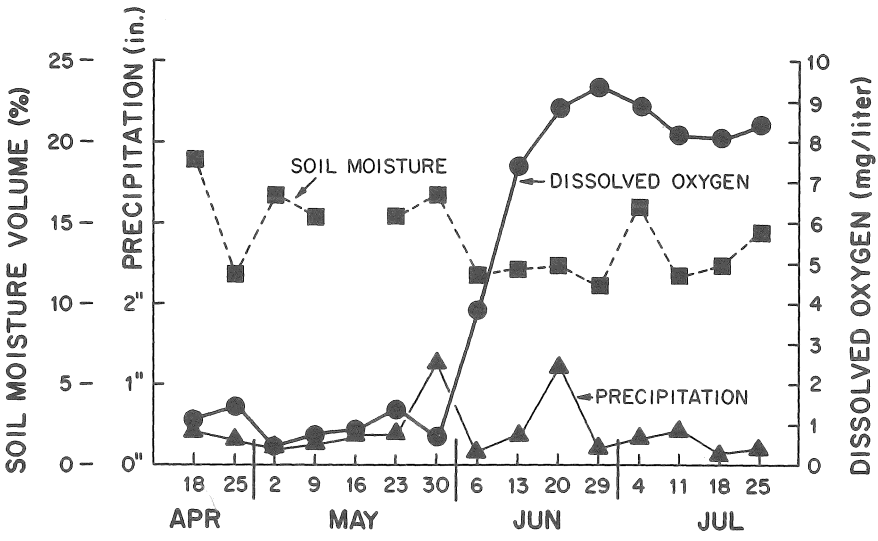


Figure 9. Weekly precipitation (in inches) as shown with surface water dissolved oxygen (Mg/l) and soil moisture by volume percent. 1976 data.

pressure changes appeared to play a role. In Figure 10 periods of abrupt pressure changes are plotted against the concentration of iron detected in well surface water. The presumption is that under conditions of sufficient mixing, the iron rich sediment from the bottom of the well (Flora, 1980) would be detected at the surface and given sufficient abrupt change in atmospheric pressure, such mixing should occur. In Figure 10, total iron concentrations often display an increase after a peak of pressure change.

SUMMARY AND CONCLUSIONS

1. Data have been presented which demonstrate that the surface water of a dug well in the glacial outwash of Whatcom County, Washington is markedly variable. Within a given year it may range from 0.6 to 9.1 mg/1.

2. Data have been presented which strongly suggest that the variation is rhythmic, i.e., it is generally high in the middle third of the year, lower in the remainder. Year to year variation is also considerable.

3. The oxygen "cycle" is held to be a function of rainfall, percolation rate, biological activity and mixing. It is hypothesized that the time required for water to penetrate the mantle ("time-in-transit") is inversely related to the dissolved oxygen level, i.e., the longer it takes, the lower the D.O. and conversely.

4. It is demonstrated that other wells in the area display high summer readings and low winter values. Thus, the study well is not unique.

ACKNOWLEDGMENTS

I am grateful to Linda Sheaffer of the Western Washington University Institute for Freshwater Studies for analytical work, advice and counsel; to Paul

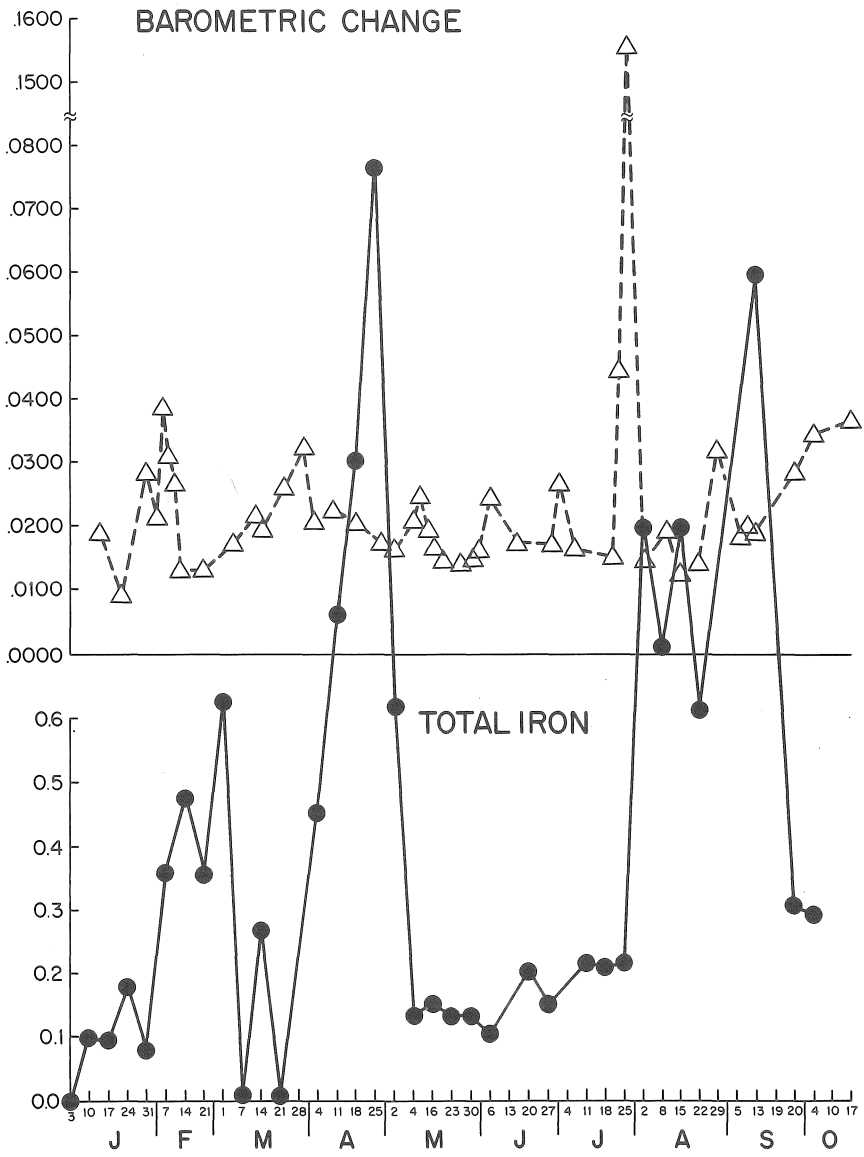


Figure 10. Dashed line (upper) -- Atmospheric pressure change in inches per hour. Solid line (lower) -- Total iron in Mg/l. Data collected in 1978.

Cassidy of Sundquist Marine Laboratory for confirmational analyses on D.O., pH and Turbidity and his predecessor George Garlick. Dr. William Summers of Huxley College was helpful in launching the project and Dr. Frank Raney of W.W.U.'s Department of Geography and Regional Planning was a helpful sounding board throughout. The project could not have been completed without Mrs. Joann Burner's secretarial skills or the willing assistance of the W.W.U. Bureau for Faculty Research, Jane Clark, Director.

I am indebted to all.

REFERENCES

Armstrong, J.E. et al. 1965. Late Pleistocene Stratigraphy and Chronology in Southwestern British Columbia and Northwestern Washington. Geological Society of America Bulletin. 76, pp. 321-330.

Blanchard, F. B.. and Byerly, P. 1935. A Study of a Well Gauge as a Seismograph. Seismological Society of America Bulletin. 25, pp. 313-321.

Da Costa, J. A. 1964. Effect of Hebgen Lake Earthquake on Water Levels in Wells in the United States. U.S. Geological Survey, Professional Paper #435-0, pp. 167-178.

Easterbrook, Don J. 1969. Pleistocene Chronology of the Puget Lowland and San Juan Islands, Washington. Geological Society of America Bulletin, V. 80, pp. 2273-2286.

_____. 1973. Environmental Geology of Western Whatcom County, Washington. Western Washington University, Department of Geology, 68 pp.

Flora, Charles J. 1980. Profile of a Dug Well. Western Washington University, Institute for Freshwater Studies, Technical Report 28, 163 pp.

Hutchinson, G. E. 1957. A Treatise on Limnology. Wiley, New York, 1, 1015 pp.

Jones, J. G. 1975. Some Observations on the Occurrence of the Iron Bacterium, Leptothrix ochracea in Freshwater, including Reference to Large Experimental Enclosures. Journal of Applied Bacteriology. Vol. 39, pp. 63-72.

Peck, A. J. 1960. The Water Table as Affected by Atmospheric Pressure. Journal of Geophysical Research. V/ 65, no. 8.

Richards, F. A., 1957. Oxygen in the Ocean in Treatise on Marine Ecology and Paleoecology. J. Hedgpeth (Ed.) Memoirs of the Geological Society of America, V. 67, pp. 185-238.

Standard Methods for the Examination of Water and Wastewater. 1976. Washington: American Public Health Association. 14th ed. 1193 pp.

Strickland, J. D. H. and Parson, T. R. 1972. A Practical Handbook of Seawater Analysis. Ottawa: Fisheries Research Board of Canada Bulletin. 167, 2nd ed. 310 pp.

Tuinzaad, H. 1954. Influence of the Atmospheric Pressure on the Head of Artesian Water and Phreatic Water, Gen. Ass. Rome. Int. Assn. Sc. Hydr., V. 2, pp. 32-37.

Wiemers, S. B. 1979. Personal Communication—the owner of the land at the time the well was dug.

Yong, Raymond N. and Warkentin, B. P. 1975. Soil Properties and Behaviour, in "Developments in Geotechnical Engineering," New York: Elsevier Science Publishing Co. Series.

III

CANADIAN-AMERICAN THEMES

CONSUMER CHARACTERISTICS AND PERCEPTION: CANADIAN VISITORS IN BELLINGHAM, WASHINGTON

Debnath Mookherjee

Relationship between environmental perception and the personal attributes of the perceiver has received considerable attention from behavioral geographers, particularly in the field of consumer research (Pocock, 1971; 1973). Convinced that the classical theories of central place and the optimization of behavior by the "economic, rational man" did not fully explain consumer behavior, geographers have become increasingly aware of the role of perception in the complex maze of interrelated factors affecting consumer space preference (Huff, 1960). As a growing body of research found evidence that socioeconomic, cultural, and demographic attributes of the consumer were reflected on behavior (Davies, 1969; Goldstein, 1966; Murdie, 1965; Nader, 1969; Potter, 1977a; Ray, 1967; Schiller, 1972), perception as an intermediate variable, influenced by the characteristics of the perceiver as well as that of the retail environment, and affecting the subsequent behavior of the consumer (Spence, 1971; Pacione, 1975; Potter, 1978), came under closer scrutiny. Studies by Potter (1977b, 1977c, 1979; Pocock, 1976; and Smith, 1976), among others, noted varied degrees of association between the socioeconomic and demographic attributes of the consumers and their perception of the retail environment.

However, the term 'perception' has always had a wide range of connotations in the social science disciplines (Wood, 1970). In the geographic literature noted above, perception has mostly been used synonymously with "mental map," "spatial information field," or "cognitive structure" of a specified spatial environment, although it is widely recognized that there are other elements of perception that may not be mutually exclusive, but nonetheless provide conceptually different aspects of cognition or awareness of the environment on the part of the individual (Wood, 1970:131; Pocock, 1973:251-257). This alternative form of urban imagery, as Burgess (1974:167) notes, "is concerned more with the meaning of places to people, and less with their reduction to nodes, edges, and paths." This may be considered as the "appraisive aspect" of perception, which is:

> emotion, concerned with feeling, value and meaning attached to the perceived—a response concerned with evaluation and, consequently, preference. It forms that part of the response, more obviously sensuous than intellectual, concerned with appraising the multifaceted urban personality or aesthetic (Burchard, 1957 as cited in Pocock, 1973:256).

Perception as conceptualized in the present paper pertains to this "appraisive" element of cognition and attempts to ascertain whether the cognitive structure of an urban place would differ significantly according to the age, sex, income, and location of non-resident visitors. One of the problems inherent in any effort to "measure" this form of perception is that it precludes any comparison between

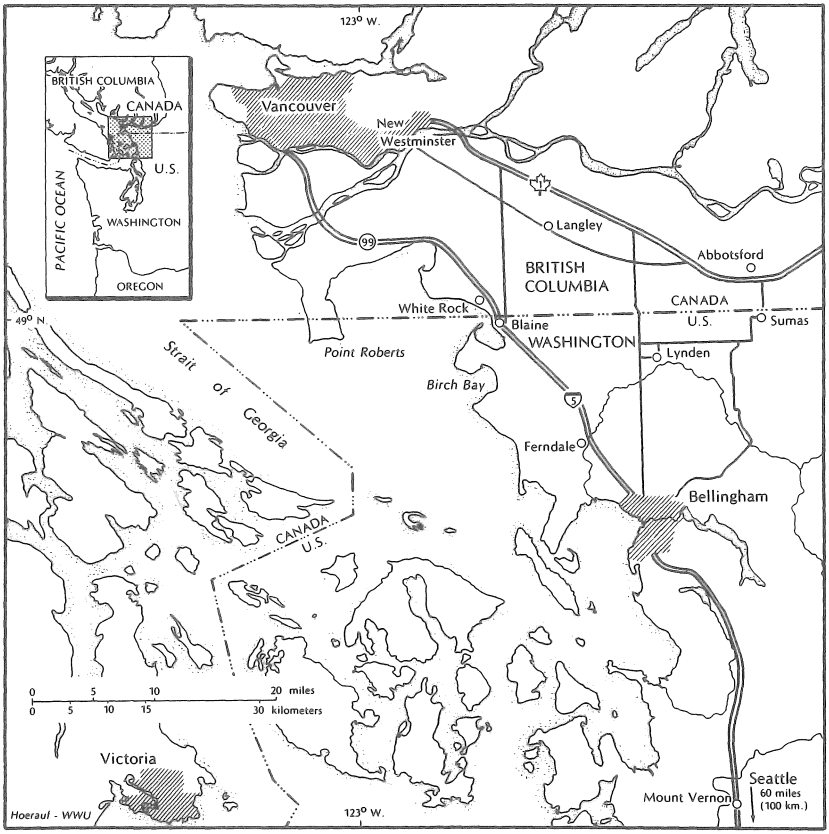


Figure 1: General Location Map

the perceived and the "real" as is the mode in the "mental mapping" or "information field" studies. Thus, only the "images" as perceived by the consumer subgroups can be compared with no attempt to ascertain the "rightness" or "wrongness" of the perceived images of the place.

THE EMPIRICAL STUDY: SETTING AND DESIGN

Data for the research reported in this paper were collected in course of a wider study on consumer attributes and behavior patterns with emphasis on the role of purpose of visit of the Canadian consumers visiting across the United States border in the Pacific Northwest region (Mookherjee, 1979). The city of Bellingham, with a population of about 45,000, which is located twenty-two miles south from the Canadian-American border, was a 1979 recipient of an "All-America City" award, and claims the major share of Canadian visitors crossing the border in Western Washington (Figure 1), was selected for this study. Importance of perception studies concerning consumers, particularly from the standpoint of urban planning, has been amply recognized in the literature (Wood, 1970:137-138; Potter, 1979:19; Pocock, 1971:323-326). In view of an

everincreasing flow of Canadian visitors across the border and implications this might have on the local economy and planning,[1] it was thought that the city of Bellingham would provide an ideal environment for consumer-oriented perception studies.

To collect the data, a structured questionnaire was administered to a random sample of 562 Canadians residing in the province of British Columbia who were waiting in line to be questioned by U.S. Customs officers at the Peace Arch border crossing point at Blaine, north of Bellingham, the major crossing point in the Pacific Northwest region. Only those Canadians who designated their destination to be Bellingham have been included in the present study. A set of items (Table 1) pertaining to (a) the attractions of shopping in downtown Bellingham, (b) the disadvantages, and (c) the quality of the city, were presented to the respondents who were asked to check as many or as few of the attributes as they felt to be relevant.[2] The respondents were grouped according to sex, age (40 and below, over 40), income (below $26,000, $26,000 and over), and place of residence (core metropolitan city of Vancouver, rest of the province). It was hypothesized that the perception patterns on each item would differ significantly among the various subgroups of consumers and a series of chi square tests for independence were employed to test the null hypothesis of no difference. Rejection was set at .05 level of significance.

TABLE 1

LIST OF ATTRIBUTES OF THE DOWNTOWN AND THE CITY OF BELLINGHAM

Item No.	Urban Attributes
	Attractions of Downtown
1	Plenty of parking
2	Wide selection of merchandise
3	Helpful sales persons
4	Wide price selection
5	Special sales events
6	Free parking
	Disadvantages of Downtown
7	Poor window displays
8	Unreasonable prices
9	Lack of variety in merchandise
10	Insufficient advertising
11	Congested streets
12	Inadequate parking
	Quality of City
13	Attractive
14	Clean
15	Friendly
16	Inexpensive
17	Aesthetically pleasing
18	Quiet
19	Safe

FINDINGS AND CONCLUSIONS

Results suggest the perception patterns of the Canadian visitors to differ more by age than either of the other three variables, sex, income, or location of residence. Out of a total of nineteen chi square values, only two in each of the sex and income categories showed differences significant enough to warrant the rejection of the null hypotheses (Table 2). Respondents residing in the core city of Vancouver showed no statistically significant variations in their image patterns from those residing in other areas.

TABLE 2

SIGNIFICANT DIFFERENCES IN CONSUMER PERCEPTION BY AGE, SEX, AND INCOME

Item No.	Urban Attributes	N	X^2	Significance	Phi
	Age				
1	Plenty of parking	332	17.50	.000	.24
3	Helpful sales persons	332	14.81	.000	.22
6	Free Parking	332	3.69	.054	.12
13	Attractive	320	14.88	.000	.22
14	Clean	328	12.44	.000	.20
15	Friendly	351	5.78	.016	.14
18	Quiet	312	8.49	.004	.17
19	Safe	299	14.87	.000	.23
	Sex[1]				
5	Special sales events	331	3.99	.045	.12
13	Attractive	320	4.10	.042	.12
	Income[2]				
9	Lack of variety in merchandise	255	4.55	.033	.15
13	Attractive	312	5.59	.018	.14

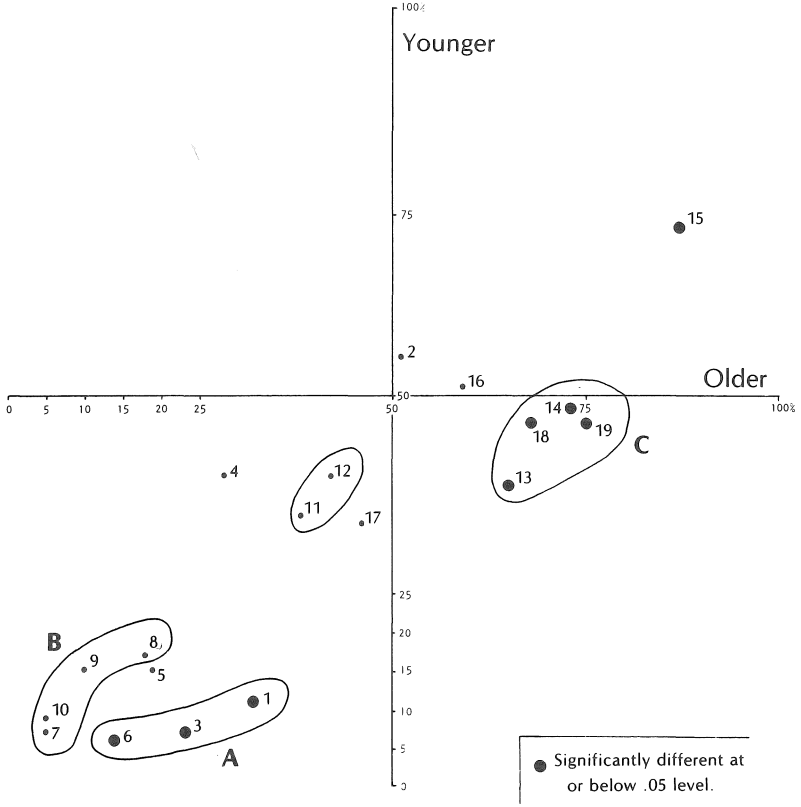
[1]Response pattern (percent agree): Special sales events: male 12%, female 21%. Attractive: male 39%, female 51%.

[2]Response pattern (percent agree): No variety: low income 11%, high income 23%. Attractive: low income 48%, high income 33%.

The distribution of scores (percent "agree") on the two sets of "images" as reflected in the responses by the two selected age groups are plotted in Figure 2. Cluster A, containing three out of the six "attractions of downtown" items, indicates a rather low level of overall agreement with distinctly lower support from the younger group.[3] Cluster B, comprised of the "disadvantages of downtown" features, portrays a low but uniform agreement pattern on "congested streets" and "inadequate parking" (#11 and #12) deviating from the cluster to record a higher level of affirmative responses.[4] Cluster C, with four of the seven "quality of city" attributes, suggests that a larger proportion of the older

visitors perceive the city as attractive, clean, quiet, and safe, then do their younger counterparts.

Although modest in scope, the findings partially support the hypothesis of an association between perception and perceiver characteristics. The images of Bellingham, especially regarding the attractions of downtown and the quality of the city, as noted by the Canadian visitors, showed significant variations by age, and to a much lesser extent by sex and income. These differences or similarities in the perception patterns across various consumer groups not only signify the need for a better understanding of the consumer characteristics but also provide urban planners opportunities towards potential improvement of the environment to ensure success in attracting consumers.



Item No.	#1-6	#7-12	#13	#14	#15	#16	#17	#18	#19
Younger (N):	253	201	248	251	262	251	225	243	234
Older (N):	79	60	72	77	89	68	59	69	65

Figure 2: Distribution of Scores

NOTES

[1]See, for example, Whatcom County Council of Government (1978), and Select Standing Committee on Agriculture (1978). In the local context, Bellingham businessmen and concerned citizens are currently in the process of intensifying their search for ways to optimize the attractiveness and efficiency of downtown Bellingham and, conceivably, any downtown renovation planning should take into considertion the perception patterns of various subgroups of consumers, including the Canadians, who contribute significantly to the economic well-being of the city.

[2]Questions regarding the "quality" of Bellingham had three response categories, namely, agree, neutral, and disagree. The last two were merged for this report to achieve a dichotomous response structure.

[3]Notably, "wide selection of merchandise" (#2) received more uniformly higher ratings from both the age groups as being one of the attactions of shopping in the downtown area.-

[4]It should be noted that with one exception (Table 2: #9), all of the "disadvantage" attributes showed a uniformity in the response patterns, thereby suggesting that the disadvantages were perceived in a similar manner by the various (age, sex, income, location) subgroups of consumers, and as such merit serious attention, with special emphasis on street congestion and parking facilities.

REFERENCES

Burchard, J. R. (1954), "The Urban Aesthetic," Annals American Academy of Political and Social Science, 314:112-122.

Burgess, Jacquelin A. (1974), "Stereotypes and Urban Images," Area, 6:167-172.

Davies, R. L. (1969), "Effects of Consumer Income Differences on Shopping Movement Behavior," TSEG, 60:111-121.

Goldstein, Sidney (1966), "Urban and Rural Differentials in Consumer Patterns of the Aged, 1960-1961," 31:333-345.

Huff, D. L. (1960), "A Topographical Model of Consumer Space Preferences," Papers and Proceedings: Regional Science Association, 6:159-173.

Mookherjee, D. (1979), "Consumer Characteristics and Behavior: Canadian Consumers in the United States," Paper presented at the Sixth Pacific Regional Science Conference, August 13-14, Seoul, Korea.

Nader, G. A. (1969), "Socio-Economic Status and Consumer Behavior," Urban Studies, 6:235-245.

Pacione, M. (1975), "Preference and Perception, An Analysis of Consumer Behaviour," TESG, 66:84-92.

Pocock, D. C. D. (1976), "Some Characteristics of Mental Maps: An Empirical Study," Institute of British Geographers Transactions, n.s., 1:493-512.

_____ (1973), "Environmental Perception, Process and Product," TESG, 64:251-257.

_____ (1971), "Urban Environmental Perception and Behaviour," TESG, 62:320-326.

Potter, R. B. (1979), "Perception of Urban Retailing Facilities: An Analysis of Consumer Information Fields," Geografiska Annaler, Series B, Human Geography, 61B:19-29.

_____ (1978), "Aggregate Consumer Behaviour and Perception in Relation to

Urban Retailing Structure: A Preliminary Investigation," TESG, 69:345-352.

_____ (1977a), "The Nature of Consumer Usage Fields in an Urban Environment," TESG, 68:168-176.

_____ (1977c), "Effects of Age and Family Size on Consumer Behaviour and Perception," Perceptual and Motor Skills, 45:842.

Ray, D. M. (1967), "Cultural Differences in Consumer Travel Behavior in Eastern Ontario," The Canadian Geographer, 11:143-156.

Schiller, R. K. (1972), "The Measurement of the Attractiveness of Shopping Centers to Middle Class Luxury Consumers," Regional Studies: Journal of the Regional Studies Association, 6:291-297.

Select Standing Committee on Agriculture (1978), Cross Border Shopping: An Investigation into Food Purchases Made Outside the Province by British Columbians Phase III, Research Report, Victoria, Province of British Columbia, pp. 65.

Smith, G. C. (1976), "The Spatial Information Fields of Urban Consumers," Institute of British Geographers, Transactions, n.s. 1:175-189.

Spence, P. S. (1971), "Orderliness in the Journey to Shop," TESG, 72:22-34.

Thomas, C. J. (1974), "The Effects of Social Class and Car Ownership on Intra-Urban Shopping Behaviour," Cambria, 1:89-126.

Whatcom County Council of Government (1978), An Assessment of the Impact of Canadian Spending and Investment on Whatcom County, Bellingham, Washington.

Wood, L. J. (1970), "Perception Studies in Geography," Institute of British Geographers, Transactions 50; 129-142.

THE URBAN FIRE HAZARD ON THE NORTHWEST COAST FRONTIER: SOME IMPLICATIONS ON BUILDING STYLE AND TOWN PLANNING

Daniel E. Turbeville III

Over the past two decades there has been a considerable amount of research on North American urban history and development, much of which has been done by urban and historical geographers. These studies have utilized such diverse approaches as economic base theory, transportation linkages, social organization and architectural history, to name but a few. However, there remains one vital element in the structure of North American urban evolution which has been either totally ignored, or, at best, only mentioned in passing: the fact that, especially before 1900, the central business district (CBD), the commercial heart of these cities, was occasionally--if not frequently--destroyed by fire.

Previous European and/or colonial experience initially proved inadequate in responding to this urban fire hazard for environmental, social and technological reasons often unique to North America. The problem was especially acute on the Pacific Northwest coast, where the fires of early steam-age technology burned constantly in the heart of the greatest coniferous forest on the continent. When these fires got out of hand, the results could be disastrous. Few colonial descriptions of conflagration match the intensity of the following eyewitness account of the destruction of the city of Vancouver in 1886:

> The city did not burn, it was consumed by flame; the buildings simply melted before the fiery blast....The fire went down the sidewalks on old Hastings Road...so rapidly that people flying before it had to leave the burning sidewalks and take to the road;...the fire traveled down that wooden sidewalk faster than a man could run.[1]

This, then, was obviously a major consideration for those who would raise, to use Carl Bridenbaugh's apt phrase, "cities in the wilderness."

The role of fire in the evolution of North American cities would seem to be a natural field of inquiry for the geographer, related as it is to such inherently geographical factors as topography, available building materials, climate and culture. However, most have dealt only with anthropological aspects of fire, or fire as a beneficial rather than destructive element.[2] The relationship between fire and architecture, and the hazards therein, was first noted by anthropologist Walter Hough in 1926,[3] but geographers writing on house form and culture mention it only peripherally.[4] Perhaps most serious has been the way that urban geographers have neglected the fire hazard, although Spate[5] and Vance[6] do briefly mention the Great London Fire of 1666. Architectural historians of North American CBDs have tended to let the study of monumental buildings overshadow the broader patterns of architectural development and their relation to fire. Only in the works of urban historians such as Carl Bridenbaugh and

Richard Wade has the role of fire been introduced,[7] but unfortunately the broad scale of their research has limited their exploration of this aspect.

This essay presents some general comments on and conclusions drawn from the early stages of a much larger research project. The choice of the urban fire hazard as an important key to understanding the evolution of North American cities is demonstrated here by utilizing the examples of five Washington and British Columbia cities: Victoria, Vancouver, New Westminster, Bellingham and Seattle. This geographical selection was made on the basis that these cities, with their relatively late founding dates (1843 to 1862), represent in a compressed form the transition from primitive clearing to industrial city that took much longer in the East. Similarities of site, situation, climate and resource bases, and differences in political, cultural and economic institutions occasioned by the presence of the 49th Parallel are utilized to provide an international dimension to a common problem.

NORTHWEST COAST BUILDING AND FIRE TECHNOLOGY

Before considering the relationship between Northwest Coast cities and the urban fire hazard, a short digression is necessary to explain the building styles, materials and firefighting techniques that were brought to the region. The modification of European architecture over time and space has been examined by several historians, but especially Mumford,[8] Gowans,[9] and Ritchie,[10] and the necessity of building in available materials, usually wood, has been noted by Rempel[11] and Rosenberg.[12] For instance, the use of medieval sawpits to cut planks for the earliest New England and Virginia settlements followed closely the techniques used in contemporary Britain. By 1750, these English building techniques had been considerably simplified as they were carried west over the Appalachians and into Ontario.

The most revolutionary change in North American building came in the mid-nineteenth century with the invention of balloon frame construction. Perfected in Chicago, the balloon frame of machine-cut 2'x4' studs and machine-made nails covered by board siding negated the need for heavy timbers, and allowed a few men to erect rapidly large buildings. It essentially made possible the rapid rise of the cities west of Chicago during the last part of the century.[13] Only the very earliest Pacific Northwest buildings were of non-balloon frame construction, and of the sites considered in this study, these tended to be chiefly in Victoria, where the early settlement date (1843) and the more direct cultural link with England postponed lighter frame construction until the turn of the 1858 Fraser gold rush. The original Hudson's Bay Company fort at Victoria, for instance, was probably the best example of medieval English building technology on the Pacific Coast.

As was the case with building technology, Euro-Americans also brought to the Northwest Coast methods of urban fire prevention and firefighting that had originated in Europe and had been modified by colonial experience. The most basic frontier firefighting technique was the bucket brigade, an assemblage of available men, women, and even children, whose efforts were usually directed at saving adjacent rather than burning buildings.[14] However, the primary firefighting defense of pre-railroad Northwest Coast communities was the volunteer fire department, which was usually the first municipal organization of any type in these rapidly growing boom towns, and one which usually preceded even the police department.

The importance of the volunteer fire department in the economic, political and social life of these communities can hardly be exaggerated. They

were comprised of a cross-section of the town's adult male population, wore distinct and colorful uniforms, were supported by voluntary donations, and, in short, represented the distilled essence of community pride and spirit that can today perhaps be compared to professional athletics. Although these western volunteers' activities were on a much smaller scale than those of large Eastern cities, they still held great parades, dances and social affairs, and were local heroes of the highest order. As might be expected, many political careers were launched from these organizations. Most important, however, the formation of a volunteer department allowed the acquisition of specialized equipment, including ladder wagons, pumper wagons and hose carts, all of which were initially hand-drawn to the scene of the fire and whose rapid and efficient employment was critical to the community's existence.[15]

Another interesting characteristic of early Northwest Coast cities was the initial lack of building codes and fire laws, despite the experiences of Eastern cities. Most major colonial cities adopted curfew (literally, "cover fire") and chimney laws during the mid-seventeenth century, while other typical fire measures included the banning of outdoor smoking (Boston, 1638) and the prohibition of thatched or straw roofs (New York, 1653). Quebec City in 1673 required masonry gables at each end of a house to serve as firewalls, a style which proved so popular it was transported to the rural St. Lawrence Valley; in 1717 the city forbade the use of anything but stone for building construction. Boston attempted to adopt a similar ban on wood construction soon afterward, but it proved unenforceable because of the hardship it inflicted on the city's poor.[16]

THE PIONEER SETTLEMENT PHASE, 1843-1889

The cities of the Pacific Northwest Coast considered in this essay were, from the time of their founding until the arrival of the first railroads, remote islands of Euro-American culture and technology in a primeval forest environment. Their economies were based on extractive resources, first fur and gold, and later timber, coal and fish. Most significant, their founders were persons with a much higher degree of previous urban experience than those of the cities of the East or Midwest; they were entrepreneurs who came to raise commercial centers at the gateway to the Orient rather than to become subsistence farmers in the Jeffersonian tradition. It is this prior urban experience which makes their initial failure to consider the fire hazard all the more difficult to understand.

The pioneer (or pre-railroad) settlement phase on the Northwest Coast was characterized by urban cores which contained extensive wood-frame construction in the industrial, commercial and residential areas, a singular lack of building codes and fire prevention laws, and protection by semi-trained volunteer fire brigades using relatively primitive equipment. It was during this period that the risk of conflagration was highest, and during which most major fires occurred.

Victoria

The capital city of British Columbia, founded in 1843, was a series of dispersed farmsteads around the Hudson's Bay Company fort on the Inner Harbor. Commercial development was discouraged by the company, although a small steam sawmill was erected in 1850 to serve the San Francisco lumber market. Real growth finally began with the 1858 Fraser River Gold Rush, when

30,000 miners arrived in a six-week period. Some 225 balloon frame buildings--all but 25 of which were stores or hotels--were hastily erected among the waterfront, making the town a major fire hazard almost overnight.[17]

In 1860 Governor James Douglas responded to this threat by spending $1600 in government funds for a used hand-powered fire engine, the first such engine in the Pacific Northwest. Within two years the city had a volunteer fire brigade—the Union Hose & Ladder Company--headquartered in the old H.B.C. compound. Two rival brigades were formed during the 1860s: the Deluge Company, which was British, and the Tiger Company, composed of Americans. Rivalry between groups was intense and positions were coveted. In addition to parades and sporting events, these fire brigades held dances and an annual "Firefighters Day" which was said to rival the Calgary Stampede. The volunteer companies were supported by charity or private donations, hence the frequency of civic money-raising events. Victoria's fire department did not become taxpayer-supported until 1886, and even then remained part-volunteer.

The interbuilding of newer commercial structures among old gold rush vintage frame buildings led Victoria to three major CBD conflagrations. The first came in 1883 when an entire block of Pandora Avenue was destroyed at a loss of $50,000. In 1904 an industrial fire that began in the Albion Foundry burned out the Government-Pembroke-Blanshard Street area; three years later the block between Government, Chatham, Store and Herald was levelled, a $75,000 loss. As was frequently the case, these conflagrations occurred during periods of economic depression, and were probably the result of arson. That the fire department was also affected by periods of economic stress is illustrated by the fact that one of the 3-hose steam pumpers was not available for the latter fire as it had settled through the floorboards of its shed because of neglect.

Bellingham

Like Victoria, Bellingham's first construction boom came with the Fraser Rush of 1858. The several hundred occupants of the small sawmill town at the mouth of Whatcom Creek were joined by 10,000 miners literally overnight, and a vast encampment of tents ringed the bay for several weeks. A tremendous amount of wood-frame construction took place on the tide flats as stores and hotels to accommodate the rush were erected. Here the potential fire hazard was even more serious, for not only were the streets and sidewalks planked over, but most buildings were raised on pilings above the flats.

From the end of the Gold Rush until the late 1880s, the Bellingham Bay communities languished in economic depression, and in spite of their susceptibility to fire, the only protection was informal neighborhood bucket brigades. This neglect was at least partially responsible for the May, 1885, conflagration which destroyed the core of the old gold rush CBD. Known to local historians as the "Division Street Fire," it began in an old hotel, and was probably a result of arson. All the citizens could do was to rescue merchandise from burning stores, most of which seems to have been barrels of whiskey. (Accounts differ as to whether the actual fire or the "salvage party" that followed it was the more spectacular and memorable event!) Even after an economic disaster of this magnitude, it was not until the early 1890s that Bellingham finally organized a regular volunteer fire department.[18]

Vancouver

The next Northwest Coast city to be levelled by a conflagration was the fledgling metropolis of Vancouver. During the pre-railroad era Vancouver--or Granville, before the Canadian Pacific Railway renamed it--closely resembled Bellingham and Seattle in that it was a small sawmill town whose lifeblood was the cutting and export of lumber and shingles. From 1862 to 1886, the only major fires were the occasional sawmill blazes, as when the Hastings Mill was levelled in 1873. In fact, sawmill fires were so commonplace that they seldom warranted more than local attention.

The modern city of Vancouver properly traces its origins to the selection of the shoreline of Burrard Inlet just west of the Granville townsite as the terminus for the CPR. At the beginning of the CPR boom in February 1886, there were 100 buildings standing, a number which grew to over 600 by May. All were wood-frame structures, and closely packed with no regard to the conflagration potential. There was some recognition of the danger involved, however, for one of the first things the new city government did was to create a 40-man volunteer fire brigade to supplement the sawmill's fire company and a local bucket, pick and shovel brigade of private citizens.

This newly-formed fire company was dickering over the purchase of a second-hand fire engine when, on Sunday, June 13, 1886, a CPR clearing fire got out of hand near False Creek. A strong wind fanned the flames toward the city, and in 45 minutes there was nothing left of the budding metropolis but smoking ashes. So intense were the flames that some residents were forced to abandon their salvage attempts and leap into Burrard Inlet to save themselves. The damage estimate was more than $200,000, but most merchants were back in business the following day since most represented branches of firms established in Victoria or New Westminster.[19] In this case the minimum amount of capital lost when a wood-frame store was destroyed was negligible when compared to the amount of investment poised to enter the city along with the railroad.

New Westminster

The 1858 creation of a separate mainland colony of British Columbia was inspired by British fear that the Fraser Gold Rush would lead to annexation or outright takeover of the mainland by American interests. The capital of the new colony reflected these fears, thus creating an urban area that differed markedly from other Northwest Coast cities. New Westminster was planned and laid out by a detachment of Royal Engineers led by Colonel R. C. Moody.[20] The use of open squares, circles, broad streets and numerous parks in Moody's plan was certainly intended to represent the latest in British urban design, but they also reflected his preoccupation with the possibility of an American invasion. When seen in this light, the choice of a steep hillside on the north bank of the unbridged Fraser River assumes a new significance, as does the fact that open parks and squares provided firebreaks while alleys provided access for firefighting in the event of a seige or artillery duel.

Although the expected American attack on British Columbia never materialized, the preparation for its possibility remained a permanent part of New Westminster's urban pattern. By 1890, the city boasted wide paved streets and numerous "fireproof" brick and stone buildings within its CBD. The 1887 arrival of the CPR led to the addition of many new commercial stores and offices to the already existing collections of government buildings erected during the 1870's and 1880's.

Largely as a result of Moody's foresight, the early fire history of New Westminster is relatively uneventful. A volunteer department was formed in the early 1860s and it dealt mainly with fires in individual buildings, particularly houses, and the occasional sawmill blaze. One of the shortcomings of the reliance on volunteers and hand-drawn equipment is typified in an 1870 accident which caused the loss of a major commercial structure: two volunteers—the first to reach the firehall—were running down a steep hill with the city's only fire engine when, at Front Street, they lost control and the runaway engine plunged into the Fraser River![21]

Seattle

Following the arrival of Henry Yesler and the construction of his sawmill in 1853, Seattle began to concentrate more on industry and commerce and less on the farming activities of the original settlers. By the 1870s, the town's waterfront was ringed with mills, and the central thoroughfare, Front Street (now 1st Avenue) was lined with wood frame buildings erected on pilings and connected by wooden sidewalks. Beyond this, at the top of the cliff, were the dispersed residences of the inhabitants.[22]

Seattle's first volunteer fire department was created in 1876, and was equipped with one side-stroke fire engine. This was replaced in 1879 by a Gould steamer, the first steam pumper on the Northwest Coast. Seattle was at least partially aware of the fire hazard in the city for, after the 1880 fire that destroyed Yesler's mill and several surrounding businesses the volunteer department was reorganized and several fire engines—including another steam pumper—were dispersed through a wider area of the rapidly growing city. In 1886, a crude telegraph alarm system was set up to report fires.

In spite of these precautions, on June 6, 1889, a building fire at 1st and Madison got out of control and, burning rapidly under pilings and along sidewalks, by the end of the day had completely destroyed the CBD. The small water mains could not handle the demands of the two steam fire engines, nor could they draw water from Elliott Bay because the tide was out.

There are a number of conclusions that can be drawn from examining the relationship between early fire experiences and later urban growth. There is an obvious correlation in the severity of conflagration and the phase of urban development which is typified by the Bellingham, Seattle and Vancouver fires. In these cities, the conflagration came immediately before a major economic boom which, while it might have led to the clearing of some older buildings, would have resulted in a much different CBD arrangement. The Seattle fire was actually described as the "greatest stroke of good fortune that could have happened to the city" and similar comments were made about Vancouver and Bellingham.[22] In all cases, the destruction allowed newer and better buildings with less conflagration susceptibility during later years when a major fire could do very serious economic damage.

A second point is the post-fire movement of the CBD. In Bellingham and Seattle, these fires caused the CBD to move away from the waterfront with its flammable sawmills and early wood frame construction. This gave the opportunity for better siting and arrangement of new buildings, a process soon facilitated by the building of electric street railways which also encouraged the physical separation of industrial, commercial and residential areas.

The primary concern in post-conflagration Northwest Coast cities was the improvement of the fire departments. Vancouver immediately began ordering new equipment, including a Ronald steam fire engine, four new hose reels, and

2500 ft. of fire hose for its volunteer department.[24] Seattle's volunteers, on the other hand, were held by many to be responsible for the losses of the 1889 conflagration, in spite of the fact that the city had gone from an 1880 population of 3533 to 40,000 in 1889, with the same size fire department. In October 1889, Seattle created a paid, professional fire department which it equipped with several new steam pumpers, a fireboat and a modern telegraph fire alarm system.[25]

For the first time, building codes were instituted: Seattle's Mayor Robert Moran banned all wooden buildings from the CBD on the day after the fire; in Vancouver, the city council's first acts included codes regarding "better construction" and "precautions against fire." Both cities also improved their municipal water systems at this time. Seattle bought out the city's private water company and replaced its fire mains and added more hydrants. In Vancouver, several 50,000 gallon cisterns were dug around the city to give the new Ronald engines a place to draw water.

CONTROLLING THE URBAN FIRE HAZARD, 1890-1920

With the arrival of transcontinental railroads in the cities of the Northwest Coast beginning in the late 1880s, a distinctly different phase began in literally every aspect of urban growth. Direct rail communication in conjunction with port facilities proved critical: Seattle and Vancouver continued to grow rapidly, while the growth of Victoria, New Westminster and Bellingham levelled off.[26] Increasing control by eastern capital—personified by the railroads—led to a political shift away from the local "sawmill aristocracy." The physical appearance of these cities changed drastically at this time as well, not only as a result of earlier conflagrations but because of improved access to building materials, more available capital for building investment and the adoption of building styles then popular in the East.

Improvements in Building Technology

Prior to the 1890s, the choice of building styles and materials was largely a function of available materials, limited capital and little or no regard for the risk of fire. As newer and more expensive buildings went up in later years, however, another factor emerged as an outside control on building styles and materials. This was the large Eastern, or often British, fire insurance company. The origin of modern fire insurance was the aftermath of the Great London Fire of 1666, and it was a service intended primarily for merchants. Buildings displayed fire marks, and insurance companies had their own salvage and fire brigades. In North America fire insurance companies developed in most major eastern cities, but especially Boston, Philadelphia and Charleston. Canadian cities were usually insured by British firms.

Fire insurance was a late arrival on the Northwest Coast frontier. Before the railroads the only thing worth insuring was the local sawmill, where the risk was high, but so were the premiums. Mills were usually insured on an individual basis, and invariably had both a night watchman and a company fire brigade to help keep the premiums down. By 1900, however, fire insurance companies had begun to make major contributions in reducing fire losses, including encouragement of better and safer methods of building construction, the increase of public awareness of the fire danger, and lobbying for improved fire departments and equipment. While these efforts gave the insurance companies a

humanitarian cast, it must be noted that the end result was to increase their profits by reducing fire losses.

It was in the context of improved building constrution that the earliest impact of insurance companies was noticeable in Northwest Coast cities, especially when it is considered that before 1870, fire insurance policies were seldom based on the construction type or predominant materials at all. In industrial construction, for instance, it was the refusal of fire insurance companies to insure New England textile mills that led to the adoption of heavy-beamed "mill construction," which was slower to burn and allowed the confinement of a fire, and also led to the earliest use of sprinkler systems. These techniques were readily adopted in Northwest Coast sawmills, and later canneries, in order to keep premiums down. In the case of sawmills, however, there is little evidence that it did any good, since the use of resinous softwood, the presence of adjacent lumberyards and waste piles and the continuous presence of sources of fire—trains, steamships, wasteburners and steam-powered saws, to note only a few—made spectacular mill fires an all-too-frequent event.

In commercial buildings, skyrocketing fire insurance premiums also ended wood-frame construction in the CBDs. Remaining frame structures were often improved with the addition of firewalls and stairwall enclosures, but in most cases relocation of the CBD after major fires isolated them and made improvements too expensive.

The most obvious visual change in Northwest Coast cities after 1890 was the rebuilding of CBDs with brick and stone. Although this was termed "fireproof construction," in practice these structures were simply masonry shells with heavy timber joists supporting softwood floors and walls, wooden window frames and wood truss roofs covered with waterproof tar. In addition to this potentially flammable interior, many elements of popular Victorian architectural styles provided further dangers. Foremost among these were: the popular Italian Renaissance (or "Palazzo") style with an open atrium interior topped with skylights, which provided a natural chimney for fire; the Second Empire style with its characteristic mansard roof which made upper floor interiors inaccessible during a fire; the profusion of lacy Victorian trimwork, most of which was resinous softwood; and the use for foundations of native sandstones, which had a disturbing tendency to spall in a high heat and water combination, leading to structural failure.

Experience proved that these "fireproof" buildings would burn as well as anything else, especially in a conflagration such as that in Chicago in 1871. Indeed, it was the case of Chicago that supports the contention that the need to protect against fire was coequal with the invention of the elevator and the perfection of structural steel in the evolution of the "skyscraper." Commercial buildings with steel skeletons and non-loadbearing exterior walls of concrete or terracotta began to appear on the Northwest Coast soon after the turn of the century. The earliest examples include Bellingham's Flatiron Building (1907), Vancouver's Sun Tower (1911) and Seattle's Smith Tower (1914). These buildings are also notable in that they mark a shift toward the use of Portland cement, another indigenous Pacific Northwest building medium which would soon surpass wood and brick as the major regional construction material.

Residential construction on the Northwest Coast has historically been, and will continue to be, of predominately wood frame design for economic reasons. Insurance company efforts to limit the fire danger in wooden buildings included the move to braced-frame construtions early in this century, a technique which cut off open spaces between floors and walls, and included firestops inside walls. They were also instrumental in lobbying for laws requiring that the

ubiquitous residential shingle roof be chemically treated to reduce inherent flammability.

Improvements in Urban Fire Planning

As previously noted, the initial impetus for improved response to the urban fire hazard was experience in early conflagrations. By 1900, the major role came to be played by fire insurance companies in a process that ultimately led to the classification of cities according to their respective fire hazards.[27] As was the case elsewhere in North America, planning for fire had become even more necessary because of the concentration of the CBD brought on by improvements such as the streetcar and the elevator. The surge of post-railroad building often left more modern buildings interspersed with wood frame areas which were considered "conflagration breeders." Conflagration experience had shown much about the spread of fire from floor to floor, and across streets via unprotected windows and exposed, flammable roofs. One method widely encouraged was to group "fireproof" buildings in an "X" at the city's chief intersection as a massive firebreak. There were also efforts to limit building heights in accordance with the capabilities of the local fire department.[28]

Some aspects of the adoption of steam powered equipment for Northwest Coast fire departments have already been noted, especially the replacement of volunteer companies by professional, paid fire departments. One of the main reasons for the switch was the need for trained personnel to operate the new steam equipment, as was the case in Seattle (1889) and Vancouver (1893). The smaller cities retained their volunteer departments considerably longer; for instance, Bellingham made the transition in 1904, but Victoria delayed until 1918.

The acquisition of heavy steam fire engines also made the horse a permanent fixture in the urban firehouse, for the new equipment was far too heavy to be manhandled about city streets as earlier manual pumpers and hose wagons had been. The arrangement to harness a team of horses, light off the boiler and roll out of the fire station were amazing examples of efficiency, and some crews could actually be on the streets less than twenty seconds after the alarm sounded. As cities grew, fire stations were strategically dispersed and designed to blend into either the urban or suburban environment, while firemen and their horses became neighborhood heroes.[29]

The introduction of steam equipment and professional fire departments during the 1890s, with one major exception, marked the end of the major CBD conflagration hazard in Northwest Coast cities. This exception was an 1898 blaze which destroyed 60 blocks of previously fortunate New Westminster, and which perhaps as well as any other example, illustrated the vulnerability of Victorian "fireproof" buildings in an intense fire situation.

Prior to the conflagration, New Westminster's Columbia Street had grown into an "ideal" firebreak of masonry buildings between the riverfront industrial area and residential neighborhoods further inland. Not only were the commercial buidings here of recent construction, but the city's fire department was both well-equipped and trained to handle major fires. However, on September 10, 1898, a situation arose which no comparably-sized North American fire department could have hoped to contend with: a small warehouse fire on a wharf ignited two vessels which broke loose from their moorings and, in a stiff wind, drifted down the shoreline starting numerous additional fires along the docks. Reinforcements from Vancouver arrived too late to prevent a fire loss of over two million dollars, and the almost complete destruction of the CBD.

After 1898, there were no more major conflagrations in any of the five cities, although there were frequent serious building fires. These were generally contained in the building of origin, or at worst, to the block where the fire began. Residential fires were unfortunately common, but the most serious threat to lives and the local economy were industrial fires, especially in waterfront areas. As a result, specialized techniques evolved for combatting waterfront fires, including the early adoption of steam powered fireboats in Seattle and Vancouver.

The complete motorization of most Northwet Coast urban fire departments did not occur until after the end of World War I, although individual pieces of gasoline-powered equipment were adopted at an earlier period. Vancouver was the first city in Canada to acquire motorized equipment, with three units bought in 1903 and complete motorization in 1917.[30] Seattle's first pieces were a fire chief's automobile in 1907 and a hose truck in 1909; full motorization occurred in 1924.[31] During these early years, horses were retained for emergencies—usually when a fire truck would fail to start—but by the late 1920s they were a thing of the past.

The introduction of the gasoline fire truck did not have the revolutionary effect on urban fire control that steam equipment had had. Instead, it was an evolutionary development of the same theme—it allowed more men to get to the scene of the fire much faster, and to fight the blaze with more pumping power and water volume. Trucks also allowed fewer suburban fire stations, and permitted them an even more "residential" look with the ultimate elimination of horse facilities. Finally, the widespread adoption of the telephone early in the century completed the technological revolution in fire control and ushered in a new era of urban safety.

CONCLUSIONS

The urban fire hazard and the human responses to it occupy a unique and frequently overlooked position in the interpretation of city evolution in the Pacific Northwest. In a region of dense forests, isolated cities and predominately wood construction, conflagration posed a much more serious danger than elsewhere in North America, and the acceptance of risk in a frontier community was alarmingly casual. The prevailing attitude in the pre-railroad, gold-rush years was to build fast and build cheaply—when one's fortune was made, then one could rebuild "for the ages." Unfortunately, cities are the product of time, and once the framework of streets and buildings are fixed in place they are seldom altered. As a result, even today the modern city governments and services of the Northwest have to contend with the "frontier attitudes" of the earliest settlers. It has really only been since the motorization of urban fire departments in the early 1920s that the technology has managed to overcome the danger of conflagration in these areas, although even today they can still be counted on to provide occasionally spectacular building fires.

On the Northwet Coast there has always been a tension between the economies of accessible local materials, available capital, fire insurance rates and local fire laws. The effect of large Eastern or foreign insurance companies on building materials and styles of architecture has only been hinted at in this essay, and is an area worthy of further research. Another theme that has been overlooked ha been the relationship of urban firefighting technology and building technology—for instance, it was first the steam (and later gasoline) fire engine which allowed "high-rise" buildings in Northwest Coast CBDs. Without the

ability to pump streams of water into the upper floors of such buildings, insurance premiums would have made them economically impractical.

One final point that deserves to be mentioned is the way in which early planning for the urban fire hazard differentiated the conflagration experiences of the five cities under discussion. It is not possible at this point to be definitive, but generally speaking, New Westminster was the most successful because of the planning efforts of Colonel Moody. The severity of the 1898 conflagration was attributable chiefly to incredibly bad luck more than anything. The tighter, more centralized municipal governments of the three Canadian cities appear to have been more successful in dealing with and preparing for CBD fires than the more haphazard and individualistic (if such a term can be used to describe a city) approach of Bellingham and Seattle, where commercial interests have historically tended to override civic planning. For the urban historian or geographer, the exploration and comparison of fire control planning and prevention in nineteenth-century cities of the Pacific Northwest can open new doors to understanding patterns of urban development.

NOTES

[1] "The Fire," (Vancouver) Daily News, June 17, 1886, p. 1.

[2] Especially notable are Carl O. Sauer, "Fire and Early Man," Paideuma #7 (1962), pp. 399-407; and H. H. Bartlett, Fire in Relation to Primitive Agriculture and Grazing in the Tropics: An Annotated Bibliography (Ann Arbor, 1955).

[3] Walter Hough, Fire as an Agent in Human Culture (Washington, D.C., 1926).

[4] The standard works are Amos Rapoport, House Form and Culture (Englewood Cliffs, N.J., 1969) and Fred Kniffen, "Folk Housing: Key to Diffusion," A.A.G. Annals #55 (1965), pp. 549-577.

[5] O. H. K. Spate, "The Growth of London, A. D. 1660-1800," in An Historical Geography of England Before 1800, H. C. Darby, editor (Cambridge, 1936).

[6] James E. Vance, Jr., This Scene of Man: The Role and Structure of the City in the Geography of Western Civilization (New York, 1977).

[7] Carl Bridenbaugh, Cities in the Wilderness: The First Century of Urban Life in America, 1625-1742 (New York, 1955); and Richard Wade, The Urban Frontier (Chicago, 1976).

[8] Lewis Mumford, Sticks and Stones: A Study of American Architecture and Civilization (New York, 1955).

9Alan Gowans, Images of American Living: Four Centuries of Architecture and Civilization (New York, 1955).

[10] Thomas Ritchie, Canada Builds: 1867-1967 (Toronto, 1967).

[11] John J. Rempel, Building With Wood (Toronto, 1967).

[12] Nathan Rosenberg, Technology and American Economic Growth (New York, 1972).

[13] Siegfried Giedion, Space, Time and Architecture (Cambridge, 1967).

[14]A popular but thorough discussion of colonial firefighting technology is found in Paul C. Ditzel, Fire Engines, Firefighters (New York, 1976).

[15]Ralph W. Andrews, Historic Fires of the West (Seattle, 1966).

[16]Ditzel, op. cit., pp. 16-23.

[17]Harry Gregson, A History of Victoria: 1842-1970 (Vancouver, 1970).

[18]The standard work on Bellingham's history, though badly out of date, is Lottie Roeder Roth, History of Whatcom County, 2 vols. (Chicago, 1926).

[19]One of the better accounts of the Vancouver fire is Eric Nicol, Vancouver (Toronton, 1970), pp. 61-72.

[20]Lillian Cope, "Colonel Moody and the Royal Engineers in British Columbia," M. A. thesis, University of British Columbia, 1940.

[21]Alan Woodland, New Westminster: The Early Years, 1858-1889 (New Westminster, 1973).

[22]Roger Sale, Seattle: Past to Present (Seattle, 1976) is the best and most recent general history of the city.

[23](Newspaper clipping), Seattle Star, June 5, 1937, in Dubuar Scrapbook #77, p. 38, Northwest Collection, University of Washington.

[24]An equipment roster of the Vancouver Fire Department is presented in Alex Matches, It Started with a Ronald (Vancouver, 1974).

[25](Unidentified clipping), Dubuar Scrapbook #83, pp. 50-51, Northwest collection, University of Washington.

[26]Norbert MacDonald, "Population Growth and Change in Seattle and Vancouver, 1880-1960," Pacific Historical Review (August, 1970), pp. 297-321.

[27]Harold A. Stone, Fire Insurance Clarification of Cities and Fire Losses (Chicago, 1934).

[28]C. F. Wieland, "Building Construction as Affecting Fire Risks,: in Fire Underwriters of the Pacific Lectures (November, 1915).

[29]Ditzel, pp. 122-131.

[30]Matches, p. 23.

[31]Jim Stevenson, Seattle Firehouses of the Horse Drawn and Early Motor Era (Seattle, 1972).

IV

CANADIAN THEMES

SOME ECONOMIC ASPECTS OF BRITISH COLUMBIA FORESTS INCLUDING RENT

Robert L. Monahan

Introduction

British Columbia is the major forest province of Canada, producing more than twice the volume of wood of Quebec, the nearest rival, and more than three times the amount of Ontario the third province in wood harvest.

TABLE 1

VOLUME OF WOOD CUT BY PROVINCE, 1976
(thousand cubic metres)

Province or territory	Volume cut	Percent
British Columbia	69,528	49.6
Quebec	29,062	20.7
Ontario	17,878	12.7
New Brunswick	7,479	5.3
Alberta	5,627	4.0
Nova Scotia	3,455	2.5
Saskatchewan	2,866	2.0
Newfoundland	2,345	1.7
Manitoba	1,742	1.2
Prince Edward Island	164	.1
Yukon Territory and Northwest Territories	127	.1
CANADA	140,275	99.9

Source: Statistics Canada, Canada Yearbook, 1978-79, Ottawa 1979, p. 455.

British Columbia produces two-thirds of the Canadian lumber output. With a conservative sustained-yield program as the basis of the harvest levels and with some land not yet in production because of isolation, British Columbia will be the leading forest province for a long time to come.

Study of the forest resources in the major producing regions of Canada is useful in understanding the forest industry of the nation and the distinct character of forestry west of the Rocky Mountains. British Columbia, with the Crown owning 95 percent of the forest land, is in a unique position to experiment with

forest policy and forest practices and to assess their impact on the industry, the communities and the provinces.

In the summer of 1975 a one man Royal Commission in the person of Dr. Peter Pearse, a member of the University of British Columbia faculty, started work on a report which would have an important and continuing impact on the Forest Service.[1] The report was submitted in 1976 and the impact of this impressive study has continued to the present.

The Pearse Commission report is a remarkable document in several ways. The Commissioner was to "inquire into, formulate recommendations and report all matters..." related to the disposition of Crown rights to harvest timber and occupy forested land including the terms and conditions of tenure excluding royalties payable. He was also asked to inquire, formulate recommendations, and to report on the extent to which the forest resources are committed to use and to users; procedures for allocating rights under the various arrangements; provisions for conservation, management, utilization, protection and development of the forest resources allocated; taxes, royalties, rents and other charges levied upon forest land, timber and primary products except the stumpage appraisal system. A final item asked him to inquire, formulate recommendations and to report on the implications of tenure arrangements for forest industry structure. The exclusion of royalties payable and stumpage appraisal cut the heart out of an examination of the return to the people of British Columbia.

This does not detract from the substantial contributions made by the Pearse Commission findings in the many other facets of the forest and forest industry. It does mean the people of the province were denied the examination, the findings and the recommendations on a vital aspect of the forest industry, the income from the publicly owned land.

The brief contribution which follows will look at the forests of British Columbia, the historical development of forestry in the province, including the reasons for the high percentage of Crown land and the allowable cut. A brief examination of the replacement of the harvested forest is also included. A short treatment of rents on forest land concludes the list of topics discussed.

Forest Land and Forest Characteristics

Forests cover about sixty percent of the 366,225 square miles of British Columbia. The bulk are coniferous species with the distribution of mature timber shown in the following table.

TABLE 2

MATURE VOLUME BY SPECIES

Species	Billions of Cubic Feet	Percent
Spruces (Picea species)	61.8	22
Hemlock (Tsuga heterophylla)	64.8	23
Balsam (Abies species)	52.6	18
Lodgepole pine (Pinus contorta)	39.6	14
Western red cedar (Thuja plicata)	32.3	11
Douglas fir (Pseudotsuga mensiesii)	15.5	5
	285.3	100

Source: Inventory Div. B. C. Forest Service. Forest Inventory Statistics of British Columbia. Sept. 1975, p.7.

The forests are usually divided into coastal and interior, with the coastal forest having the very large trees and the highest concentration of moisture-loving hemlock and spruce. The southwest coast is also the most important area of Douglas fir, Pseudotsuga mensiesii. The coastal forest now supplies nearly half the annual harvest from one-sixth of the forest area of the province and it contains about two-fifths of the net forest volume.

The interior forests in general enjoy less precipitation and this has the effect of reducing mature tree size and causing some changes in the forest composition. Lodgepole pine is an important tree in much of the interior and hemlock drops out of the forest community altogether.

The southwestern area continues to be, as it has been, the major producer of Douglas fir lumber, recognized throughout the world markets for its superior construction qualities. Until very recently this area has been the major producer and still is responsible for nearly half of the total wood volume.

Substantial growth in harvest has occurred in the interior of British Columbia in the past twenty years. The siting of nine new pulpmills in this region, plus an expanding sawmilling industry, are responsible for the growth. Factors which led to this manufacturing growth were guaranteed supplies of wood at low stumpage rates, availability of low cost wood chips, adequate investment capital, and expanding world markets for pulp and paper.

Because so much of the forest land of British Columbia is owned by the province, the British Columbia Forest Service has a rarely realized opportunity to introduce sound forest management on nearly 95 percent of the one hundred and twenty-nine million acres of forest. Much of the private land is in industrial ownership and hence receives well funded management. Because of the large blocks of land plus knowledgeable and concerned managers, the forests of British Columbia have been well handled in comparison with many U.S. forest areas and the introduction of new ideas and techniques has been a relatively easy matter.

Pertinent Historical Background

Commercial exploitation of British Columbia forests began about the middle of the nineteenth century with shipments to the gold rush markets of California. The first production was on Vancouver Island and after the discovery of gold on the Fraser River in 1858, sawmilling spread to the Mainland.[2] The southwestern part of the province is still a major area of production, although the bulk of the harvest comes from the interior areas because of the rapid growth of pulp mills and the expansion of sawmilling in the period since 1961.

It is useful to examine some of the antecedents of the highly successful programs of economic growth formulated by the government of British Columbia. The first truly significant development was the closing of rights of purchase and stopping grants of forest lands to private individuals. This was accomplished by the Act of 1888 which also included special cutting licenses and royalty rates for timber harvest.[3] A number of additional Acts were passed and in the Act of 1901 a noteworthy provision was added: "All timbers cut from Provincial lands must be manufactured within the confines of the Province of British Columbia, otherwise the timber so cut may be seized and forfeited to the Crown and the lease cancelled.[4]

The early restriction on sale of forest land is responsible for 95 percent of the forest remaining directly under Crown control. The public ownership of the forest land has speeded the adoption of sustained yield forestry and has eased the problem of introducing new practices and techniques in the forest industry.

The regulation requiring processing in British Columbia probably hastened the development of sawmilling and the pulp industry. In any case, the early adoption of the regulation precluded the development of a significant export market for logs.

The annual harvest has shown a general tendency to increase over time except for the occasional periods of economic downturn. Harvest dropped during the years of the "Great Depression", the latter years of World War II when shipping was unavailable for normal markets, and the recessions of 1958 and 1975. In recent times, the potential for expansion of the harvest has been the relation of harvest to the allowable cut. The British Columbia Forest Service now calculates the allowable cut on the basis of stand classification, stand age, uses of forest land and length of rotation. The determination of allowable cut is undergoing continuing refinement largely as the result of recommendations of the Pearse Royal Commission report.

The 1970 data were examined by A. L. Farley in conjunction with Forest Service officials and the utilization level was found to be fifty-six percent.[5] In 1975 the percentage harvested of the allowable cut increased to 59 percent.[6] This figure is based on the forest land and the wood harvest in the Tree Farm Licenses and the Public Sustained-Yield Units managed by the Forest Service. The area of productive forest is 90,000,000 acres which is 70 percent of the provincial total of 129,000,000 acres.

The situation for 1977, only two years later and the latest year for which complete data are available, shows a dramatic change in several ways. A major change is the area in Public Sustained-Yield Units which is over ten million acres larger as a result of substantial additions in the Prince George Forest District. The Forest Service now sets the allowable cut on over ninety million acres of three-quarters of the forest land of British Columbia. This area produced over two billion cubic feet of wood which was 84 percent of the British Columbia total. The wood harvested was 90 percent of the allowable cut of 2.3 billion cubic feet. This represents a growing maturity in the British Columbia forest industry and successful achievement of long standing goals. The province has encouraged the expansion of wood processing based on the extensive wood resources with guarantees of supplies. The pulp industry is represented by 25 mills. There were over 700 sawmills operating in 1977, 31 veneer and plywood plants and over 100 shake and shingle mills. With the possible exception of the shake and shingle mills the forest processing industry has no concerns for future wood supplies.

The remarkable success of the Forest Service in setting up forest units geared to the support of processing industries and encouraging industry to locate in the province is most laudable and praiseworthy. A relatively small group of skilled and dedicated foresters, technicians and support people have accomplished much. The Pearse Royal Commission report was very timely because it provided a review of activities and gave new directions for development, frequently with alternative routes for achievement.

Replacement of Forest

The replacement of the capital stock of the forest, trees, is of primary importance in the continuation of this resource. For many years the forest regenerated naturally, if at all, with little encouragement or assistance from man. Gradually man developed techniques to encourage regeneration. The use of seed blocks strategically placed to wind throw seed over cutover areas was a simple but effective technique in most areas. Replanting was commonly

employed in areas where brush competition choked out the seedlings. However, there are some disadvantages with natural seeding. A good seed crop may be expected about once in seven years. Therefore a piece of land may stand idle for several years before seeding occurs. During this time, especially on the more favorable sites, the brush competition may preclude forest establishment of Douglas fir and retard the introduction of other species. With the increasing value of wood, the delay becomes more and more costly and immediate replanting becomes the favored practice.

To show the intensification of forest practice the number of acres planted is related to the millions of cubic feet harvested. The trend towards intensified forestry is shown in Table 3. The drop in 1977 was due to heavy losses in the interior nurseries, a lack of site preparation because of unfavorable weather conditions in 1975 and 1976 and heavy turnbacks of planting stock by some companies. This, coupled with the highest timber harvest in the history of British Columbia, nearly two and one-half billion cubic feet, served to lower the planting per million cubic feet.

TABLE 3

ACRES PLANTED PER MILLION CUBIC FEET HARVESTED

Year	Amount
1936	3.66 ac. (estimated)
1967	30.88
1970	44.15
1972	56.41
1975	80.34
1977	60.16

Source: Various Annual Reports of the Forest Service of British Columbia.

Rents on Forest Land

The province has some very valuable and extensive forest stands and forest lands. Nearly 95 percent of the 129 million acres of forest are Crown lands, owned by the province. Much of the harvest goes to large corporations which control the pulp mills and large sawmills in the province. Interest in the "rent," the money obtained from selling the Crown-owned trees, might be expected to run high. Quite the contrary is found, perhaps because people are content to see the forests providing jobs in the various communities of the province. It is possible to get a reasonably good idea of rents paid on Crown lands by looking at the sums collected per million cubic feet of wood harvested.

The values for selected years are shown in Table 4.

TABLE 4

RENTS ON CROWN LANDS

Year	Total Rent Paid	Rent per Million Cu. Feet
1936	$ 2,755,060	$ 5,471.84
1967	40,268,288	25,593.14
1970	61,687,854	31,913.01
1972	98,141,366	49,970.14
1975	51,253.974	28,989.80
1977	72,682,906	29,414.37

Source: Various Annual Reports of the British Columbia Forest Service. The reports provide the rent and the annual cut, the rest is calculated.

For one year, 1970, a secondary sources is available which gives the net value of output.[7] Using this and the rent the discount rate is obtained in the following way:

$$\frac{\text{Rent}}{\text{Total Value}} = \text{i or the discount rate}$$

$$\frac{\$ \quad 61,687,854}{\$1,073,000,000} = .0575 \text{ or } 5.75\%$$

The rate seems low but there are several possible qualifications for this. Because most of the land is owned by the Crown, a major social goal has been the creation of jobs, not the maximization of rent. There are many small sawmills, especially in the interior of the province, which would be adversely affected by higher rent and, in many cases, forced to close. The province has developed a very complicated formula for determining rental rates—one which slides with changes in market prices and other factors. It is unlikely that this system will be abandoned quickly, or without strong protest from industry.

The low rate of return has been reduced even further to encourage close utilization. From the moralistic point of view, "waste not, want not" this is commendable but from the market viewpoint it does not always make sense. Close utilization is a useful concept but blanket application is not in the best interests of the industry.[8] Close utilization often means submarginal material must be removed from the woods. The return is the lowest on this material and the handling costs are the highest. The requirement causes the net value of the stand to decline and reduces the potential revenue to the resource owners. An analogy is the recovery and recycling of waste paper on a university campus. In major paper producing centers, around the computers, registrar's office, central duplicating and major offices it pays to recycle paper. If one is forced to pay even minimum wages to collect and use the paper from student and faculty wastebaskets the collection costs exceed the revenue and lower the average

return per ton to the institution. If the revenue were assigned to scholarships there would actually be less money available under the condition outlined above.

Another factor in the low rate of return is the relation of coastal stumpage prices to the Vancouver log market. In the past when a number of independent operators had timber licenses and permits the market served a useful purpose. Now with most producers of logs also owning processing facilities the log market serves as a place to swap logs rather than as an open market. This tends to depress the price and indeed one writer has indicated log prices twice as high in adjacent forest regions.[9] According to Copithorne the economic rents for the natural resource are passed on as income to the processing operations of the companies where the profits are not subject to the special tax on logging income. The uncollected rents by the resource owners—the people of British Columbia through their elected government—are enjoyed as profits by the companies and as higher wages by forest industry workers, especially those in the mills.[10] There seems to be some truth to this as a July 1979 settlement between the industry and the International Woodworkers of America gave the fallers a $156.00 per day scale plus travel time.[11]

Summary and Conclusions

This brief examination of some economic aspects of forests and the forest industry of British Columbia indicates some impressive successes for the Forest Service. The giant forest holdings of the province are inventoried, divided up into the large management units, made available to the various sectors of the industry in a way which assures a stable wood supply, provides adequate fire protection and provides a sound basic management program.

Intensification of management is one of the current trends in forest management. Replanting, to reduce lost production time on forest land and to shorten the rotation, is well under way. Other facets of intensive forest management such as fertilization, thinning and pruning have not become firmly established practices.

The question of distributing the rent from the forest resource has been raised. The people of the province have foregone collection of the rent to encourage the growth of the industry. They have also provided a disproportionate share of the rent to forest industry workers unwittingly rather than by design. Rents have also been foregone to increase the recovery rate of wood in harvest through concessions for close utilization. In the 1975-76 fiscal year rents dropped below Forest Service expenditures for the first time in many years and this continued through 1977, the last year for which data are available. Government services are rarely run to make a profit but in the case of British Columbia forests this would be possible and proper. The Forest Service is managing a resource of great value with a large reservoir of accumulated capital. The demands for recreational use while growing are still very modest. The struggle to develop buyers for the trees and to open the forests for harvest is well in hand. The time for improving the economic efficiency of the foret industry and the forest labor force is here.

British Columbia people may increase the rent portion of the income from their forests and have this available to improve forest productivity, expand the services of government, reduce their individual tax load or invest the returns in other development.

NOTES

[1]Royal Commission on Forest Resources, Peter H. Pearse, Commissioner. Established by Order-in-Council, June 12, 1975.

[2]A. R. M. Lower, W. A. Carruthers and S. A. Saunders. The North American Assault on the Canadian Forests. Toronto: Ryerson Press, 1938. p. 260.

[3]Ibid., p. 233.

[4]Ibid, p. 236, refers to British Columbia Statutes, 1901, c. 30, s. 7.

[5]A. L. Farley, "The Forest Resource," British Columbia: Studies in Canadian Geography, J. L. Robinson, ed., Toronto: University of Toronto Press, 1972, p. 97. The volume harvested was 1,932,628,437 cu. ft. and the allowable cut 3,450,000,000 cu. ft.

[6]Pearse, Peter. H. Timber Rights and Forest Policy in British Columbia, Vol. 1, 1976, p. 225. The figure should be regarded with some caution because it uses moving averages for production and excludes the production from TFL No. 2.

[7]F. L. C. Reed and Associates, Ltd. The British Columbia Forest Industry: Its Direct and Indirect Impact on the Economy. Victoria, 1973, p. 8.

[8]Pearse, Op.Cit. p. 245.

[9]L. Copithorne. "Natural Resources and Regional Disparities: A Skeptical View." Canadian Public Policy, Vol. 5, No. 2, Spring 1979, p. 187.

[10]Ibid., p. 188.

[11]CBC Radio, Vancouver, B.C. July 18, 1979.

BIBLIOGRAPHY

British Columbia Forest Service. Report of the Forest Branch of Department of Lands, 1927. Victoria, B.C., 1928.

British Columbia Department of Economic Development. Monthly Bulletin of Business Activity. Various issues 1972-1975.

British Columbia Department of Industrial Development, Trade and Commerce. The Sawmill Industry of British Columbia. Victoria, Oct. 1972.

British Columbia Department of Lands. Report of the Forest Branch for the Year Ended Dec. 31, 1942. Victoria, 1943.

British Columbia Forest Service. Annual Report 1975. Victoria, 1976.

British Columbia Forest Service. Annual Report of the Forest Service for the Year Ended Dec. 31, 1973. Victoria, 1974.

British Columbia Forest Service. Report of the Forest Service for the Year Ended Dec. 31, 1967. Victoria, 1968.

British Columbia Forest Service. Report of the Forest Service for the Year Ended Dec. 31, 1970. Victoria, 1971.

British Columbia Forest Service. Report of the Forest Service for the Year Ended Dec. 31, 1972. Victoria, 1973.

British Columbia Forest Service. Report of the Forest Service for the Year Ended Dec. 31, 1977. Victoria, 1978.

British Columbia Forest Service. Inventory Division. Forest Inventory Statistics of British Columbia. Victoria, September 1975.

Copithorne, Lawrence, "Natural Resources and Regional Disparities: A Skeptical

View." Canadian Public Policy (Analyse de Politiques). Vol. 5, no. 2, Spring 1979. Pp. 181-194.

Forward, C. N., editor. Environment and Man in British Columbia and Washington. Bellingham: Western Washington University, 1974.

Lower, A. R. M., W. A. Carrothers and S. A. Saunders. The North American Assault on the Canadian Forest. Toronto: Ryerson Press, 1938.

Pearse, Peter H. Timber Rights and Forest Policy in British Columbia. 2 Vols. Victoria, 19767.

Reed, F. L. C., and Associates, Ltd. Department of Lands, Forests and Water Resources. The British Columbia Forest Industry: Its Direct and Indirect Impact on the Economy. Victoria, 1973.

Robinson, J. Lewis, editor. British Columbia: Studies in Canadian Geography. Toronto: University of Toronto Press, 1972.

Urquhart, M. C. and K. A. H. Buckley. Historical Statistics of Canada. London: Cambridge University Press, 1965.

Figure 4. State Climatologist

PRINCETON: THE FIRST TWENTY-FIVE YEARS

George A. Rheumer

Princeton, together with many other small interior British Columbia towns, owes its well being to the resources of its hinterland. Ochre, furs, gold, grass, coal, copper, and timber have each played important roles in the continued development of the community. Unlike some of the centers which had similar resource bases, Princeton has managed to survive a series of boom and bust cycles. Today it is a reasonably prosperous community, its well-being predicated upon mining, forestry, ranching and tourism. This prosperity has not been a continuing part of the town's history, particularly in the first twenty-five years after its founding in 1860.

First called Yak-Tulameen, "Place where red earth is traded" by the Indians who gathered there to exchange red ochre obtained from the cliffs of the river bank nearby, the site was to be re-named Vermilion Forks after the same cliffs by the fur traders who came to trade with the Indians. The ochre, however, had nothing to do with the Colonial Government's decision to establish a town at the Forks.

The Gold Rush

Gold was discovered on the Similkameen River above Princeton in 1860 and by the fall James Douglas reported that there were eighty to a hundred miners at work (Goodfellow, p. 79). In August, 1861 some two hundred miners, many of whom were Chinese, were working the Similkameen. Among the miners were Theodore Kruger, John Fall Allison, his partner Hayes, George Barratt, John Marsden and John McDonell all of whom played some important role in the community. Kruger is remembered in Kruger Flat, the site of Blackfoot, the focus of the gold strike. Allison and Hayes became the first permanent settlers, John Marsden had the first store and all but Hayes were among the first to pre-empt land at the Forks.

Supplies for the mining camp were brought from the Oregon Territory until the Dewdney Trail was completed from Hope in the Fall of 1860. The miners made from fifteen to twenty dollars per day but these records may be misleading for the Chinese were reticent about reporting their earnings for fear of losing their place at the diggings should it become known that they were getting good returns for their labours. This situation led to some Chinese being nicknamed "Two-biddie" and "Six-biddie" in accord with their report of daily earnings.

Gold was not plentiful, however, and by the late Fall of 1861 Blackfoot was practically deserted. The miners moved on to diggings in the Cariboo, Kootenays, and elsewhere, but not before the Colonial Government had become interested in the Forks area.

James Douglas

In his attempt to bring the southern interior under British influence and to offset the possibility of American take-over of the mining country around Princeton and Rock Creek, Gov. James Douglas ordered that the Dewdney Trail be cut from Hope to Princeton and eastward to Rock Creek. Also the Governor was particularly concerned with the cost of overland transport. He was positive that the sixty-mile water transport down the Similkameen would reduce costs appreciably between Hope and Rock Creek, thus enabling the Colony to supply goods rather than having them imported from the Oregon Territory.

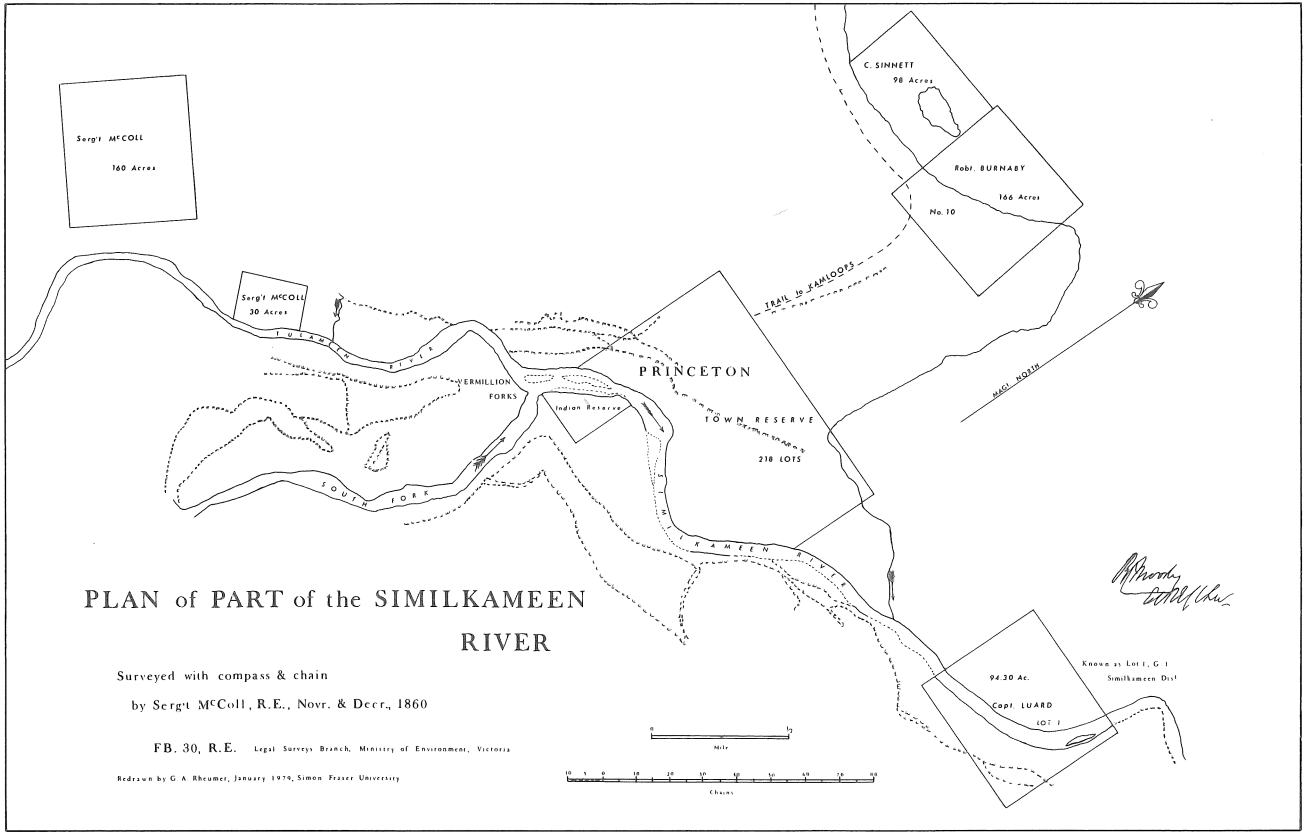
After his visit to the Forks in 1860 he was of the opinion that the Similkameen could be made naviable "...by a small outlay..." from Prince Town to the border. About the Forks he stated also that the ground was favourable and the situation pretty, reporting "...the peculiar feature of the country is the profusion of grass that covers both woodland and meadow, affording rich pastures for domestic animals, a circumstance which gives to this district, an extraordinary value, as every part of the surface, whether hill or valley, may be turned to account and made available either for tillage or stock farming" (James Douglas, p. xix). Douglas ordered Sgt. McColl, R.E., to lay out a townsite of six or seven hundred acres (Fig. 1) in spite of the report of Lt. Palmer, R.E., "...the undeveloped state of British Columbia and the absence of any good roads of communication with the interior would render futile any attempts to settle the Similkameen..." (Further Reports, p. 88). Douglas was optimitic about the possibilities for settlement, a view supported by an earlier report of J. F. Allison, and furthermore the Dewdney Trail had been cut thus overcoming one of the major concerns of Lt. Palmer.

The Spectre of Speculation

The enthusiasm and optimism associated with the gold mining and the official recognition which stemmed from Douglas' visit in the late summer of 1860, resulted in thirty-two pieces of land being pre-empted between August 22, 1860 and November 15, 1861 (Fig. 2). Basically there were two groups who pre-empted land: those already in the area who knew it first hand, for example, John Fall Allison, George Barratt, John Marsden and John McDonell, and those who were either associated with the Colonial Government, for example, Charles Good, later to be the son-in-law of James Douglas, Walter Moberly, and Edgar Dewdney, or with the Royal Engineers, for example Col. Moody, Capt. Luard, Sgt. McColl, and Cpl. Turner. It may well be significant that of the thirty-two claims, fifteen were held by persons in the public service of the Colony. Officials of the Colonial service recorded eight of the claims, officers of the Royal Engineers, five, and the Hudson's Bay Company, through the agency of a colonial official, recorded two of the pre-emptions (Liang, p. 4).

Only one of the pre-emptions taken up by Colonial officials can be excused from the spectre of speculation, that of P. O'Reilly, the magistrate at Fort Hope, who was encouraged by Douglas to take up a pre-emption as an alternate site for the townsite chosen by him and surveyed by McColl (Private official Letter Book, p. 50).

Of all the pre-emptions taken up in 1860-61, only one, that of Capt. Luard, R.E., was completed by Crown Grant which was issued to him on Feb. 11th, 1861 upon an application to purchase. He was granted Lot 1, G. I. Similkameen, 151 A. at 4s.2d., four shillings and two pence per acre (Figure 1).



PLAN of PART of the SIMILKAMEEN RIVER

Surveyed with compass & chain

by Serg't McColl, R.E., Novr. & Decr., 1860

FB. 30, R.E. Legal Surveys Branch, Ministry of Environment, Victoria

Redrawn by G. A. Rheumer, January 1979, Simon Fraser University

Figure 2

Pre-emptions at Princeton 1860-1861

Aug. 27, 1860	James Phillips	- E. of S. Fork & N. of Ashnola
Sept. 20, 1860	George Barratt	- next to Marsden to West
	John Fall Allison	- West of Barratt
	John Marsden	- point of Forks on east side S. Fork
	John McDonell	- across S. Fork opp. Marsden
	Charles Good	- next to McDonell & east side of S. Fork
Sept. 24, 1860	James Orr	- N. side of Tulameen - about 1 mile W. of the mouth of S. branch
Oct. 15, 1860	John Riley	- south of Marsden, & Barratt on West side
	Highman & Johnstone	- 8 mis. from junction 1/4 mi. south
	Richard Connor	- E. side of River (Simil.)
	Col. Moody, R.E.	- E. side of Simil.
Oct. 20, 1860	F. Highman	- around Johnstone's store
	Capt. H. R. Luard RE	- 1-1/2 mi. below Forks on N. Side
Nov. 3, 1860	John Coer	- N. side of Simil.
	Sgt. McColl	- same land as Jas. Orr (above)
Nov. 3 or 4, 1860	HB. Co. - 2 claims	- E. side of Simil.
	Walter Moberly	- N. side of Simil. & E. side of Simil.
	Edgar Dewdney	- N. side of Simil. & E. side of Simil.
Nov. 20, 1860	Louis F. Marshall	
Nov. 30, 1860	Thomas Lett Stahlschmidt	- 1/2 mile above Forks - N. side of Simil.
	Robert Burnaby	- N. side of Simil. - E. of Forks
Dec. 10, 1860	Wm. Young	
Dec. 28, 1860	P. O'Reilley	- on W. side - 1/2 way between Princeton & Whipsaw
Jan. 19, 1861	Capt. H. R. Luard RE	- 12 mi. E. of Forks - N. side Simil.
Mar. 18, 1861	A. Craigie	- 6 mi. south & 6-1/2 mi. from River
Mar. 25, 1961	Sgt. McColl RE	- in same area as ORR
June 20, 1961	Edward Pemberthy	- E. side of 1/2 mi. River
Nov. 15, 1961	John MacDonell	above Johnstones 6 chains on each side of bridge being built over R.

(Liang p. 4)

After receiving title, Luard returned to England, eventually selling the land to Allison.

The influx of miners encouraged John Marsden to build a store at the Forks to cater to their needs. Supplies were brought in via the Dewdney Trail from Fort Hope. Evidently he prospered, for in 1861, Dewdney and Moberly built a second store near Blackfoot to compete with that of Marsden. Ormsby suggests that Marsden remained only one winter at Prince Town (Ormsby, p. xx). If this was so, it is possible that Dwedney and Moberly took over his store. It is apparently this second store which is referred to in the records of pre-emptions (Higman's claim, Figure 2). Fate being fickle, however, both stores failed, when, in 1862, the miners moved to diggings elsewhere. There was a temporary respite when Capt. Hawkins of the Boundary Commission established his headquarters at Princeton. By 1865 only John Fall Allison and his partner, S. W. Hayes, remained at the Forks. A few miners, mostly Chinese, remained searching for gold along the rivers.

Frontier Princeton

Allison lived on his own pre-emption, where he had built a cabin, until 1863 when it burned. He then moved to the townsite, and built a two-story trading post. About the same time he entered into a ranching partnership with Hayes. Together they bought eighty head of cattle which, by 1867, had increased to five hundred. Allison and Hayes continued to ranch in the area until 1880, when the partnership was dissolved. Allison continued ranching until his death in 1897.

The story of Princeton in the 1860's and 1870's is that of John Fall Allison. Although not the first white to visit the area, he and his partner Hayes were the first whites to spend a winter, 1860-61, at the Forks. Besides James Douglas, he and Hayes were the first and only ones for twenty years to recognize the continuing potentiality of the rich bunch grass of the valley and its hillsides as rangeland for cattle herds. It was Allison who realized that the site, one day's travel on horseback from Hope, would require some sort of hostel and also that the Indians of the area could be a source of income in trading their furs, skins, mocassins and gloves for the goods of the white man as they grew increasingly dependent upon the latter. It was Allison who recognized, more than anyone else, that it was the location and the abundant grass, not mining or agriculture, which would be the most important during the years after 1860. Although he was to remove the base of operation of his ranch for eight years, he returned to Princeton in 1880, and again established a store which became a stopping place for travellers.

Allison arrived in Princeton in 1860 (Ormsby, p. xix) and was to become the first permanent settler, and a permanent resident until his death in 1897. Although he moved to Westbank between 1872 and 1880, he maintained a home in Princeton as a base of operation for summer grazing of his livestock. He married Susan Moir in September, 1868, bringing his bride from Fort Hope in a two-day journey over the Dewdney Trail.

It is Mrs. Allison's Memoirs which record many of the details of life in Princeton in the periods 1868-72 and 1880-85 (Ormsby). She tells of the difficult but fascinating trip over the Dewdney Trail and of her first contact with Indian servants, and their folklore, an example of which were their stories of "Ogopogo" whom they called "N'Ha-A-Itk."

She describes the log house which her husband had built "on the townsite" as being large and comfortable. It had five rooms and plank floors covered with

deer and buffalo hides. There were out-buildings including a stable, smoke-house, and of course, an outhouse. Only the corral and garden were fenced initially.

The lumber for building had to be whipsawed and, as it cost seven cents per foot, it was very expensive. Timber, however, was readily available, the high cost of the lumber resulting from the difficulty with which it was whipsawn, one man being in a pit below the log, the other on top. The sawdust made life miserable for the sawyer below.

Although Mrs. Allison makes no direct reference to the isolation of Princeton, she points out, that, apart from Mr. Young and Mr. Marsden, who had cabins near the river, the nearest neighbour was the Hudson's Bay Company post at Keremeos, forty miles distant. There was no one else, apart from Indians at Otter Lake and Nicola Lake, and the few prospectors, mostly Chinese, who worked the Similkameen and Tulameen, but only during the summer. The three hundred Indians wintered either at Nicola or Chuchuewa, near Hedley. Winters, even the milder ones, must have been particularly difficult. The Dewdney Trail was practically impassable for three or four months and thus there were no pack trains and few travellers to bring news or supplies. The mail was brought from Fort Hope once every two months, carried by Indians on snow shoes, and they usually took eight or nine days on the trip. If mail was to be sent between the regular trips, Indians were hired at a cost of fifty to one hundred dollars.

The nearest doctor was at New Westminster, unless one used the services of the Indian "doctors." The only mid-wife in the area was sixty miles distant from Princeton, across the border in Washington. Nontheless she once made the trip through a blinding snowstorm alone.

Winters were so severe that cattle were rounded up in the fall. After roundup, Allison drove the saleable cattle over the trail to Hope, usually in October. The remainder were driven to winter pasture near Westbank in the Okanagan, via the Old Indian Trail which Allison had re-cut in 1874 for the purpose. Only a few ponies, together with the dairy cows, were winter fed at Princeton. These animals required constant attention. Mining coal for heating and cooking purposes, repairing saddles, making furniture and looking after the horses and cows kept the men busy for the most part. Mrs. Allison, with the help of her Indian servants, spent most of her time preparing meals, sewing, tending the store and looking after the children. The store, of course, was a minor chore during the winter, there being only the occasional customer, most often an Indian from Chuchuewa.

With the coming of spring, usually in April, occasionally in March when chinook winds cleared the snow earlier than usual, the livestock was herded back over the Old Indian Trail to graze in Similkameen Valley. The Indians began to move out from Chuchuewa to go gathering, trading and working with the whites. The garden was planted in late May but often would be delayed by frosts which can occur in any month of the year. At this time Mrs. Allison would be busier with the store as miners would begin to return in June to spend their time seeking gold along the rivers and they would need the various supplies obtainable at the store.

During the summer the pack trains from, and to, the Okanogan and Kootenay Valleys would give a welcome diversion from the loneliness and day to day tedium. Travellers into the southern interior would stop being most welcome as overnight guests for they were the "newspapers," bringing the latest news of the Colony and probably a great deal of gossip and misinformation about the state of affairs in general. News, gossip or whatever, all were welcome at Allison's, so much so that Princeton was frequently referred to as Allison's, even

on official maps of the day. Creeks were named for their distances from Allison's, not from the Forks.

Mr. Allison and his three or four cowboys spent most of their time out in the range with his cattle so his wife and children were left at home to mind the store and look after the chores. Indians brought their grade goods, moccasins, gloves, furs and hides to trade for flour, sugar, axes, rifles and ammunition. The Chinese and white miners along the rivers would also occasionally come to the store, often giving the children small gifts.

In the Fall, the garden products were brought in and canned, fish and venison were smoked or salted and spiced, then stored for the winter. The cattle were rounded up, a task taking two or three weeks, and the beef steers driven over the Dewdney Trail to Hope for shipment to New Westminster and Victoria. The remainder were then driven to the Okanagan for the winter pasture.

The Allison family moved to the vicinity of present-day Westbank in November 1873, where again their home was a focal point, for it too was designated "Allisons" on maps of the day. Mr. Hayes remained at the Princeton residence so that its function as a store and stopping place was continued, uninterrupted until the spring of 1880 when, after a particularly severe winter they lost two-thirds of their cattle. At this time the partnership was dissolved, and because Allison could not afford to keep two places, he decided to return to Princeton, much to the disappointment of his wife who disliked the long cold winters there. Allison had, of course, spent most of his summers at Princeton for the cattle were on summer range in the valley. After selling the Okanagan holdings to one John Phillips, the Allisons returned to Princeton in April with one hundred and twenty head of thoroughbred shorthorn cattle and seventy-five horses.

Arriving at Princeton they found six inches of snow "on the flat." The heavy winter snow of that year had been too much for the roof of the house, which had caved in. They were welcomed by the entire Indian population of Chuchuewa, about three hundred, who arrived for a visit of several days, camping across the river from the Allison house. In addition to the Indians there were only four whites in the neighbourhood, the McKellop brothers mining on the Tulameen, Mr. Boshan and Billy Royal mining on Whipsaw Creek and, in addition, a number of Chinese.

By 1880 Allison had purchased about four thousand acres from the government and he pre-empted the former townsite, which had been cancelled in 1878, giving him a total of almost five thousand acres. This rangeland, together with the store which Mrs. Allison ran, gave them a "good income."

In the Fall of 1880 the Princeton area experienced an earthquake. While there are no reports of damage to the log house, the outbuildings or to the cabins by the river, it did cause a religious revival among the Indians. Since their conversion to Christianity by the various Catholic priests, the Indians had drifted back toward their former ways, and away from the Church. They feared tht the white man's God was angry with them when the earthquake occurred. Consequently some Indians resolved to keep only one wife and they decided to build a church at Chuchuewa, in order to pacify Him. Many were baptized.

Fire was one of the most readed occurrences associated with pioneer life and Princeton was no exception. John Allison's cabin on his first pre-emption, that which had been the hostel for James Douglas during his 1860 visit in Princeton, was burned in 1863. Mrs. Allison gives an account of their journey over the Dewdney Trail with their infant son, Edgar, in 1869 when "even the Skagit was boiling" according to a rider whom they met. At one point the fire burned the leg of Mrs. Allison's horse and the dense smoke made passage along the trail

virtually impossible. The third and presumably last encounter with fire occurred on April 1, 1882 when the house and store burned with a loss of everything but a sack of flour and a hundred pounds of gunpowder in tins which were hurriedly thrown from the second storey of the burning building. A snowstorm added to their misery.

An interesting aspect of pioneer life is reflected in the actions of their neighbours, near and far, after the fire. The children went searching through the deserted shacks and came home with some tins with which Mrs. Allison was able to cook some bisuits. The Indians sold them sugar at one dollar per cup. A few days later having heard of their misfortune, Barrington Price, a neighbour from Keremeos, brought them supplies of bacon, flour and beans. Ah Lee, a Chinese prospector made wooden sandals for all of the children. Such was the teamwork of neighbours in pioneer days, everyone did what they could to help anyone who was in need. They were able to move into the new house in two or three weeks for John Allison and the cowboys hurried back from the cattle drive to the Okanagan and began building a new log house, sixty feet long, immediately.

Cooper and Gold: A Renewed Optimism

In 1883 the mineral wealth of the Princeton area again attracted the attention of miners. This time it was the copper outcrop which had first been noted by John Allison in 1860. A group of three men from San Francisco came to investigate. Allison showed them where it was from across the river which was too high to ford at the time. The leader, a Captain Nicholls, was a spiritualist, and after wandering in the bush for awhile, he returned saying that the spirits told him that there was nothing there. The spirits guarded Copper Mountain and its ores well that day. Nicholls left but Ferguson, the mining expert of the group, remained, explored and later staked a claim as did Allison. Nothing came of it however as there was no transport facility to take the ore to the market outside the area. Princeton's isolation was a deciding factor in her well being. The railroad must come to the area before the community cold "cash in" on her destiny. Ranching would remain the backbone of the Similkameen economy. Copper mining was something for the future.

Far more significant for Princeton was the rich 1885 gold strike on Granite Creek, a tributary of the Tulameen. One afternoon while hunting grouse for the evening meal of a group of prospectors, Johnny Chance found a secluded spot by the creek and had a nap. Upon awakening he got a drink from the stream and noticed a number of gold nuggets which he picked from the stream bed.

The rush to the Tulameen was on, no longer would Princeton be the focus of mining in the area, for Granite City grew almost overnight into the third largest community in British Columbia. Although the strike was to last for only a few years it did serve to bring about a variety of changes in the upper Similkameen.

During the peak years, 1885-88, half a million dollars worth of gold was recovered from the sixty-two claims along the creek. Along the three main streets were twenty-four hour saloons, boarding houses, a variety of stores, livery stables, jeweller's stores, blacksmiths, bakery, shoemaker, chemists, attorney's office, doctor's office and a butcher (Phipps, p. 132). Presumably there were bawdy houses also.

The impact upon Princeton was immediate. Allison, who had been appointed a Justice of the Peace in 1876, was made temporary assistant Gold Commissioner in 1885. The lonely family had been joined early in 1885 by the Jameson family and more were to come, attracted by the business to be derived

from the gold strike at Granite Creek. Albert "Pop" Irwin, F. P. Cook who built the first chain store (he had one in Granite City), Bill Garrison who operated the first freight and stage coach business and many others, came and remained. Princeton no longer was simply a stopping place for travellers and pack trains on the Dewdney Trail. It became the supply center for the mining activity at Granite Creek. Allison set up a slaughter-house and sold his meat directly to the butcher at Granite City. The meat was hauled to the market via a crude wagon road. Miners en route to Granite City paused to buy supplies and horses. They came from the east and west along the Trail.

Not all came to Granite City via the Trail however. The newly constructed Canadian Pacific Railway was to have its impact, one which foreshadowed the future, for by the 1890's, the Trail fell into disuse. Goods still came to Princeton, but from the Okanagan, supplied from the C.P.R. to the north. By 1901 a wagon road extended from Princeton to Penticton via Keremeos. Cattle from the Similkameen now moved eastward to the Okanagan. Pack trains, now no longer needed, vanished from the scene. The Dewdney Trail, so long the lifeline of Princeton and the Similkameen, was dead. It had served its purpose for twenty-five years and only its ghost remained to haunt a succession of governments until sixty years later, it would be resurrected. New technology had killed it but newer technology would demand its return a the Hope-Princeton Highway.

Conclusion

Princeton's history was bound by its geographic facets even during its first twenty-five years. Its situation made it important. It was a focus of activity on the Dewdney Trail, gold discoveries were made in the vicinity, having the effect of focussing attention upon the community, and the perception of the area's worth for agriculture added to the perceived value of the area. The isolation of its site made it impossible to exploit the copper ores until important technolgical changes in transportation, namely the railway, came into being. Nevertheless gold, and the mobile beef steer assured the community a place in the history of British Columbia for the twenty-five year period.

The early settlers were beset by the isolation, loneliness, and the monotony of day-to-day living, but they kept the site alive between gold rushes. Through their perseverance of seasonal changes, fires and floods, a focus of attention was maintained.

It was the resources of Princeton which enabled the community to survive. Gold provided the initial interest, the rich grassland the continuing interest, while the copper and the dream of the rail connection provided a promise for the future.

SELECTED REFERENCES

Dawson, G. M. and Bowman, Amos, Map of a Portion of the Southern Interior of British Columbia, Ottawa, Department of the Interior, December 1888.

Douglas, James, "Gov. Douglas to Duke of Newcastle, 25 October 1860," Papers Relative to the Affairs of British Columbia 1862 (Cnd. 2952, 1st Series) 4: 28 cited in Ormsby, Margaret A., ed., A Pioneer Gentlewoman in British Columbia, p. xix.

Goodfellow, John C., "Fur and Gold in the Similkameen," B. C. Historical Quarterly, 12: April 1938: p. 79.

Liang, F. W., "Colonial Farm Settlers on the Mainland of British Columbia 1858, Victoria: British Columbia, Provincial Archives, Unpublished, 1971: p. 4.

Ormsby, Margaret A., ed., A Pioneer Gentlewoman in British Columbia, Vancouver: University of British Columbia Press, 1976.
Phipps, Barry, "Granite City," Annual Report, Okanagan Historical Society, 26: 1972: p. 132.

Government Documents

Further Reports Relative to the Affairs of British Columbia, Part III, London, 1860: p. 88.
Private Official Letter Book of Sir James Douglas, 1859-64, Provincial Archives, Victoria: p. 50.

V

OVERSEAS THEMES

INTRA-URBAN RESIDENTIAL MOBILITY IN CAPE TOWN: WHO MOVES

H. L. Zietsman

To effectively answer the question "who moves" in the context of intra-urban residential migration also requires information on who does not move. A comparison between the population, housing and environmental characteristics of those who had changed residence during a specified period of time with that of those who had not moved is therefore necessary, in others words, a mover-stayer framework as proposed by Brown and Moore (1970). An analysis of these differences should throw more light on the underlying factors that are responsible for the phenomenon of intra-urban residential mobility, as "who" moves is related to "why" households move.

The Research Problem

A study of the literature reveals that life style, life cycle, level of living and the residential environment are possible labels which could be applied to the general factors which influence the residential mobility of households. These underlying dimensions are not mutually exclusive, but act interdependently (Bell, 1968). It is also not very clear which variables represent these factors most satisfactorily, so that the multitude of possible interactions between chosen variables poses a complex problem in an attempt to distinguish between movers and non-movers. Traditionally, the approach has been to select a limited number of variables and to analyse the mutual relationships between these variables by way of control variables during cross-tabulation. The problem with this approach is that the number of categories and control variables makes high demands on the sample size, so that this requirement excludes the possibility of controlling for a whole range of possible interactions.

An alternative to this problem is the application of discriminant analysis. By measuring residential mobility on a nominal scale each household can be classified as a mover if the household had changed address during a specified period of time, or as a stayer if it had not moved. By the application of discriminant analysis all variables thought to be relevant can be analysed simultaneously, whereby it is possible to identify a subset which in combination provides the best separation between the groups. This approach not only provides an indication of the most relevant variables but also of their relative importance. The overall success of the discriminatory power of the selected variables can be evaluated by re-classifying the households on which the analysis was originally conducted (King, 1970).

A Case Study: Cape Town*

The data on which this research was based was obtained from a 5% sample of White households resident in the Cape Metropolitan Area in 1977. Questionnaires provided the necessary data for approximately 5,000 households, of whom 34.1% had moved within Cape Town at least once during the study period 1971-1976. As many variables as possible were included in the analysis, giving a total of 24. The approach was exploratory so that preselection of variables was avoided as far as possible. A complete list of variables is to be found in the Appendix. The variables measure characteristics of the head of the household, household composition, the housing unit, the household's satisfaction with housing unit and neighborhood, as well as other aspects such as distance to work, duration of stay and future mobility expectations. It is important to note that housing characteristics of movers refers to previous places of residence while that of non-movers to their present residence.

A stepwise discriminant analysis was conducted with the aid of a computer program (Nie et al, 1975) during which the most important discriminating variable was entered first. Other discriminating variables were subsequently entered in an iterative manner by pairwise comparison, to select the next most "important" variable for the discriminant function which has the form:

$$D_i = d_{i1} Z_1 + d_{i2} Z_2 + \ldots\ldots + d_{ip} Z_p$$

If the addition of a variable led to redundancy of another variable already included in the equation the least useful variable was omitted. This procedure resulted in the selection of a subset of variables which maximally distinguished the movers from the non-movers. The selection criterion chosen was Rao's V, which is a generalized distance measure that results in the greatest overall separation of the groups (Klecka, 1975).

After fifteen interactions the analysis was ended because the additional improvement in the ability of the discriminant function became statistically negligible, as measured by an F-ratio of 1.0. The 15 variables selected by the discriminant analysis are listed in Table 1, as well as the coefficients of the two classification functions. Nine variables were not included in the discriminant function, namely sex, marital status, nationality, language, religion, occupation, number of occupants, future expected mobility and size of dwelling unit. These variables therefore make no contribution toward distinguishing between movers and non-movers, either because the variables are inherently unrelated to the phenomenon of residential mobility or because they are subsumed by other variables already included in the discriminant function, which is probably the situation, for example, in the cases of "number of occupants" and "number of children."

The five most important variables which distinguished most between movers and stayers are briefly discussed in the sections which follow.

*Cape Town is the oldest city in the Republic of South Africa, with a total population (1970) of 1,100,000.

TABLE 1

DISCRIMINANT AND CLASSIFICATION FUNCTIONS
DERIVED BY DISCRIMINANT ANALYSIS

Variables	Function Coefficients		
	Discriminant	Classification	
	(Standardized)	Movers	Non-Movers
Ownership	0.618	14.609	12.844
Age	-0.454	0.356	0.399
Duration of Stay	-0.254	0.134	0.172
Length of Marriage	0.247	0.326	0.308
Housing Satisfaction	-0.246	-1.036	-0.749
Housing Type	-0.182	4.910	5.462
Age of Dwelling	0.168	0.925	0.801
Length of Residence in City	0.168	0.064	0.052
Number of Children	-0.110	2.292	2.406
Employment	0.102	8.036	7.694
Income	0.089	-0.363	-0.433
Housing Condition	-0.078	10.349	10.545
Neighbourhood Satisfaction	0.066	5.009	4.911
Education	0.049	1.715	1.692
Distance to Work	0.030	0.098	0.095
Constants		-71.961	-71.267

Home Ownership

Ownership emerged as the most important discriminating variable between movers and non-movers with a discriminant coefficient of 0.618 (Table 1). A result which is in accordance with numerous previous studies on residential mobility (Pickvance, 1973). Renters are the most mobile group and owners the most stable, or the movers vis-a-vis the non-movers. A cross-tabulation between ownership and residential mobility reveals that renters are about three times as mobile as owners (Fig. 1(a)). This difference in the mobility behavior between owners and renters is ascribed to the economic and psychological ties which are established with a property as soon as ownership of the residence is acquired. It is especially the economic tie which is immediately present when a financial commitment is made by the household's investment in a home. In addition to this factor it is much more expensive for an owner of a single dwelling to change residence than for a renter (Shelton, 1968). This differential cost probably results in owners being much less sensitive to attractive alternatives than renters. Apart from these implications of cost it can be argued that home-ownership also provides the possibility for on-site home alterations to suit changing needs of the family, thereby reducing the necessity to move. Fredland (1974) is also of the opinion that the decision to buy a home is taken in view of future expected mobility, so that these factors all contribute to the difference in mobility behavior observed between owners and renters.

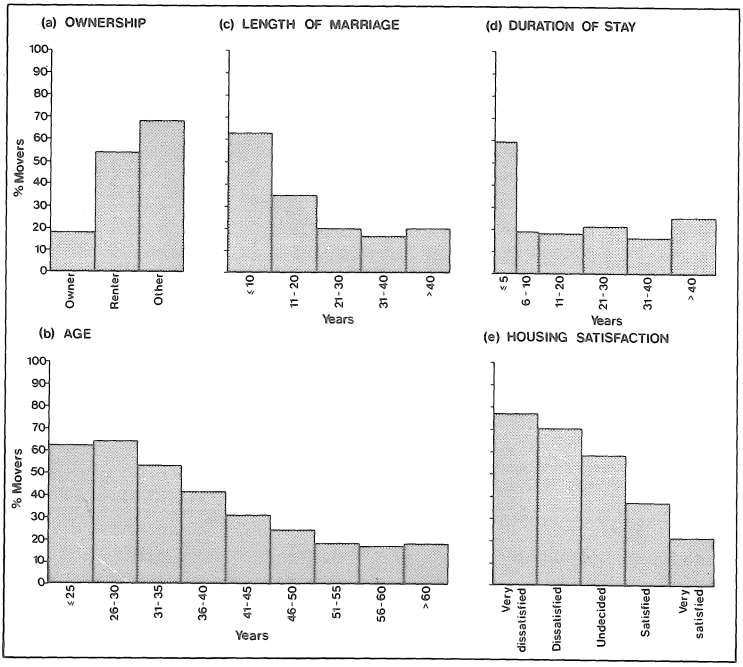


Figure 1. The Five Variables

Age

The age of the household head was found to be the second most important discriminating variable. Also the relationship between this variable and residential mobility is well documented. The consensus is that age of the head of the household is related to residential mobility behavior via the life cycle (Speare et al, 1974). As a household progresses through the stages in the life cycle its size and composition changes and accordingly housing needs also change. To satisfy these changing housing needs—for example the need for space—some households find it necessary to adapt by changing residences from time to time. It is especially during the early stages of the life cycle when household size increases markedly that housing needs are dynamic. Stabilization gradually enters as the household ages and children eventually leave home (Sabagh, 1969). The result of a cross-tabulation between age and residential mobility shows that 63.8% of all households with heads between the ages of 26 and 30 years had changed residence during the study period, whereas this percentage for those in the age group above 60 years was only 18.2% (Fig. 2(b)).

Duration of Stay

The length of time that a household has been living in a particular dwelling unit also emerged as a strong distinguishing characteristic between movers and stayers. This negative relationship between duration of stay and residential mobility is known as the axiom of cumultive inertia and has already been used in stochastic models of the residential mobility process (McGinnis, 1968). This

phenomenon has ben explained in terms of the development and strengthening of social ties with friends in the neighborhood. But apart from this possibility there is a considerable overlap between duration-of-stay effects and that of aging, refered to previously. To this can be added the duration of residence in the city, because the probability that a household has found a satisfactory dwelling place is directly related to the length of residence in a particular city, so that the overall propensity to move is further reduced. Movers are typically households that have lived in their present dwellings for five years or less. Up to 60% of these households had moved during the period of study, in comparison to approximately 20% in the case of households which had a duration of stay exceeding five years (Fig. 1(c)).

Length of Marriage

The propensity to move is negatively related to the number of years that a household head has been married. Also this relationship can be explained in terms of the relationships between life cycle, family size and housing needs. A large number of movers are shown by the literature to be young married couples with small children (Chevan, 1971). Couples with older children have by implication been married longer and are residentially more stable, probably because moving is disruptive to social ties which take a long time to become established, while the presence of school children complement these social considerations. Parents possibly argue that a residential move could negatively influence the psychological development of their children, so that the total effect of all these factors would lead to greater residential inertia with increased length of marriage (Long, 1972). Of the households in which the marriage had been ten years and less, 62.4% had changed residence during the period 1971-1976. This percentage decreased gradually to 19.7% for the households with a length of marriage exceeding 40 years (Fig. 1(d)).

Housing Satisfaction

The last variable which distinguished between movers and non-movers to be treated explicitly is overall housing satisfaction. Speare (1974) regards residential dissatisfaction as a necessary prerequisite for a household to even consider a search for an alternative dwelling. Housing dissatisfaction is generated by the changing housing needs of households and their perception of the place utility of the current dwelling relative to all other potential dwelling places in the system (Wolpert, 1965; Brown and Moore, 1970; Clark, 1975). The classic study by Rossi (1955) emphasized that the size of dwelling unit and especially the household's dissatisfaction with the size of the unit plays an important role in the desire of the household to change residence. Satisfaction with the dwelling unit is most definitely an important distinguishing characteristic between movers and non-movers, as 77.1% of all movers expressed great dissatisfaction with their previous dwelling units, whereas only 21.5% were actually satisfied with their previous dwellings (Fig. 1(e)).

Other Distinguishing Characteristics

The five variables discussed above are representative of some of the factors underlying the process of residential mobility, namely life cycle, social and economic ties and housing. With regard to the other distinguishing variables which were selected by the discrminant analysis it is suspected that some of the

results may be spurious. This can be noticed in the direction of the signs of the discriminant coefficients. Housing type shows a negative association with the propensity to migrate, which is contrary to the expected relationship. Single dwellings were designated by a value of 1 and apartments by a value of 2, so that one would expect a positive discriminant coefficient, as apartments are characterized by higher mobility rates than single dwellings. Both length of residence in the city and the index of neighborhood satisfaction show similar unexpected inverted relationships. A possible explanation for these results can be afforded by the inter-correlations which exist between independent variables, so that when these intercorrelations are partialled out it could lead to the unexpected results obtained (Johnston, 1978). It is also interesting to note that stated neighborhood satisfaction ranks very low on the list of possible reasons for changing residence. This is contrary to what would be expected, as numerous studies have identified environmental factors as important contributing variables (Clark, 1975; Daly, 1968).

Evaluation

The re-classification of households on the basis of their characteristics through the application of the two classification functions has enabled an evaluation of the discriminatory power of the discriminant functions in separating the movers from the non-movers. Re-classification was done without a priori specification of the proportional distribution of movers and non-movers in the sample, and thereby reducing the percentage "erroneous" classifications. In spite of this results were very satisfactory (Table 2). The percentage classified correctly was 74.7%. Slightly more non-movers were correctly classified than movers, namely 75.9% to 72.5%. This indicates that non-movers are identifiable with greater confidence than movers; however the differences are small enough to ignore and are probably related to the disproportional presence of non-movers in the sample.

TABLE 2

EVALUATION OF THE DISCRIMINANT POWER OF THE DISCRIMINANT FUNCTION

Classification	Number of Cases	Estimated Group Membership			
		Movers		Non-Movers	
Movers	1.708	1.238	(72.5%)	470	(27.5%)
Non-Movers	3.299	796	(24.1%)	2.503	(75.9%)

Discriminant analysis holds promise for practical application in an attempt to identify potential movers, so that mobility rates can be calculated on the basis of which the residential mobility component of urban housing demand can be estimated at any given point in time (Kaiser and Weiss, 1969). A possible drawback could be the large number of variables required to obtain an acceptable level of accuracy during classification. In spite of this, the technique has

heuristic value as it is possible to ascertain to a certain extent which variables are the most important in distinguishing between movers and non-movers. Although discriminant analysis has proved to be a fairly robust technique, not too much importance can be attached to subtle differences in the rank order of variables, due to the problems of measurement and multi-colinearity in data of this nature.

Finally, it may be said that movers are renters, younger than 30 years of age, and if married then for less than ten years, have a duration of stay of five yers and less and are very dissatisfied with their current dwellings.

Acknowledgement

This paper was adapted from research which formed part of Report no. 4/1979 by the Institute for Cartographic Analysis, University of Stellenbosch, with the title: "Residensiele Mobiliteit van Blankes in die Kaapstadse Metropolitaanse gebied."

REFERENCES

Bell, W. (1968). Social choice, life styles and suburban residence. In Dobriner, W.A. (ed.). The Suburban Community. New York: Putnams.

Brown, L. A. and Moore, E. G. (1970). The intraurban migration process: a perspective. Geografiska Annaler. Vol. 52B: 1-13.

Chevan, A. (1971). Family growth, household density, and moving. Demography. Vol. 8(4):451-458.

Clark, W. A. V. (1975). Locational stress and residential mobility in a New Zealand context. New Zealand Geographer. Vol. 31:67-79.

Daly, M. T. (1968): Residential location decisions. New Castle, New South Wales. Australian and New Zealand Journal of Sociology. Vol. 4:18-35.

Fredland, D. R. (1974). Residential Mobility and Home Purchase. Lexington, Mass.: Lexington Books.

Johnston, R. J. (1978). Multivariate Statistical Analysis in Geography. New York: Longman Inc.

Kaiser, E.J. and Weiss, S. F. (1969). Some components of a linked model for the residential development decision process. Proceedings of the Association of American Geographers. Vol. 1:75-79.

King, L. J. (1970). Discriminant analysis: a review of recent theoretical contributions and applications. Economic Geography. Vol. 46:367-378.

Klecka, W. R. (1975). Discriminant Analysis. In Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K. and Brent, D. H. (eds.). SPPS. Statistical Package for the Social Sciences. 2nd ed. New York: McGraw-Hill Book Co.

Long, L. H. (1972). The influenceof number and ages of children on residential mobility. Demography. Vol. 9(3):371-382.

McGinnis, R. (1968). A stochastic model of social mobility. American Sociological Reveiw. Vol. 33:712-721.

Nie, N. H., et al. (1975). SPSS. Statistical Package for the Social Sciences. 2nd ed. New York: McGraw-Hill Book Co.

Pickvance, C. G. (1973). Life cycle, housing tenure and intraurban residential mobility: a causal model. Sociological Review. Vol. 21(2):279-297.

Rossi, P. H. (1955). Why Families Move. Glencoe, Ill.: The Free Press.

Sabagh, G., Van Arsdol, Jr. M.D., an dbutler, E. W. (1969): Some determinants of intra-urban residential mobility: conceptual considerations. Social Forces. Vol. 48(1):59-72.

Speare, A. (1974). Residential satisfaction as an intervening variable in residential mobility Demography. Vol. 11(2):173-188.

Speare, A., Goldstein, S. and Frey, W. H. (1974). Residential Mobility, Migration and Metropolitan Change. Cambridge, Mass.: Ballinger Publishing Co.

Wolpert, J. (1965). Behavioral aspects of the decision to migrate. Papers and Proceedings of the Regional Science Association. Vol. 1:159-169.

PINUS RADIATA AS A BEACH DUNE STABILIZER IN NEW ZEALAND

Michael P. McIntyre

The drowned and broken coast of the northern part of New Zealand's North Island gives the appearance of innumerable sheltered harbors, some of considerable size. And many of them have been heavily utilized from early historic time to the present: the Bay of Islands, Waitamata, Whangarei, Tauranga, Poverty Bay, Mercury Bay. But all of these have easterly exposures. Long years of harsh experience have brought about the realization that a distinct difference exists between the east coast and west coast harbors in terms of practical shipping. It is simply a matter of the lee position relative to the stormy Tasman Sea with its boisterous, sometimes savage winds; especially in the days of sail, ease of harbor entrance and egress dictated something less than pervading high winds directly onshore. But above and beyond this drawback has been the effect of the Tasman storms as they kick up surging, plangent surf along the western beaches and harbor entrances. Virtually every large coastal indentation has a shallow restricting bar at its mouth which not only constitutes a major hazard to navigation but limits free tidal penetration. Lacking tidal scour, sand washed in from the sea, combined with silt from debouching streams, fouls the waterway at an accelerated rate transforming it into a series of shallow mudflats. Hokianga, Kaipara, Manukau, Raglan and Kawhia all suffer to greater or lesser degrees from these maladies. This is nature at work attempting to fill in the indentations along a fretted coast and ultimately to smooth it into an uninterrupted, featureless, littoral.

In places where this has already been accomplished and the straight shoreline faces an active sea, as for example 90 Mile Beach, Bayley's Beach, the Kaipara Heads, Muriwai and Waiuku, yet another natural eroding process is at work. Here are migrating sand dunes put into motion by surf and wind. As they march inexorably inland, phalanx upon phalanx they overwhelm forest and farm alike.

So the west coast has its problems: seemingly commodious, landlocked harbors are rendered almost useless for ship navigation by treacherous entry bars and shallow waters; beaches are stormy and hazardous for swimmers; and long stretches of shelving coast are afflicted with ambulating beach dunes threatening to engulf the adjacent countryside. This last is the topic at hand—how to develop effective methods to slow or suppress entirely the insidious sands? It has not been a simple task.

Efforts to control dune migration began as early as 1910 with the introduction of marram grass (Ammophelia arenarea) grass from the North Sea coast of Europe. Here was a rank grass with an extensive root system whose natural bedding ground was the sterile, restless, beach dunes and a plant that actually seemed to prefer a moderately saline soil. Except for the especially active foredunes just above high tide line, marram proved to be a very effective stabilizer in a number of locations.

But another European model in dune stabilization was intriguing. In the Landes region of France, fronting on the stormy Bay of Biscay, the introduction

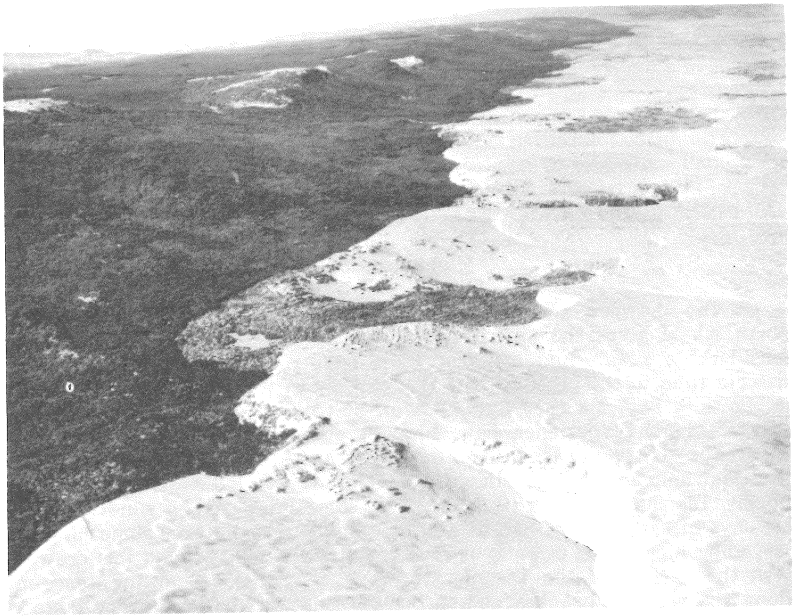


Fig. 1. A general view of unimproved sand country. To the left are manuka covered back-dunes; at the right, actively migrating foredunes.

of grass to impede advancing sand had been followed by pine tree plantings. These had taken hold and grown into mature forests producing valuable economic products as well as permanently solving the dune problem. However, early attempts in New Zealand were only moderately successful from the standpoint of persuading the pine trees that sand was the ideal soil for propagation and growth, and when some exotic pines did finally survive and reach maturity, they were all too often varieties that produced an inferior quality of saw log.

The real breakthrough came in the 1930s and 40s with the widespread planting of Monterey Pine (Pinus radiata). In its natural habitat—the Monterey Peninsula of California—radiata grows with moderate success on a light and sandy soil; but when transported halfway around the world and planted widely in the coarse pumice of the North Island volcanic plateau, this remarkable tree not only survives where other trees had not done well at all but whole forests now flourish. It also has proved to be an excellent timber tree; it is both fast growing and susceptible to processing into a wide range of wood products. With these impressive credentials it became only a matter of time before radiata was introduced into the dune habitat, and given a helping hand by the forester it demonstrated growth habits superior to all species tried before.

Through the years a system has been perfected which culminates in a mature radiata forest on the beach dunes within thirty years; a forest which: (1) stabilizes dune migration, (2) produces a continuing supply of merchantable saw timber, and (3) as a happy by-product, supplies for the harried urban vacationer a pleasant quasi-wilderness recreation site.

Just 20 miles north of Auckland is the southernmost reach of extensive Kaipara Harbor, the largest enclosed waterbody in New Zealand. But fronting on the Tasman Sea it suffers from all of the indignities of west coast harbors in

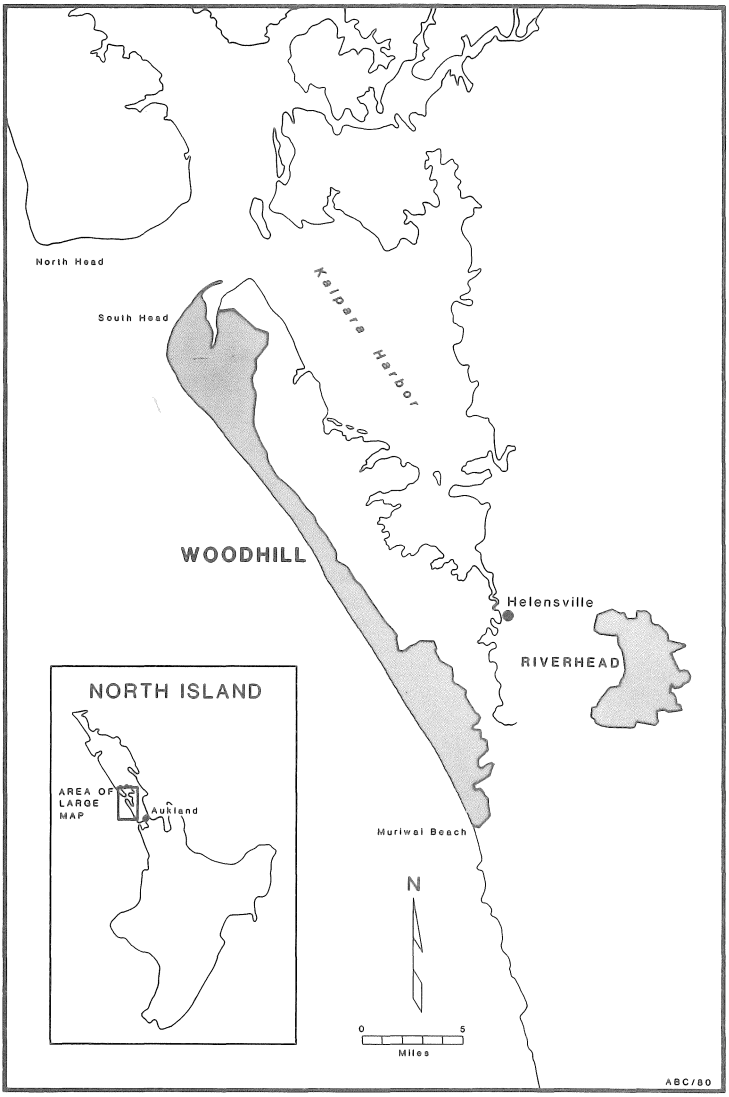


Fig. 2. (map) Woodhill and environs

Fig. 3. Marram

Fig. 4. Lupin

general, hence throughout its recent history Kaipara, despite early high hopes, has been relatively useless for any kind of significant shipping. The entrance to the harbor, less than 5 miles wide and gradually narrowing, separates long narrow peninsula bars which in turn isolate the harbor from the open sea. The southernmost of these called Woodhill, which extends 30 miles or more from Muriwai to South Head has been one of the pioneer sites for experimental coastal dune fixation.[1]

The system of artificial plant succession that has evolved utilizes three basic steps. First, the marram grass is planted directly by hand on the shifting beach sand. Sometimes the movement of the sand is arrested a bit by installing sand fences, sometimes the newly planted grass clumps are watered and fertilized. But the marram is amazingly tough and persistent and a high percentage of success is achieved with a minimum of care. Once the marram is established and flourishing (usually 1-2 years) then a perennial tree lupin (Lupinus arboreus) is sown broadcast amongst the tussocks. Despite its name this yellow lupin is only 2 feet high at maturity, but it comes on rapidly over a period of a year or so between the more widely-spaced grasses and eventually covers the greater part of the sand surface helping to further stabilize the dune.

It is at this point, perhaps 2-3 years after the initial grass plant, that the Monterey pine seedlings are introduced. Normally the lupin is tractor-crushed and the new little foot-high trees planted at about 10 foot intervals amongst the debris.[2] It should be noted that lupin is a legume and studies have demonstrated that the nitrogen released by crushing is of distinct benefit to the radiata seedlings.[3] And further that the partial recovery of the lupins following crushing, at the same time the trees are taking hold, provides both a sheltering nursery crop to shield the delicate seedlings from sun and wind, and a contiuing supply of nitrogen to the soil through their developing root nodules.[4] Years of trial and error prove that it is difficult to establish lupins on an ambulating sand bedding medium without the initial stabilization by marram; and almost impossible to establish young healthy trees without the aid of lupin.

Much of the Woodhill district can be divided into two types of dunes: (1) the lower and more active foredunes at the tidal periphery and (2) the higher, older billowed back-dunes. The former are not always susceptible to complete control since they are newly developing almost on a daily basis and, moreover, are afflicted by soil salinity, high winds and sea spray.[5] Nonetheless, near their inner margin marram grass normally prospers and lupin and radiata follow in sequence. But the closer to the sea the more difficulty is encountered in forest establishment as the trees are affected by "salt burn" and stunting, which render them relatively useless as timber. They do arrest the dunes, however, and the question is often simply one of marram vs. radiata measured against cost and sand stabilization efficiency.[6]

The massive back-dunes present, on the whole, somewhat lesser problems. In many places they are already effectively fixed by a dense cover of native manuka (Leptospermum scoparium). This is a woody shrub, rather than a tree, that rarely exceeds 20 feet in height. It is often regarded on the north country farms as a weed but it establishes itself rapidly and acts as a protective cover over large areas of light, unstable and eroding soils. On the back-dunes, although generally stunted by the wind, it forms dense 10-foot high thickets. Manuka can be readily bulldozed and lupin, followed by radiata seedlings, successfully planted right through the trash. Only on the steepest slopes or where it has invaded the foredunes is the manuka cover allowed to remain.

In the young radiata forest early management techniques revolve strongly about pruning and thinning. This is especially significant during the first ten

years because research has shown that continuing lupin growth contributes strongly to the health and vigor of the young trees, and lupin will not survive without a certain minimal light at the forest floor. Experimental pruning as early as the fourth year appears to be beneficial; and thinning at ten years not only opens up the developing high canopy of the now sizable trees but produces saleable chips and/or poles which aid in defraying costs.[7] A second thinning at 22 years reduces tree density to a final 80 stems to the acre, to use the forester's terminology, and again produces useful timber. By now the importance of lupin is nil and other kinds of secondary growth have taken over. If grass is well represented or has been deliberately sown, neighboring farmers are allowed to pasture their cattle beneath the trees, their movement limited by temporary electric fences. Other management problems include rabbits and possum, which are controlled by poisons; fire; and plant diseases (fortunately not widespread in New Zealand radiata forest) which are attacked by an array of aerial sprays.

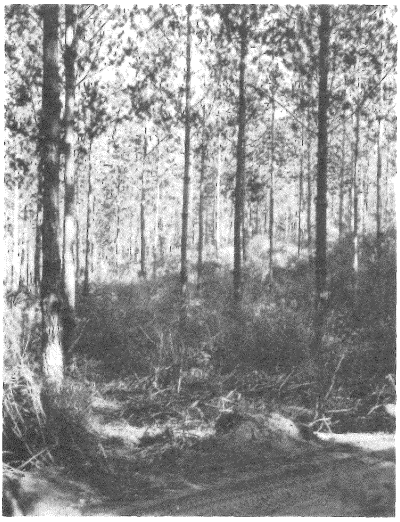


Fig. 5. A 15-year old radiata forest

One of the reasons Woodhill is of particular interest is that due to its selection as a pioneer site in dune stabilization, overall management has evolved here to the point that second-generation forests, already well underway, are projected as doubling the per-acre productivity of their predecessors. Precise planting schedules, proper spacing, pruning and thinning, and replacement of early experimental groves of such marginal timber trees as Monterey Cypress (Cypress macrocarpa), European Maritime pine (Pinus pinata), Bishop pine (Pinus muricata), and sundry eucalyptus varieties, improve the yield of valuable wood products.[8] In traveling north from Muriwai to South Head one progresses from older plantings to newer. At South Head proper there are still dunes to conquer, one reason being that the sandy wasteland had been set aside as a military aerial bomb range. But plans call for eventual silviculture both here and across Kaipara entrance to include another 30 miles of beach dunes to the north.

Lumbering is regulated by the New Zealand Forest Service but contracted out to private firms and they in turn service a private mill near Helensville equipped with saws, kiln and a chemical plant. A separate chip and particle board factory is not far away. This specific location for wood processing was in part dictated by a second sizeable radiata state forest at Riverhead, southeast of Woodhill, which supplies supplementary saw logs. Riverhead is not a dune control project but rather an attempt to produce exotic trees on a heavy clay soil which at one time supported a Kauri (Agathis australis) forest--an exercise in solving an entirely different set of problems.

As an interesting and related aside there is a radiata forest at Waiuku on the huge dunes just north of the Waikato River mouth, 25 miles south of Auckland.[9] This district, like Woodhill, was an early experimental site for beach sand stabilization and it has shown a very similar developmental pattern, even to the point of current second-generation trees already thriving. But there is a major difference. The dune sands at Waiuku are titanium-rich ironsands suitable for use as commercial ore; and with the establishment a few years ago of an integrated steel mill just eight miles distant, the Waiuku forest is in the midst of a mineral as well as wood products development.

The ore-rich region has been divided into 250 acre blocks for clearing and mining one at a time. Mature timber goes to the mill and the ironsand to a separator for preparation of blast furnace charges. There the process is a simple scrubbing with water followed by magnetic separation of the useful titano-magnetite. All residue, which makes up a very high proportion of the initial product, is returned to the quarry site and a new forest begun. So, a sustained-yield, block-cutting, lumbering regime has been initiated complicated only slightly by the short-term borrowing of the soil so that some of its useful elements may be removed. Curiously, preliminary research tends to indicate that the trees grow slightly better on the processed sands than the original.[10]

Large parts of both Woodhill and Waiuku forest and beach are kept open to the public on a year-around basis for recreational purposes. Only in areas of active logging, planting, mining, or military use are there normally any restrictions. But New Zealand has not, as yet, been faced with the "blessings" of trail bikes and dune buggies in large numbers, nor have there been hordes of hunters, so far, where rabbits and tiny fallow deer are the only game. But all of these folks may well find their activities curbed in some fashion sooner or later if merely to protect them from each other. And although experienced surfers find the beaches exhilarating, these can be treacherous in the extreme for a casual recreational swimmer. Nonetheless, as of now, the general ambience is one of quiet solitude where it is difficult to envisage a major metropolis only a half hour's drive away.

CITATIONS

[1]Jew, P. J., Foredune Stabilisation—Muriwai Beach Domain, Soil and Water, Vol. 7 Nos. 1 & 2, 1970, pp. 1-5.

[2]Sutton, W. R. J., Initial Spacing and Financial Return of Pinus radiata on Coastal Sands, New Zealand Journal of Forestry, Vol. 13, No. 2, 1968, pp. 203-219.

[3]Gadgil, Ruth L., The Nutritional Role of Lupinus arboreus in Coastal Sand Dune Forestry, II. The Potential Influence of Damaged Lupin Plants on Nitrogen Uptake by Pinus radiata, Plant and Soil, Vol. 34, 1971, pp. 575-593.

[4]Gadgil, Ruth L., The Nutritional Role of Lupinus arboreus in Coastal Sand Dune Forestry, I. The Potential Influence of Undamaged Lupin Plants on Nitrogen Uptake by Pinus radiata, Plant and Soil, Vol. 34, 1971, pp. 357-367.

[5]Jew, op. cit.

[6]Whiteside, I. D., Timber Quality of Radiata Pine at Woodhill Forest, New Zealand Journal of Forestry, Vol. 9, No. 2, 1964, pp. 171-183.

[7]Mead, D. J., et al., Responses of Pinus radiata to Thinning and the Presence of Lupins, New Zealand Forest Research Institute Silviculture Report No. 119, Feb. 1969.

[8]Whiteside, op. cit.

[9]New Zealand Forest Service, Waiuku Forest, folder (6 pgs), E. C. Keating, Government Printer, Wellington, 1978.-

[10]Gadgil, Ruth L., Miscellaneous Glasshouse Experiments on the Nutritional Potential of Some North Island Coastal Sands, I. The Effect of Titano-Magnetite Extraction on Growth of Lupinus arboreus and Pinus radiata in Waiuku Sand, New Zealand Forest Research Institute Soils and Nutrition Report No. 17 (unpublished), 1970.

OTHER REFERENCES

Ber, P. J. and C. Smithies, "Subsurface Sowing of Yellow Lupin (Lupinus arboreus) for Economical and Rapid Sand Dune Stabilization at Woodhill Forest," New Zealand Journal of Forestry, Vol. 18, No. 2, 1973.

Gadgil, Ruth L., "Nutritional Availability in Coastal Sands With Particular Reference to Lupinus arboreus on Pinus radiata at Woodhill." Three Preliminary Experiments, Forest Research Institute Silviculture Report No. 90, November, 1967.

Gadgil, Ruth L., "Miscellaneous Glasshouse Experiments on the Nutritional Potential of Some North Island Coastal Sands, III. The Effect of Added Nitrate and Phosphate on Growth and Nodulation of Young Lupin Plants in Woodhill and Mangawhai Sands," New Zealand Forest Research Institute Soils and Nutrition Report No. 17 (unpublished), 1970.

Goncar, A. I., "Use of Lupins in Afforestation," Lesn. Hoz, Vol. 3, pp. 84-85, 1950.

Levy, J. W. and D. St. John, "Silviculture on Dune Sands," New Zealand Journal of Forestry, Vol. 9, 1964, pp. 162-170.

Restall, A. A., "Sand Dune Reclamation on Woodhill Forest," New Zealand Journal of Forestry, Vol. 9, 1964, pp. 154-161.

Sutton, W. R. J., and J. O. Drewitt, "The Volume and Form of Woodhill Grown Pinus radiata—A Comparison With Trees Grown in Other Areas," New Zealand Forest Research Institute Silviculture Branch Report No. 79 (unpublished), 1967.

NOTE

This study derives primarily from field work on the dunes during a 1973-4 sabbatical. New Zealand Forest Service personnel were inestimably helpful in on-site interpretation.

AGRICULTURAL SOUTHLAND; PASTORAL MURIHIKU REVISITED

William J. Brockie

INTRODUCTION

It is fitting if, in paying tribute to Professor Howard J. Critchfield, it is recalled that some 30 years ago, as a visitor to the University of Canterbury in the South Island of New Zealand, he spent the period from 1948 to 1950 gathering material for his doctoral dissertation. This research presented the first comprehensive statement on the agricultural geography of Southland. As a model, it stimulated a generation of New Zealand geographers to analyze their rural landscapes; as a document it has provided a baseline against which subsequent development could be assessed.

From the perspective of the 80s it is clear that Critchfield identified the trends that would underpin Southland's agricultural prosperity through the following decades. Moreover, even if it has since become unfashionable to emphasize physical constraints on agriculture, the reality of the regional patterns he identified has persisted. Despite attempts to overcome their fundamental limitations, modern mechanized agriculture maintains an uneasy equilibrium with the natural environment, and with energy supply now holding a decisive position, this relationship may be taken as an expression of the long term stability of agricultural systems (Fig. 1). As efficient economic agriculture is the key to New Zealand's wealth and standard of living, this dependence on support energy demands evaluation so that the knowledge gained may be used both to achieve desired goals and to preserve objectives already attained.

It is in this context that the agricultural evolution of Southland in the last three decades is assessed.

BACKGROUND

The Pre-Development Period of the Early 1950s

By the early 1950s, efficient purposeful management of Southland's lowland farms had been achieved. It complied with the general goals and objectives of New Zealand agriculture in that it combined food production according to sound ecological principles with both adequate return for the farmer and a surplus that provided the nation with overseas exchange. If subject to stress, these goals might be to some extent incompatible and under then-prevailing circumstances lowland Southland reached a plateau in development. The classic strategems of energy- and capital-intensive western agriculture—the deployment of fertilizer, mechanized equipment and chemicals—had reached a level where marginal production gains did not appear to justify the progressively disproportionate investment in goods derived from overseas funds.

Critchfield summarises this argument and observes that an alternative solution to increased production would be to extend the efficient lowland practices to the 500,000 hectares of undeveloped downland and hill country, that

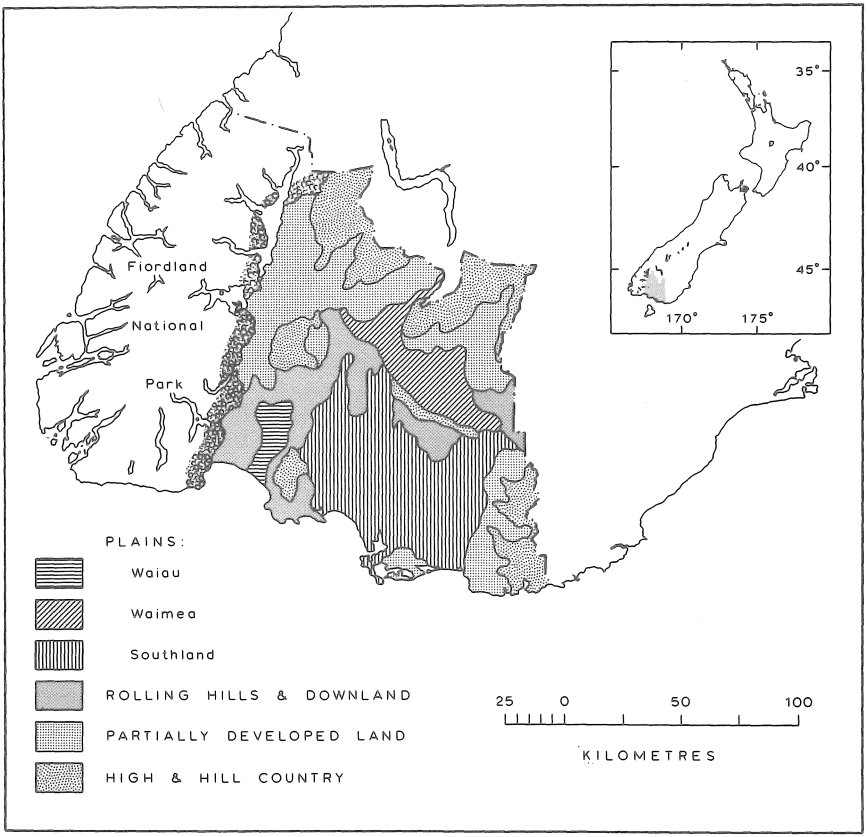


Figure 1. Southland Regional Farming Systems, 1979

together comprised some 35% of Southland's occupied area. In this alternative, there was doubt of the extent to which intensification could be achieved by conventional farming methods. Transformation of the uplands could only be accomplished by replacing nutrient-low grazings of indigenous tussock and browntop (Agrostis tenuis) with high yielding clover-rich pastures. Yet because much of the area was unploughable any simple extrapolation of lowland farming practices was likely to be both areally limited and economically prohibitive.

In some ways the early 50s were propitious for such an alternative solution. A fresh, younger, generation of postwar farmers was more strongly motivated; confidence had been established through firm wool prices and a continuing demand for meat and dairy products by a protein-hungry world—a confidence reinforced by sympathetic government policy. Major commitments to the purchase of heavy agricultural machinery to work the tussock slopes ensured that the initial development was highly capital-intensive.

In the decade that followed, 'terms of trade' became increasingly adverse for agricultural exporters. Prices for farm products increased at rates lower than those for manufactured goods. As elsewhere, Southland farmers were forced to seek lower cost solutions to boost pastoral production and efficiency. Development was only able to continue by the acceptance, and progressive application, of a series of scientific-technological innovations that increased production dramatically without commensurate increases in capital or energy commitments, so that, paradoxically, as development was extended into more difficult hill country, it became, of necessity, less capital- and energy-intensive. By the decade's end, economic, technological and social factors were mutually reinforcing to the extent that farm improvement became not only possible, but obligatory.

Farm Improvement

If the Southland farmer had one lesson to teach the world, it was the appreciation of the role of legumes in grassland farming and the associated efficient management practices. In this system clovers, stimulated by topdressings of phosphatic fertilizer, fixed atmospheric nitrogen which, in turn, supported high-producing strains of pasture grasses. The integral role played by soil micro-organisms was also appreciated and the drilling of clover seed inoculated with rhizobia became common practice. Even so pasture vigor declined through time and it became accepted routine to plough under such reverting pastures and grow a winter fodder crop or a cereal crop, before sowing back into pasture.

The intervals between 'rotational ploughing' could be extended by massive applications of lime, but, in combination, ploughing and liming effectively confined farming both physically and economically to the less rugged country. The role of lime was something of an enigma, and Critchfield comments on the logic of a situation where lime was applied where no lime deficiency could be shown to exist, and he draws attention to the detrimental consequences of excessively high soil pHs. Nevertheless, continued pasture response ensured that liming as a practice persisted. It took several years before a trace element deficiency was confirmed--that of a mineral either supplied inadvertently as impurity in the lime, or one made available by an alkaline pH. Little doubt as to the identity of the trace element remained after it was demonstrated that molybdenum increases in availability with increasing alkalinity, and that nitrate nitrogen taken up from the soil cannot be released as a step toward protein synthesis without its presence. Excessive liming had masked critical molybdenum deficiencies both in the alluvium of the plains and the loess of the hills. Application

of sodium molybdate at rates of 150 grams per hectare gave pasture responses equivalent to liming at rates in excess of 7.5 tons per hectare and removed immediately the logistical problem of distributing tonnage quantities of lime. In turn, this meant that one major obstacle to realizing the potential of Southland's unimproved land had been overcome. Using aircraft molybdate superphosphate could be be distributed economically to areas wholly inaccessible by other means.

The problem of introducing improved grasses and clovers into difficult or unploughable tussock remained as an equally formidable obstacle. In overcoming this too, aircraft were to play a decisive role. Once grazing management was ensured by dropping accessory fencing materials from the air, mobs of cattle and sheep were employed in a "hoof and tooth" role to trample or eat out scrub and tussock growth. Aerial topdressing, and oversowing with pelleted, inoculated clovers and grass seed, was then followed by stock trampling to consolidate the seed after it had fallen.

Although major capital outlay was minimised, this model of farm improvement meant a decade or more of financial stringency before benefits accrued from the increased productivity. The employment of stock as an agency of development was not without disadvantages. Concentrating stock on nutritionally poor herbage had its repercussions in lowered meat and wool quality, besides reducing lambing and calving percentages. Sales of animals actually decreased as higher proportions of them were retained on the farm to ensure that the progressively increasing carrying capacity of the improved pastures was matched by grazing pressure. The better to control prolific pasture growth, stock, particularly cattle, had to be purchased—an item of expenditure that (like superphosphate, seeds, and their distribution costs) was a new item in many budgets. Further paddock (field) subdivision fencing, gates, access tracks, enlarged sheep yards, cattle yards, woolsheds haybarns, topdressing landing strips and fertilizer storage bins were consequent, downstream, expenditures.

During these early stages a particularly high degree of managerial skill and personal resolve were demanded. Not all farmers met the challenge. Nevertheless by the early 70s—the conclusion of the most rapid phase of farm development—over 350,000 hectares of rough pasture had been transformed from farming units carrying 2.5 stock units per hectare to ones carrying an average of 8 or 9 stock units per hectare.*

Overall, production increased by 259% between 1950 and 1978. Such increases are by no means unique. United States data over the same period, for example, indicate increases of the same magnitude. What is different and significant is that these increases were achieved without the corresponding disproportionate increases in auxiliary energy inputs that have characterized most other systems of intensified western agriculture.

---

*Stock Units (also known as Ewe Equivalent Units)

Sheep:	Ewes, per head	1.0 s.u.
	Hoggets, per head	0.6 s.u.
	Lambs, per head	0.0 s.u.
	Others, per head	0.8 s.u.
Cattle:	Cows, per head	6.0 s.u.
	Bulls, per head	5.0 s.u.
	Calves, per head	3.0 s.u.
	Others, per head	4.0 s.u.

This is perhaps best emphasized by demonstrating that in achieving its increase in production, indirect inputs into Southland agriculture increased by only 55%. Even the already intensively developed Southland plain doubled its gross output for only 10% additional indirect auxiliary energy.

METHODOLOGY

In addition to assessing the changes in Southland agriculture, the study also seeks to present a methodology for the synthesis of man, agriculture, and energy, within a regional framework. An integral part of this objective has been to quantify energy components for Southland farming systems for two representative periods: the first in the early 1950s, the second in the late 70s. Little information has been available on the energetics of New Zealand farming until very recently, and this present paper draws heavily on methodology developed at the Joint Centre for Environmental Sciences at Canterbury University to achieve its aims.

The approach selected is tht of Energy Analysis* which seeks to define and formalize the gross energy requirements and energy yields of Southland's farming systems, but with solar and human energy inputs excluded. Simple direct inputs of fuel and power are supplemented by indirect components including energy implicit in the manufacture and transportation of, say, fertilizers, and that in capital expenditures on tractors or buildings, suitably depreciated. Throughout, quantities are expressed in S.I. units, with energy in joules (J). The units used here are the megajoule (MJ—one million joules—and the gigajoule (GJ)—one thousand million joules.

For comparison, an average man has a daily intake of 3100 kilocalories—the 3100 Calories of the nutritionist—a figure equivalent to 13 MJ; a kilogram of wheat has a total energy content of about 16.6 MJ, and a litre of diesel fuel, 39 MJ, or 142 MJ per U.S. gallon.

Because there is, as yet, no established methodology, it is difficult to make direct comparisons, but it is clear that in capital-intensive western agriculture, food production requires auxiliary energy in amounts little different from the energy value of the food produced. For grain crops, the energy ratio is perhaps 3:1; for intensive livestock production, the ratio is less by perhaps one order of magnitude. Labour-intensive agriculture may achieve energy ratios in excess of 10:1, and occasionally, in rice culture, as high as 50:1.

---

* Definitions

AUXILIARY ENERGY: the energy purposefully sequestered in the process of producing a farm good or to modify a farming system.

ENERGY INTENSITY: the amount of auxiliary energy expended per hectare (MJ/ha)

ENERGY REQUIREMENT: the amount of auxiliary energy expended per kilogram of product (MJ/kg)

ENERGY RATIO: the amount of energy returned divided by the amount of auxiliary energy expended to obtain this return

ENERGY YIELD: the energy value of the output on a per hectare basis.

NET ENERGY YIELD: the energy value of the harvestable produce per hectare less the auxiliary energy input

DATA

Southland comprises a number of sharply-defined terrains each representing a distinct integration of landforms, soils and local climates. Southland farming mirrors this physical pattern closely and at the outset there was a priori reason to believe that the major spatial pattern of contemporary farming systems remained in essence the agricultural regions recognized by Critchfield (Fig. 1). Accordingly a stratified sampling scheme based on the proportion of farms within these geographical regions was adopted. For analytical purposes a target of 240 farms (a 5% sample) was considered desirable in view of known farm-to-farm variability in farming efficiency. In practice this proved impossible to achieve, and a high proportion of selected farms had to be excluded because of the inadequacy of their records. Such farms were often adjudged to be among the least progressive; consequently the balance—117 farms representing a 2.4% sample of farm numbers, but totalling 3.8% of total area--is, on aggregate, perhaps biased towards better-managed units.

Each responding farmer provided information on the quantities and sources of materials brought to and despatched from, his farm for the years 1977-79. From this a simple energy-based input-output analysis was computed (Table 1). The energetics of on-farm activities were less well documented, but the application of standardized New Zealand data that included cultivation work rates, tractor fuel consumption etc. enabled energy values to be assigned (Harris, et al., 1979). Because of the reduced sample sizes, the standard deviations of various input and production factors are large, with average values possessing limited significance. Consequently the data do not provide a wholly satisfatory base from which to derive spatial variations in the energy economy of Southland farming. However, extrapolations yield data that can be tested against the information from other sources relating to Southland. In aggregate, all agricultural parameters fell within the 95% confidence limits save two—direct fuel usage and new machinery purchases—which were within the 90% limits. In terms of output—input data in energy terms, linear correlations were significant, if low, for each region. Regression analysis confirms that the regional samples represent different statistical populations. Thus combining the data to demonstrate overall Southland relationships has little physical meaning but in the present context, space precludes a regional discussion in Table 1.

The data reveal that only in the intensive grassland farming systems of the Southland Plain and Lower Mataura Valley, and the stock-cropping systems of the Waimea Plain, were farm outputs highly and significantly correlated with inputs. This could be taken to indicate a greater degree of managerial and physical uniformity within these farming systems. 'Best fit' regression lines seem to indicate the operation of the law of diminishing returns.

In each of the other regions, data points are much more dispersed suggesting that energy yields are determined by a combination of variable factors such as management objectives, stage of development or local differences in physical controls. The data available neither justifies nor permits more detailed analysis.

Comparable data for regional farm production in the 1950s, were expectably lacking. Only 37 farmers retained adequate records though a further 81 provided less comprehensive information. The Agricultural Advisory Officer of the period was interviewed and his files and personal recollections, together with some theses and land-utilization surveys, supplemented published information. Precise fuel use data were obtained from excise duty repayments for motor spirits used for agricultural purposes.

TABLE 1

SOUTHLAND: ENERGY INPUTS AND OUTPUTS 1979
(in brackets, average for 1948-51)

	Inputs ($\times 10^6$ GJ)			Outputs ($\times 10^6$ GJ)	
Direct			Pastoral System		
Diesel	1.317	(0.073)	Sheepmeat	3.429	(1.52)
Petrol	1.584	(0.596)	Wool	1.181	(0.33)
Electricity	0.038	(0.001)	Beef	0.929	(0.13)
Other	0.001	(0.005)	Dairy	0.250	(0.46)
Total	2.940	(0.674)	Other	0.031	(0.0)
			Total	5.820	(2.44)
Indirect			Cropping System*		
Fertilizer	0.340	(0.117)	Cereals	1.937	(0.50)
Machinery	0.329	(0.203)	Seeds	0.011	(0.07)
Cartage	0.123	(0.110)	Lucerne	0.034	(0.0)
Fences	0.118	(0.116)	Hay	0.085	(0.03)
Buildings	0.235	(0.200)	Total	2.067	(0.60)
Contractors	0.050	(0.020)			
Chemicals	0.067	(0.010)			
Other	0.020	(0.001)			
Total	1.282	(0.777)			
Total Inputs	4.222	(1.451)	Total Outputs	7.887	(3.04)

*(For processing or for sale only

On a regional basis the data sample is small; nonetheless the information is internally consistent and the results have been regarded as providing a suitable base for broad-scale comparison with the late 1970s data (Table 2).

ENERGY INPUTS

The objective of this section is to quantify the energy inputs of Southland farming systems. To this end, criteria had to be established for defining the boundary considerations and energy requirements for each physical input. Space precludes setting these out in detail or justifying the assumptions made, but a brief explanatory discussion is provided under each of the major headings in Tables 1 and 2.

Direct Fuel Use

This was clearly the largest input of all Southland farming systems for each period. The gross fuel use represents the total used for all agriculturally-based operations. It includes not only on-farm usage, but fuel used in transporting stock and fertilizer and by agricultural contractors developing land, as well a allowances for attendance at stock sales, visits by veterinarians or agricultural extension officers.

TABLE 2

REGIONAL ENERGY INPUT 1979
(in brackets, average for 1948-51)

$x10^6$ GJ

	Southland Plain	Waimea Plains	Waiau Plains	Down lands	Partly Developed	Hill & High Country	Southland Total
Direct							
Diesel	0.351	0.234	0.152	0.224	0.269	0.086	1.317
Petrol	0.422	0.269	0.186	0.280	0.323	0.104	1.584
Electricity	0.016	0.007	0.005	0.005	0.004	0.001	0.038
Total	0.789	0.510	0.343	0.509	0.596	0.191	2.939
	(0.196)	(0.108)	(0.055)	(0.126)	(0.150)	(0.039)	(0.674)
Indirect							
Fertilizer	0.118	0.056	0.026	0.034	0.073	0.033	0.340
Machinery	0.098	0.056	0.032	0.039	0.078	0.026	0.329
Cartage	0.038	0.020	0.017	0.014	0.027	0.008	0.124
Fences	0.031	0.011	0.016	0.022	0.024	0.014	0.119
Buildings	0.069	0.029	0.025	0.035	0.056	0.021	0.235
Contract	0.009	0.010	0.002	0.006	0.019	0.004	0.050
Chemicals	0.018	0.016	0.005	0.009	0.017	0.002	0.067
Other	0.005	0.005	0.002	0.004	0.003	0.001	0.020
Total	0.386	0.203	0.125	0.163	0.297	0.109	1.283
	(0.348)	(0.141)	(0.114)	(0.084)	(0.071)	(0.019)	(0.777)
Total Inputs	1.175	0.713	0.468	0.672	0.893	0.300	4.222
	(0.544)	(0.249)	(0.169)	(0.210)	(0.221)	(0.058)	(1.451)

Note: Because of rounding errors, columns or rows may not add precisely.

Farmers interviewed were rarely able to define actual figures of fuel use for various farming operations though total consumption was usually available. The total energy input for each farm was then calculated from the area under cultivation and the passes necessary for the various crops. This was then multiplied by a factor modelled on prevalent slope, soil character, tractor power and the size and lay-out of the farm. Even so, only 43 to 68% of direct on-farm fuel usage was accounted for. This disparity was particularly evident in the case of dairy farms. It appears that a surprising proportion of direct fuel use must be attributed to ancillary activities such as the use of vehicles and tractors on a variety of tasks, from routine supervision, feeding and shifting of stock, the

transport of equipment and materials for fence, track or ditch maintenance, to collecting supplies from the nearest town. Employment of the tractor power take-off for various farmyard tasks was also a significant user of fuel. On the cereals farms of the Waimea Plains, grain drying to meet the statutory requirements of the Wheat Board was also an important fuel user.

Field Contractors

Intermittent demands for heavy or specialized equipment during farm development, supplementary assistance during critical weather-dependent operations and the demand for the wide range of services offered by agricultural aviation, have provided one stimulus for the emergence of contracting firms providing a range of machinery and services. A second stimulus has been the program of State land development which has offered long term contracts leading toward the subdivision and settlement of unimproved grazing 'runs.' Other bodies such as county councils and the Southland Catchment Board are also included here insofar as they may be involved in roading, flood protection or drainage schemes.

State land development has few constraints on capital or resources, and large blocks of 25,000-30,000 hectares have been cleared of scrub and tussock and sown down to pasture, employing practices that are highly energy-intensive. Such schemes are comprehensive, and farm buildings, subdivision fencing, water supplies, drainage and roading are provided. The energy inputs for these have been included separately under the appropriate headings.

The field contractors' component of the total development costs for the less rugged country of northwest Southland is about 7.5 GW/ha, but in the southeast peat swamp development poses greater problems, and auxiliary energy inputs have been assessed as 11.5 GW/ha. These latter energy inputs are included somewhat anomalously in the data for the already highly-developed lowland agriculture of the Southland Plains.

Auxiliary energy associated with land development presents the problem of how it should be 'costed' in the analysis. In theory at least, it is analagous to a capital investment with benefits in perpetuity, but to be consistent with procedures adopted elsewhere, it was considered rational, if arbitrary, to amortize land development energy inputs over a nominal 40-year period.

As an indirect component of energy usage the calculated inputs are surprisingly low, notwithstanding the allocation of high maintenance, repair and depreciation energy charges. The inclusion of direct fuel usage increases the energy commitment of this sector to about 10% of all inputs. This represents a five-fold increase over the early 1950s when contract cultivation, haymaking and crop harvesting together only just surpassed the energy contributions associated with itinerant shearing and fencing gangs.

Fences

Efficient pasture management demands close control over stock grazing and intensification of farming has been accompanied by reductions in paddock size. Original internal subdivision was usually wire and wooden posts cut during the original land clearance from 'bush' (forest), and by the 1950s these required replacement. An alternative had been gorse hedges and, where well maintained, they offered tight, compact, stock-proof divisions that also provided needed shelter from cold wet "southerlies" at lambing time. Poorly maintained, they were sources of gorse infestation and by the 1950s many were being grubbed out

by farmers anxious to replace both hedges and fences by low maintenance concrete posts and wire. Such fences account for the high energy expenditure (70 MG/m) in the 1950 data. Experience revealed concrete posts were brittle to cattle and many have since been replaced by undressed, preservatized, timber posts with lighter, high tensile, wire and droppers. Internal subdivision by electric fences permits retention of large permanent fields for cropping, but provides the tight control and flexibility for grazing herbage, or feed crops, directly. At 17 MJ/m, such combinations offer substantial energy savings.

Only in the high country have energy inputs for fencing increased. Subdividing large grazing blocks and retirement of sub-alpine zones have often had to be accompanied by costly preparation and the provision of access tracks, while snow and rime ice at high altitudes also ensure that maintenance-energy inputs remain high.

Farm Buildings

Whether to include all farm buildings in a review of energy use in agriculture is a moot point. As with individuals in any occupation, farmers have to be housed; consequently it is appropriate to exclude consideration of the energy value of the farm house from the energy budget of farming. The argument has additional merit when it is recognized that the characteristic farm house serves no specific agricultural function. Consideration of the energy implications of rural roads, schools and non-agricultural services has likewise been excluded.

Yet the farm house had an important, though indirect, role in modifying the development of Southland's agriculture. The economic depression of the 1930s followed by wartime shortages of materials meant that only essential house maintenance had been undertaken, and by the early 1950s many of the original wooden homesteads were approaching the end of their useful lives. Opportunity to replace them came with the higher wool prices of the early 1950s and for over a decade money that might have been put to farm development was tied up in new housing. The rural landscapes of Southland are noteworthy for these replacement houses, which are architecturally and functionally indistinguishable from their urban contemporaries—their presence is witness to yet another factor favouring avoidance of high-cost development technology.

The energy investment into what has been termed the 'ensemble of structures' is wholly relevant. As the complexity and magnitude of farming operations increased, so important financial (and energy) investments were made in new buildings. Most farms possess a woolshed or milking shed (dairy parlor), implement sheds, hay sheds, garage and workshop facilities, open or, more recently, covered stockyards and silage towers. Often the old farm house and stables have been pressed into service as additional barn space. The more remote high country sheep stations are also likely to possess accommodation for itinerant contract workers—shearing gangs or musterers—as well as a manager and permanent hands.

In aggregate, farm buildings represent an important proportion of the indirect energy input of Southland farming—some 18.3% at present. Compared with the early 1950s, this represents a marginal increase, despite a 16% decrease in the total number of farms, and despite modern structures having lower maintenance 'costs,' and depreciation spread over a longer period.

Machinery

In his 1950s' analysis, Critchfield describes farming systems already substantially mechanized. Competition for the limited labour force and, increasingly, repugnance toward the drudgery of non-mechanized repetitive operations provided the initial stimuli. Southland, as elsewhere, had chosen to substitute cheap imported energy for high wages; a trend reinforced in the ensuing decades when the country was forced into ever more competitive external trading situations, and the incentive for low-cost efficiency became paramount. The extension of farming operations provided a further impetus toward increased mechanization and a wide range of specialized machinery and ancillary equipment was purchased, or leased, to speed land development. If today this tendency to mechanization has been reversed as machinery prices have escalated disproportionately to farm returns, reliance has increasingly been placed on the farm contractor to undertake the non-routine specialized operations of the farming calendar.

Listing the machinery present on most farms reveals few differences from the 1950s—one or two tractors, a utility vehicle, trailers and a range of tillage and hay-making equipment. Substantial additional machinery present usually reflects development strategies or cash cropping. On the other hand, the basic vehicles are more sophisticated, and substantially more powerful and fuel-consuming than their 1950s' counterparts.

The indirect input from machinery is second only to fertilizer in all Southland farming systems. In 1950 it was at the top, but relatively there has been little change over the period. The energy assessment is derived from published data including an additional component for transport to, and assembly in, New Zealand.

The increase in four-wheel drive vehicles and farm bikes has been matched by a decline in saddle horses, except for the few stations mustering high country sheep, but vehicle fuel requirements have far exceeded the energy value of crops and stocks produced from land formerly reserved for fodder.

Contract Cartage

In terms of the definitions adopted in this study, the transport energy costs of all goods moved from their new Zealand point of origin to the farmer, and from the farmer to the first stage of processing must be included here. Considering both direct and indirect energy inputs, their contribution exceeds that of fertilizers. It is estimated that over 27.5% of all liquid fuel used in agriculturally-based operations is expended in the actual transportation of farm goods. If allowance is made for the indirect energy component, over 21.5% of all the inputs to Southland's agriculture may be subsumed under this heading. The efficiency of agricultural cartage is inherently low. Strong seasonality of demand, one-way loads and low-loading factors characterize the goods must frequently carried—stock, fertilizers, lime, wool, and baled hay. To this must be added energy costs implicit in specialized handling equipment for bulk materials and high maintenance, repair and replacement factors resulting from long hauls over back country roads.

Although complete data could not be obtained for the early 1950s' situation, the relative energy costs must have been of the same magnitude. All fertilizers had to be transported by rail some 200 km from Dunedin, and very substantial quantities of lime were moved throughout the district in smaller, less

efficient, rail wagons and trucks. Only after molybdate superphosphate—produced from a new, local plant—reduced lime usage by 70%, were significant transport energy savings realized.

Fertilizer

Ranking second to machinery in the early 1950s, today the largest single indirect input to Southland farming is that associated with superphosphate fertilizers. Towards the mid-1970s fertilizer tonnage applied stabilized at almost exactly 10 times that of 25 years earlier. As the rate of application (0.3 tons per hectare) has not changed significantly, the increased usage is related almost exclusively to the extension of the area topdressed.

A strong relationship between fertilizer application and production may be demonstrated statitically. The 'best fit' regression lines for both total and regional farm data are curvilinear—indicating that the highest producing farms are now subject to the law of diminishing returns.

As has already been emphasized, the main difference between indirect energy inputs in New Zealand and those of other developed nations lies in the replacement of fertilizer nitrogen by biological nitrogen fixed by clovers. A conservative calculation shows that Southland clover pastures fix the equivalent of 126,000 tons of Nitrogen per year for the application of 22,500 tons of superphosphate containing about 10% phosphorus.

The total energy cost of this 22,500 tons of phosphorus is about 0.50×10^6 GJ, whereas to fix the same amount of nitrogen industrially would require some 8.8×10^6 GJ—an energy cost double that of all the direct and indirect inputs of Southland agriculture today. In other words, clovers, stimulated by superphosphate provide a 17-fold saving in energy. This saving may well be an underestimate as enhanced leaching, ammonification and associated pollution, are likely to be additional consequences of intermittent heavy applications of soluble forms of nitrogen.

Moreover, there still remains considerable potential in this system. The clovers are eaten by animals which excrete mostly nitrogen in the form of urea that in turn stimulates grass growth. At the same time, decaying roots and the return of dung build up nitrogen in soil organic matter. As the basic principle of superphosphate and trace element application is to correct nutrient deficiencies likely to limit clover growth, this situation is not yet achieved. The optimum ratio of nitrogen to phosphorus in pasture is 10:1, but in Southland the average ratio is little more than half this (5.6:1). However, this is in part due to different management objectives. Maximum nitrogen is linked to attempts to establish an 'all-grass' wintering system whereby 'capital' superphosphate is applied to obtain the peak sustainable level of nitrogen production from clovers (Fig. 2). In conjunction with careful management at very high stocking rates, this state is stabilized by subsequent light 'maintenance' dressings—enough to offset any nitrogen losses from the system. However, a second strategy is current on the Waimea Plains, where the accumulating soil nitrogen is used to 'fertilize' one or two successive cash or fodder crops before the land is resown to clovers and pasture grasses. Initially, this new pasture is clover-dominated because of the low nitrogen-status of the soil, and as such it provides excellent sheep food. With the subsequent build up of soil nitrogen, this is succeeded by grass-dominated swards more suited to cattle. A particularly stable economic base from a closely integrated sheep-crop-cattle system characterizes this strategy.

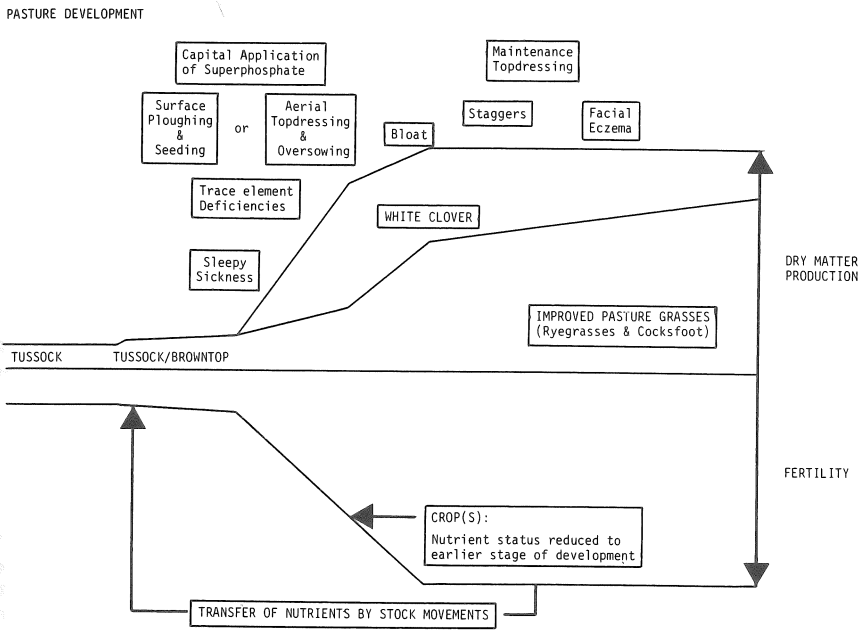


Figure 2. Pasture Development

Chemicals

That only 5% of indirect energy and 1.6% of all auxiliary energy inputs are involved, emphasizes the limited extent to which Southland relies on agricultural chemicals, yet their role is totally disproportionate to the actual quantities applied.

Helicopter spraying of hill slopes or river beds may be necessary during farm development, but extensive treatment of established pastures is unusual, and spot spraying is the norm. Elsewhere, weed control in cereal crops, or aphid control in seed potato areas provide instances of small-scale local use.

The most widespread employment of agricultural chemicals is in dips and drenches designed to control external and internal parasites in stock. Locally, selenium and cobalt deficiencies have also been countered in this way, but these minerals are now incorporated in fertilizer, and stock obtain them from the herbage or by direct soil ingestion.

Compared with 1950, there has been a six-fold increase in the usage of agricultural chemicals, but, in large part this has been due to the development of new products and techniques. Of these, 'chemical ploughing' is finding favour as an alternative to conventional seed bed preparation on lighter soils susceptible to wind erosion. From an energy conservation viewpoint, direct drilling offers savings of more than 60%, and, as fuel prices rise, the economic attractiveness of the technique is likely to increase.

Independently of direct agricultural use of chemicals, significant quantities of the organic phosphorous poison 1080 are being used by Rabbit Boards to control introduced pests--principally the rabbit and the opossum. A killer policy--reinforced by total decommercialization—enabled a measure of control to be achieved and rabbits no longer pose the threat they did when Critchfield studied the area.

ENERGY SAVINGS

The present study reveals that, in aggregate, Southland farmers are relatively low users of direct and indirect energy. They have correspondingly restricted choices of action to achieve either direct or indirect energy savings without risking drastic losses in output.

While this is true in the aggregate, individual farm data emphasize inputs vary significantly, with all components being strongly, positively, skewed above the mean. Management policy was probably the most important factor in determining energy efficiencies. Some farmers were revealed as using up to eleven times more indirect energy—mainly in fertilizers or purchased concentrations--than their neighbours, without significantly superior outputs being obtained.

In terms of direct fuel use, it is possible that some overall savings could be achieved mainly through the use of more economic vehicles for routine, non-specific, farm servicing tasks. The wide variations in tillage practices also seem to offer scope for economies particularly if chemical ploughing were more widely adopted.

OUTPUT

The output data have been calculated on the "at the farm gate" condition of livestock and crops. In line with normal practice, the concept of f.o.b. is applied in the context of the energy used to transport the farm products to the next stage in the system (freezing works, stockyard, wool store, dairy factory, etc.) (Table 3 and Fig. 3).

TABLE 3

REGIONAL ENERGY OUTPUT 1979
(in brackets, average for 1948-51)
x 10^6 GJ

	South land Plain	Waimea Plains	Waiau Plains	Down-lands	Partly Devel-oped	Hill & High Country	Total
Sheepmeat	1.611	0.431	0.287	0.457	0.462	0.181	3.429
Wool	0.650	0.168	0.095	0.138	0.080	0.050	1.181
Beef	0.180	0.137	0.079	0.092	0.291	0.150	0.929
Dairy	0.229	0.017	0.003	0.001	0.0	0.0	0.250
Other	0.020	0.004	0.002	0.005	0.0	0.0	0.031
Total Pastoral	2.690	0.757	0.466	0.693	0.833	0.381	5.820
	(0.159)	(0.630)	(0.281)	(0.150)	(0.184)	(0.036)	(2.440)
Cereals	0.770	0.930	0.088	0.094	0.025	0.030	1.937
Seeds	0.001	0.004	0.001	0.002	0.001	0.001	0.010
Lucerne	0.007	0.021	0.002	0.003	0.001	0.001	0.035
Hay	0.026	0.041	0.011	0.007	0.0	0.0	0.085
Total Cropping	0.804	0.996	0.102	0.105	0.027	0.032	2.067
	(0.186)	(0.236)	(0.115)	(0.035)	(0.015)	(0.017)	(0.604)
Total	3.494	1.753	0.568	0.799	0.860	0.413	7.887
	(1.345)	(0.866)	(0.391)	(0.185)	(0.199)	(0.053)	(3.040)

It should also be noted that the gross energetic value of farm output has been used, i.e., the total energy content of the animal carcass has been used. Output data so derived are substantially greater than the digestible energy by a factor of 3 in the case of sheep, and 2 in the case of cattle. This convention is necessary and particularly important in the case of the wool clip which, as an industrial "crop," has a gross energy content of 23 MJ/kg although as an alternative to petroleum-based man-made materials, it has a value four times this.

Sheep

The predominant farming system is that based on sheep farming. Of 5,100 farm holdings in Southland, 4,600 gain their predominant income from sheep, and, in aggregate, produce 17% of New Zealand meat and 16% of wool. Several different emphases may be subsumed within 'sheep-farming,' but apart from the 'runs,' the production and sale of fat lambs is the main objective with cattle or cropping subsidiary. Only on the 'runs' is wool production the dominant objective, and even here improvement of 'winter' country has often implied a surplus of high nutritional feed available to maintain a subsidiary fat lamb flock (Fig. 4).

Energy use has been strongly influenced by the development of downland and hill farms for more intensive grazing. The substantial energy required to improve this country is not yet matched by output, and, as indicated, such areas return the lowest energy ratios (Table 4). Even so, most of these properties are

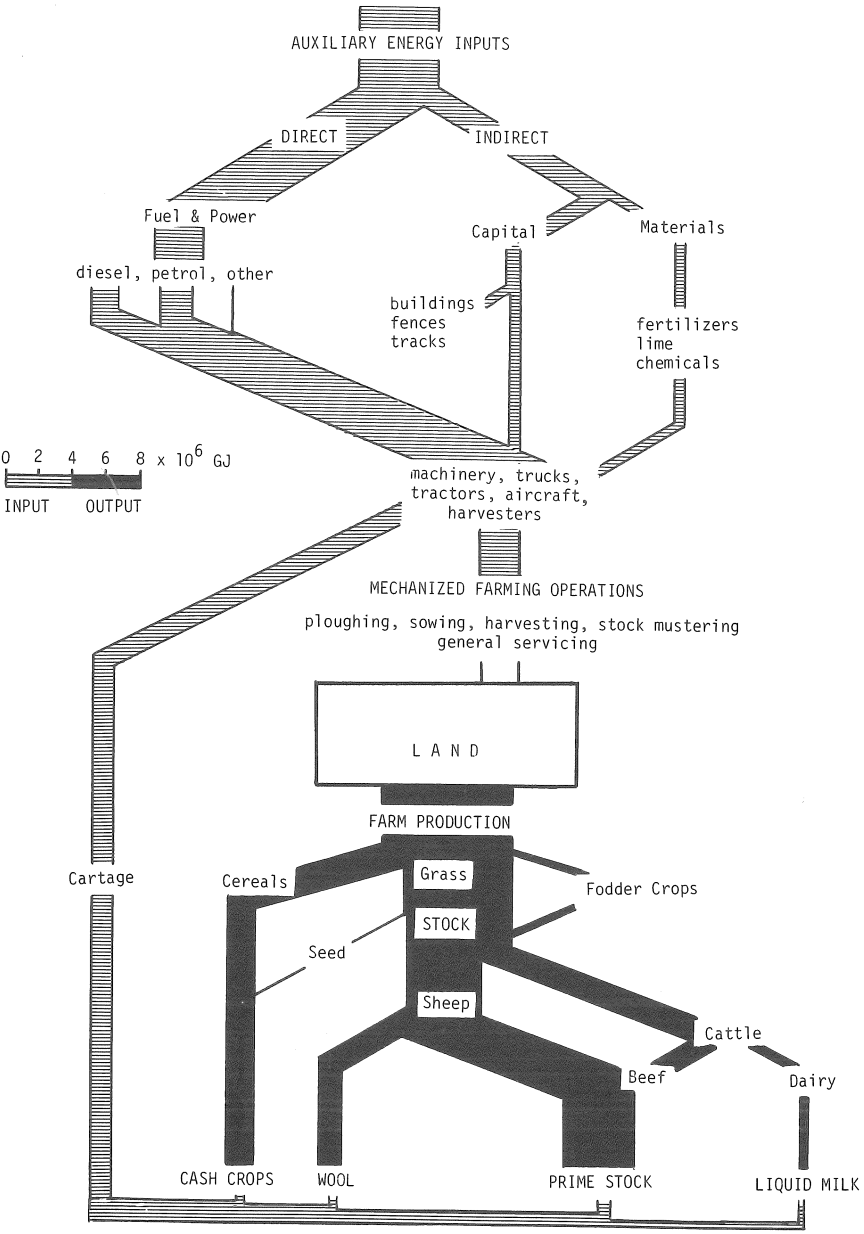


Figure 3. Energy Flows in Southland Farming

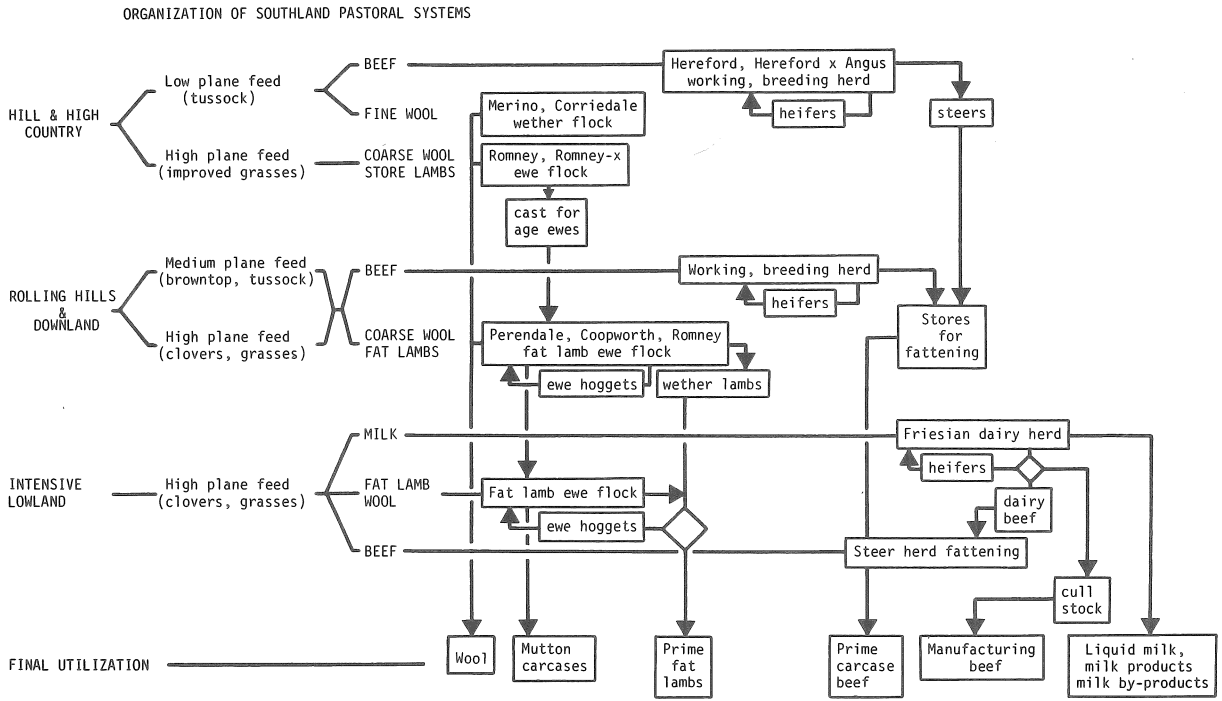


Figure 4. Structure and Organization in Southland Pastoral Systems

now able to fatten lambs and provide store cattle for finishing on the lowland farms.

TABLE 4

REGIONAL ENERGY PERFORMANCE 1979

	Southland Plain	Waimea Plains	Waiau Plains	Downlands	Partly Developed	Hill & High Country	Total
Total Input ($\times 10^6$ GJ)	(0.219)* 1.175	0.713	0.468	0.672	0.893	0.300	4.222
Total Output ($\times 10^6$ GJ)	(0.230) 3.494	1.753	0.568	0.799	0.860	0.413	7.885
Energy Intensity GJ/ha	(12.29) 3.604	6.541	5.258	4.634	3.461	0.521	2.809
Energy Yield GJ/ha	(12.80) 10.718	16.083	6.382	5.510	3.334	0.717	5.189
Net Energy Yield GJ/ha	(0.57) 7.175	9.542	1.124	0.876	-0.127	0.196	2.380
Energy Ratio	(1.14:1) 2.97:1	2.46:1	1.21:1	1.19:1	0.96:1	1.38:1	1.85:1

*in brackets, dairying on the Southland Plain

In general as farms have been developed, their energy intensity has increased, but this has, to some extent, been counterbalanced by improved management practices, particularly the near elimination of energy-demanding brassica winter feed crops by all-grass wintering. It is nonetheless a comment on the innate conservatism of farmers that this system introduced in the late 1950s has only recently become an accepted management technique—supporting the adage that it takes 20 years between a successful demonstration in field trials and widespread adoption.

On the positive side, the lamb kill has increased three-fold since 1950 and ewe mutton by 3.5 times, though, like wool, the ewe kill varies considerably from year to year, depending on seasonal conditions determining feed availability and farmer response to market prices. The wool figure of 50,300 tons for 1979 used in the energy calculations is about 25% lower than the average for the late 70s. Downstream, the increased production of meat has led to considerable direct transport energy savings through the establishment of a fourth freezing works in the center of major regional production.

Farming emphasis is now directed to consolidating the advances in pasture productivity and improving the per head performance in terms of higher lambing percentages and heavier fleece weights. As indicated subsequently, in the next

30 years the geneticist is likely to provide the same sort of contribution from livestock as was achieved from pasture in the past.

Beef Cattle

One of the main contributions towards attaining high energy ratios has come as a result of a six-fold increase in cattle numbers. Unlike most overseas ranch or feedlot systems, specialized beef cattle production in Southland is almost unknown, and cattle form an integral part of the development and maintenance of intensive grassland farming focussed on sheep (Fig. 4).

In land development, their role is as working cattle—browsing, trampling and thereby weakening scrub, fern and tussock, to create access for sheep. On improving pastures, breeding herds consolidate soil and suppress any tendency to reversion—while in intensive lowland farming systems, young, fattening stock control the seasonal flushes of prolific growth that can produce metabolic problems for the sheep (Fig. 2). In the longer term, the trend towards all-grass farming systems will mean that beef cattle will perform an increasingly important role in the maintenance of a balanced soil nitrogen-clover-grass sward.

In precise figures can be allocated to either direct or indirect energy inputs in the integrated sheep-cattle grazing system, but it is evident that the benefits are obtained with little additional investment in money or energy. Appropriate fencing, cattle yards, the purchase of breeding or fattening stock and managerial expertise are the only unequivocal inputs.

The precise relations of the breeding and fattening aspects of the beef sub-system remain to be determined, and, until that has evolved, a continuing problem is likely to be the maintenance of viable breeding herds in conjunction with fat-stock production flexible enough to meet the cyclic demand and price fluctuations that have characterized world export beef markets over the past decade.

Dairying

No other branch of Southland's agriculture has changed so radically as that of dairying. Its contraction, already well defined by 1950, continued undiminished during the following decades, and its contribution to Southland's energy production decreased from 17.8% to 2.7%. For a variety of reasons, dairying lost its attractiveness, and the majority of producers who possessed a viable option exercised it. Many farmers had regarded dairying as little more than a supplementary income source, or even a temporary expedient that provided regular weekly cream checks until other, more profitable, enterprises could be established. Escape from dairying's rigid, twice daily, milking schedule, the continuing financial commitments to meet increasingly stringent hygiene requirements, allied to decreasing profitability, were 'push' factors for many more. Conversely, sheep offered the greater security of two independent income sources (meat and wool) and price schedules not determined by more efficient North Island producers and contracting overseas markets.

The elimination of many marginal producers has been accompanied by a contraction of the geographical areas serving the two town-milk treatment stations and the sole remaining cheese factory of the 42 operating in 1950. The consequences have been disseminated throughout the area. As factories closed, employment opportunities contracted and services were reduced or withdrawn.

In energy terms the impact has been equally great. To meet contratual obligations for year-round town-milk, both indirect and direct energy inputs have

increased so that the energy intensity of dairying now exceeds any other Southland farming system. Compliance with hygiene regulations has meant new milking parlors; the installation of refrigerated stainless steel holding vats, elaborate sterilizing equipment as well as frequent inspections by veterinary and herd-testing services. A significant increase in the use of electric power for machine milking, chilling and hot water has also accompanied the changeover. Now that production is no longer seasonal, hay- and silage-making must be supplemented by fodder crops and purchased concentrations. Direct fuel use is likewise increased, with twice daily stock mustering and the daily collection by factory tankers now uninterrupted throughout the year.

However energy outputs have also increased significantly. Herd sizes and yields per lactation have both increased by over 30%, and cull cows and 'dairy beef' also contribute so that energy yields of the order of 2.8 GJ/ha are second only to those of the most intensive sheepfarming areas. Nonetheless, the resultant energy ratio of 1.14:1 is low among the regional subsystems.

Crops

Only crops grown for sale are considered under this heading. Fodder crops for winter feed on the farm are considered part of the pastoral system and their energy usage has been set againt the outputs of stock and stock produce.

Cereal cropping (wheat, barley and oats), with some lucerne for sale, are regionally important sources of income for many farmers. For a variety of sound physical and historical reasons, commercial cropping tended to concentrate on the drier alluvial soils of the Waimea Plains and this tradition has persisted. Most decisions to cultivate land combine the need to replace degenerating pasture with guaranteed contract prices. In this way an additional economic base and stability is provided for the farm enterprise.

The present survey revealed that energy inputs in the cropping subsystem varied widely between farmers and from season to season. These differences were greater in respect of tillage practices and fertilizer programme. Seed bed preparation and drilling varied particularly both in terms of the implements used and the number of tractor passes. A single direct drilling to as many as a dozen separate operations were reported, practices varying according to soil conditions and the whim of the farmer, but the greatest differences in energy inputs was associated with varying dependence on the use of nitrogenous manures.

Total direct and indirect energy inputs ranged from 1.3 to 3.3 GJ/ha, which when compared with the yield of an average crop of wheat or barley (4100 kg/ha) gives an average energy requirement of 1.8 MG/kg of cereal. With 1 kg of grain containing 16.6 MJ of energy, the input:output energy ratio is about 9.2.

By comparison, commonly quoted figures for the United States indicates it takes between 5 and 6 MJ to produce 1 kg of corn, with a corresponding ratio of the order of 3.

Compared with the early 1950s the energy input has increased but yields have increased even more. Table 1 implies that the energy ratio has more than doubled during the period.

This increase reflects the success of operating cropping as an adjunct to intensive grassland production. It has become increasingly common practice to utilize the soil-nitrogen buildup under clover-based pasture to grow cereals or lucerne without the need for additional fertilizer. As all-year-round grassland systems continue to develop, green fodder crops can be replaced by cereals or even 'energy crops' such as beet within such long term rotations with advantage to the energetics of both livestock and cropping systems (Fig. 1).

FUTURE DEVELOPEMENT

To adverse terms of trade must be added the problem of finding stable markets for pastoral production. Trade barriers in the form of tariffs and quotas presently characterize New Zealand's traditional markets. In consequence, farmers' incomes have been erratic, and sustained land development increasingly difficult. In seeking economies, it is often fertilizer usage that has suffered, as in the short term, production can be maintained. Despite over a quarter-century of intensification, more than 90% of Southland's hill soils are sub-optimal in terms of their phosphate—and hence nitrogen—levels. While stocking rates have increased more than three-fold the major benefits accruing from the attainment of a high level nutrient status have not been achieved.

One solution that offers possibilities is to replace the present 'blanket' topdressing of properties by differential applications. In this strategy, the most responsive areas are boosted beyond the optimum fertility level. Those areas are then extended by stock transferring that fertility through their excreta to the next most responsive blocks which are boosted in turn by heavy dressings of superphosphate (Fig. 2).

It seems probable that under the prevailing ecoomic and world political circumstances, the deliberate pursuance of low cost, low energy solutions will dominate agronomic research. In the New Zealand context, this will imply increasing emphasis on 'natural' or biological means of enhancing both production and profitability.

Three of the major threats to pasture productivity--clover cyst nematodes, the porina caterpillar (Wiseana spp) and the grass grub (Costelytra zealandica)—are being countered by biological measures rather than chemicals. These solutions include both breeding herbage strains resistant to attack by these pests, and introducing natural parasites or predators as controls. Further example of such applications have been the substantial productivity increases associated with supplementing the native earthworm fauna with exotic species, and mycorrhiza research into increasing the efficiency of clovers to utilize phosphate. Already increased knowledge of phosphate fixation to inorganic forms unavailable to legumes has modified the amount, frequency and timing of phosphate applications. Continued research into soil requirements has revealed that in the low rainfall areas of northern Southland, phosphate can be replaced by one-tenth its weight in sulphur, and elsewhere, that high stocking rates can lead to hitherto unsuspected deficiencies in potash.

Despite the overall dependence on sheep farming, it is surprising that only now is attention being given to improving Southland lambing percentages which have shown no gain over the past 30 years. Flock fertility varies from 50% to 140% with a mean of about 110%. Such low figures are partly the result of using ewe mobs as instruments of development with consequent poor nutrition and low fecundity, but now that land development has peaked, rigorous culling programmes are likely to permit annual improvements of 1 - 1-1/2% in lambing performance. Much more significant increases, to the extent of taxing management skills, are arising from replacing the traditional Southdown ram/Romney ewe fat lamb flock with more prolific breeds. In conjunction with the Suffolk ram, the Coopwroth (Romney x Border Leicester) and Perendale (Romney x Cheviot) are offering immediate lifts of 15-20% with potentials of about 40%. Even greater improvements are expected from diffusion of te Booroola strain of the Merino with its capability of 120% lambing in high country flocks (presently about 74%), and 180% in lowland flocks.

Selenium deficiency is now recognized as affecting fertility, fecundity and mortality and dramatic increases have been obtained from its correction, yet of the farmers surveyed, only 45% had begun to use it.

Also limiting improvements in lambing performance has been the inadvertent encouragement of oestrogenic strains of (red) clover. Plant oestrogens occur also in lucerne (alfalfa) and the extent to which such substances have a deleterious and permanent effect on ewe fertility is only now being appreciated.

Application of existing knowledge in these three areas represents the greatest potential for increased production during the next decade. Intensificiation by this means is much more attractive than increasing the carrying capacity of pastures, in that already, mechanical damage by trampling to soils and herbage is becoming significant barriers to the progressive build up of soil nitrogen.

For the future it is not beyond possibility that Southland pastures would be able to return a net energy yield from animal products equivalent to that of the best energy-intensive grain farming systems in the United Kingdom or North Ameria.

CONCLUSIONS

The study has reviewed trends in Southland farming over the last 30 years and implicitly has compared its development strategies with those of western capital- and energy-intensive agricultural systems. For the most part the trends reflect decisions made in response to shortages of capital, labour and land. Externally, adverse terms of trade, together with marketing problems for produce, have combined to create an increasingly invidious trading position. To the degree that contemporary economic performance can be improved through reduced dependence on direct and indirect inputs of energy, the internal and external trends are mutually reinforcing. Until recently it would have been misleading, however, to ascribe successive objectives in management policy to anything more than fortuitous coincidences with energy-efficient farming.

The one persistent exception is the deliberate continued dependence on biological nitrogen, and as management expertise has evolved, other, consistent, practices have emerged that also have favoured a low cost, low energy-input approach to farming. Grassland farming, developed and sustained by aerial topdressig and oversowing, in conjunction with efficient stock management, epitomises this. The reality of its success may be emphasized by noting that the energy ratio of regional pastoral production is approaching that of many western cropping systems and in some cases equalling them.

Nevertheless, to offset a deteriorating trading situation, further significant gains in output--or reductions in inputs—must be attained. The temptation to achieve this objective through increasing the auxiliary input to farming is a real one, but, in the context, it can only be at the cost of higher prices and decreased competitiveness on world markets. The choice of options is thus severely circumscribed. Deliberate energy conservation seems to have little potential. Any substantial reductions in direct or indirect energy use are likely to have strongly adverse effects on yields. Farmers consider themselves as low users of energy, with expenditure on liquid fuels a minor item in most farm budgets; consequently there is unlikely to be any strong motivation towards conservation. In view of the high costs involved, many farmers feel that further land development would be unwise. Many others feel that they are approaching the physical carrying capacity of their land. The most viable alterntive would appear to be 'intensification' based on continuing research into achieving higher productivity from pastures, crops and animals. Of these, the greatest potential

is seen to be improving livestock performance. As this is closely related to profitability, it promises to provide a further incentive towards low cost, low energy solutions to the problems of both farming income and national trade imbalance.

It is ironic that, because of international agricultural protectionism, one of the world's most efficient producers of high quality protein cannot compete on world markets.

SELECT BIBLIOGRAPHY

Critchfield, H. J., 1951: "Pastoral Murihiku, New Zealand Geographer, Vol. VII (1).

Critchfield, H. J., 1952: "The Agricultural Geography of Southland, New Zealand," Unpublished Ph.D. Dissertation, University of Washington.

Critchfield, H. J., 1954: "The Growth of Pastoralism in Southland, New Zealand," Economic Geography, 30 (4).

Dawson, S. M., 1978: Energy Requirements of Inputs to Agriculture in New Zealand, Joint Centre for Environmental Sciences, Occasional Paper No. 4

Dornom, H. & Tribe, D. E., 1976: "Energetics of Dairying in Gippsland (Aust)." Search 7.

Harris, G. S., et al., 1979: The Potential of Energy Farming for Transport Fuels in New Zealand, New Zealand Energy Research and Development Committee, Report No. 46.

Johnson, A. J., Stoltzfus, V. & Craumber, P., 1977; "Energy Conservation in Amish Agriculture," Science, 198.

Leach, G., 1975: Energy and Food Production, London.

Lord, R. F., 1974: Energy Costs in Agriculture, East of Scotland College of Agriculture, Report No. 1.

Odum, H. T., 1971: Environment, Power and Society, New York..

Pearson, R. G., 1976: Energy Analysis, Joint Centre for Environmental Sciences, Occasional Paper No. 2.

Rappaport, R. A., 1971: "The Flow of Energy in an Agricultural Society," Scientific American, 255.

Smith, D. J. & McChesney, I.G., 1979: A Review of Energy Use in New Zealand Agriculture, N.Z. Energy Research and Development Committee, Report No. 48.

Steinhart, J. S. & C. E., 1974: "Energy Use in the U.S. Food System," Science, 184.

Ward, G. M., Knox, P. L. & Hobson, B. W., 1977: "Beef Production Options and Requirements for Fossil Fuel," Science, 198.

VI

GENERAL THEMES

THE WIDENING VIEW OF LANDSCAPE APPRECIATION: WESTERN LANDS

Ralph E. Lewis

Americans have traditionally judged the beauty of landscape in terms of a balanced blending of water, forest and relief. This paper suggests that traditional landscape preferences are expanding to include all types of topography. This is not to say that the writer believes that grasslands, prairies and various arid or semi-arid landscapes will, in the foreseeable future, become more popular than those with well-marked relief-water-forest combinations. However, with the current intense interest in environmental matters, the appreciation of other landscapes appears to be increasing. The American West with its diversity of landscapes is an excellent region in which to explore this subject.

Wilderness and the American

Current attitudes toward landscape preference relate in varying degrees to wilderness. Even though most Americans never enter actual wilderness areas, their perception of "wilderness" is influenced by the way they look at nature in general. And as the American views nature in terms of protected forests, abundant water and varied relief, the perception of wilderness is a strongly biased one. This point can be validated if the concept of wilderness is examined in its historical context. Before doing this, however, the term should be defined. The Wilderness Act provides a useful definition:

> A wilderness, in contrast with those areas where man and his own work dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrampled by man, where man himself is a visitor who does not remain.[1]

In other words, within the wilderness man is not allowed to pursue economic activity, is not allowed to trample, and is a short-time visitor. Introduction of exotic vegetation is unlawful and trails and campsites are deemed ugly.

Partly in response to these constraints, attitudes to wilderness have sharpened and hardened. Many wilderness worshippers maintain that only a select few should ever enter demarcated wilderness areas, but that they, because of their particular understanding of nature and their spiritual insights, should be included among the few. When Justice William O. Douglas tramped through the Cascade wilderness areas, he would curse when he met another party. Such behavior, while selfish in most people's eyes, represents the attitude of many wilderness lovers. And essentially this is the attitude of members of the Sierra Club.

Fortunately, not all persons react to the wilderness in this way. To the woodsman or the sheepherder, the sight of a discarded tin can or a candy wrapper is not necessarily upsetting; rather it may be exciting. Man is nearby. Company, civilization, comfort, needs and desires are all suggested by the tin

can or other discard. They are not seen as ugly, nor are they necessarily seen as beautiful. Being a discarded, erstwhile useful object, the tin can or candy wrapper fails to upset the woodsman's or the sheepherder's concept of wilderness. Similarly, although the proximity of a metropolis might disrupt the woodsman's and the sheepherder's attitude to nature, a small village or hamlet near the timberline likely would not. The latter, in fact, would likely be perceived as part of the scene, even part of the wilderness. To such persons, not everything that announces the presence of man is ugly. In short, wilderness to the woodsman and the sheepherder encompasses much more than the ideas and the ideals of John Muir.

In earlier centuries, however, wilderness was frequently perceived as a place of evil, invaders, sin, death, fear—things that in most societies were sought out for destruction, or at least amelioration. Babylon watered the desert and made it bloom, early European man cleared the forest, and the Romans conquered both forest and swamp. When the ancient Greek philosophers spoke of "going into the wilderness," however, they were not referring to the uncleared forests of the north. They were referring to the well-cared for farm landscape not far from the city. To the English of the Viking period, on the other hand, the wilderness was the home of the Viking and the forest his lair. The forest therefore was land to be cleared not just for farming purposes but so that this "wilderness" would not provide shelter for the feared northern invaders. To today's Englishman the untrammelled forest areas of, say, Western Montana or northern Idaho would certainly be regarded as wilderness, but not wilderness as we Americans perceive it. To the Englishman it would be undesirable wilderness. Desirable wilderness in his eyes may be no more than a pleasant woodlot or pasture outside London, where nature can be enjoyed and handled with gentlemanly grace.[2]

When the first European settlers arrived on the North American continent their concept of wilderness was influenced by the all-pervading forest that provided places of hiding for the indigenous peoples (who were quickly labelled "savage") and an impenetrable vegetative cover that hid most of the best potential farmland. The wilderness in consequence became something to be destroyed out of both fear and need. Forests were razed and little thought was given to the conservation of forest resources, and certainly none at all to wilderness as a recreational amenity. In general, the European settlers came well-equipped to deal with such land. Their ancestors for a thousand years had been felling trees and clearing land. And, in turn, they learned quickly how to crop and graze both humid and subhumid lands. They performed their tasks with marked success. From coast to coast the wilderness was "reclaimed," and settlements established. Railroads, canals, roads and manufacturing industries helped round out the landscape to make the land a habitable and blooming scene. As Yi-Fu Tuan points out, old biblical commandments were being obeyed.[3] In Hans Huth's words: "The axe was even accepted as the most appropriate symbol of the early American attitude toward nature."[4] But slowly—ever so slowly—the concept of wilderness, ingrained in the minds of the masses, began to be modified in the minds of the few.

The Romantic Era

In all probability the first conscious act of conservation in the United States took place in Pennsylvania in the seventeenth century. William Penn, the founder of the colony of Pennsylvania, did not himself care for wastefulness, but

it was not long after his colony was founded that he began to think of the wilderness as a place that could offer spiritual solace and become a spiritual refuge. As a consequence he ordered that one acre of forest be left for every five acres cleared.[5] His idea, however, did not spread beyond the Quaker colony, and in the following century what came to be called Jeffersonian Doctrine precluded all hope of it doing so. While believing in the concept of harmony between man and nature, Jefferson believed also that the settler should clear the forest and farm the land, and that none of it be wasted.

During the early nineteenth century, however, writers, painters, and poets in the Eastern states began to speak of nature in ways other than of conquest. The artist Thomas Cole was one Easterner who began to paint the wilderness in the 1830s. His paintings soon became popular in Eastern cities in which prosperity had increased both leisure time and the quest for knowledge. In paintings like those of Cole the wilderness was romanticized and nature depicted as arrestingly beautiful rather than something to be feared. In literature James Fennimore Cooper deplored the destruction of nature's wilderness, and in his "Leatherstocking" novels he instilled in his readers the idea that man should work to preserve the beauty of nature. During this same period, Henry David Thoreau and Ralph Waldo Emerson emerged as ardent advocates of nature. Their Transcendentalism, with its doctrine of the harmony of nature and God, persuaded many who sought to understand nature in both actual and aesthetic terms. The Transcendentalists emphasized that wilderness was part of God's creation, not something to be totally destroyed or irrationally feared. Unlike John Muir, a few decades later, they believed that wilderness could and should be utilized—not totally destroyed nor entirely preserved. According to Ekirch, "Emerson was optimistic over the way in which man could alter his environment."[6] Emerson himself wrote:

> ....perhaps the most striking effect of the accurate adaptation of man to the globe, is found in his love of it....I am thrilled with delight by the choral harmony of the whole. Design! It is all design. It is all beauty. It is all astonishment.[7]

Thoreau thought and wrote in similar fashion:

> I go and come with a strange liberty in nature. Shall I not have intelligence with the earth? Let us improve our opportunities then before the evil day comes.[8]

However, while the work of these writers and painters was appreciated and studied in the East, which had been settled for more than two centuries, on the western frontier, where wilderness was a fact of life, the concept of the conquest of nature strongly endured. New ideas--ideas of change--were in the making, however, and among the initiators of a new philosophy of wilderness were men who spanned more than a century—from Alexander Von Humboldt to Stephen T. Mather. The romanticists had introduced a new concept of wilderness and helped re-educate the thoughts of Easterners at least—politicians and educators, the educated and, most importantly, the wealthy. It was these men who were to implement the rising new ideas and turn them into a new concept of wilderness and the outdoors.

The Rise of the Conservationists

The most important of the pioneer conservationists was George Perkins Marsh. His book Man and Nature which appeared in 1864 was the first great work on the conservation of natural resources.[9] His emphasis on the word 'destruction' is distinctive. His was the first strong plea for moderation and for an understanding of the deleterious effects of the pressures that man had long exerted on the earth's resources and amenities. He writes:

> Could this old world, which man has overthrown, be rebuilt; could human cunning rescue its wasted hillsides and its deserted plains from solitude or nomad occupation, from barrenness, from nakedness, and from insalubrity, and restore the ancient fertility and healthfulness.[10]

Marsh's work was studied carefully and his ideas in part tested during his lifetime. Gifford Pinchot, the driving force behind much of Theodore Roosevelt's conservationism, employed many of the ideas of Marsh. Pinchot was never a wilderness advocate in the manner of John Muir, who at the time was pleading for the West to be left untouched by the hand of man. Rather Pinchot pushed for the conservation of natural resources—especially of the forest--and eventually he was appointed Chief Forester of the United States.

Another of the early pioneers was Frederick Law Olmsted, the father of landscape architecture and the planner of Central Park, New York. A contemporary of Marsh, he was intrigued with the idea of protecting some parts of the West, and for some years much of his time was spent in laying the foundations for what was to become Yosemite National Park. John Muir, on the other hand, was to spend a great deal of his life preaching the values of untouched wilderness. But it is unnecessary here to consider in turn all the men who were instrumental in one way or another with the emergence of a new doctrine of conservation that has done much to change our concept of the outdoors. The examples given will suffice. In essence, because of these men and others like them the change was made and it came rapidly.

Changing Attitudes Regarding Arid Lands

As Bakker has pointed out, appreciation of arid lands has evolved more slowly than the appreciation of other landscapes. He writes:

> Of all the physical features found in North America, the desert is perhaps the most underrated, the least understood, and, in a multitude of ways, the most beautiful of our landforms.[11]

There are many reasons for this later development. The first and foremost is likely the perceptions held by settlers of the West who came from the forested areas of the East. Early writers on the West depicted the desert as a thing of beauty. Washington Irving's description is typical:

> It spreads forth in undulating and treeless plains, and desolate sandy wastes wearisome to the eye from their extent and monotony.[12]

Zebulin Pike's description of the land west of the Missouri River as waste is

likely the origin of the myth of the "Great American Desert," as it came to be called.[13]

Later when the transcontinental railroads opened up the West, and the companies running them promoted tourism, the high mountains, the evergreen forests and the lakes, rivers and ocean were all emphasized, while the dreary prairies and the "lifeless" deserts were virtually ignored. As train travel through such areas was usually uncomfortable, dusty and generally hot, early Western travellers reinforced the unfavorable image these lands had by now gained.[14]

The works of Edwin James,[15] Josiah Gregg,[16] Henry Sienkiewicz,[17] W. F. Rae,[18] F. Trench Townshend,[19] Horace Greeley,[20] Randall Hewitt,[21] J. W. Boddam-Whetham,[22] and a host of others, and the official reports of such explorers as John C. Fremont,[23] provide ample testimony. Almost to a man they complain of the dustiness, dreariness and emptiness of these dry regions. The comments of Josiah Gregg are typical:

> It have been determined upon, however, to strike across this dreaded desert the following morning, the whole party was busy in preparing for the "Water scrape" as these droughty drives are very appropriately called by prairie travellers. This tract of country may truly be styled the grand "prairie ocean," for not a single landmark is to be seen....[24]

While not quite so forbidding as the Great American Desert, much of the prairie region of the Great Plains and the Midwest was generlly avoided by early settlers. They believed that trees grew in good soil and only grass and weeds in poor soil;[25] hence treeless regions came to be considered vast wastelands. In consequence, parts of the Great Plains region were among the last fertile agricultural land in the United States to be settled. Settlers moving west, were familiar with the humid East, and their agricultural methods reflected their expectation of adequate rainfall.[26] When the rainfall failed to materialize, at least in the quantities needed for farming, attempts at settlement in many arid regions failed, and the perception of arid regions as barren wastelands was further reinforced.

Conclusions

Changes in recreational preferences have been, for the most part, subtle, and it is necessary to search the contemporary travel and other literature to identify these. It is apparent, however, that great changes have occurred. Western lands once deemed ugly are now considered beautiful. Deserts, semi-arid grasslands and rolling prairies with low relief and few landmarks are today being viewed in a new light. Forest, water and high relief are still the preferred elements in landscape but aridity and other hitherto "dreary" features are being admired by increasing numbers of people. The turning of American attention to these other landscapes is not without its problems, however. Such landscapes are usually ecologically fragile, and the problems of environmental management are considerable. If attention is paid to these problems and to the historical background, critical environmental decision-making may be successfully achieved.

NOTES

[1]United States Congress, 88th Congress, S. 4 Wilderness Act, Public Law 88-577, September 3, 1964, p. 5.

[2]David Lowenthal and Hugh C. Prince, "The English Landscape," Geographical Review, 54 (1964), pp.

[3]Yi-Fu Tuan, Man and Nature. Washington, D.C., Association of American Geographers, Commission on College Geography, Resource Paper #10, 1971, p. 25.

[4]Hans Huth, Nature and the American: Three Centuries of Changing Attitudes. Berkeley: University of California Press, 1957, p. 2.

[5]Ibid., p. 9.

[6]Arthur A. Ekrich, Man and Nature in America. New York: Columbia University Press, 1963, p. 2.

[7]Quoted in Ekrich, op. cit., p. 2.

[8]Ibid., p. 2.

[9]George Perkins Marsh, Man and Nature: Or Physical Geography as Modified by Human Action. New York: Charles Scribner, 1864. This work, issued during Marsh's lifetime in a number of editions was eventually published under the title, The Earth as Modified by Human Action: A Last Revision of "Man and Nature". New York: Charles Scribner, 1885.

[10]The Earth as Modified by Human Action, p. 46.

[11]Elma Bakker, "The Many Faces of the Desert," The American West IX (5), September 1972, p. 19.

[12]Washington Irving, Astoria, edited by Edgeley W. Todd. Norman: University of Oklahoma Press, 1964, p. 210.

[13]Zebulon M. Pike, The Southwestern Expedition of Zebulon M. Pike, edited by Milton M. Quaife. Chicago: The Lakeside Press, 1925. See also G. Malcom Lewis, "Three Centuries of Desert Concepts of the Cis-Rocky Mountain West," Journal of the West, 4 (1965), pp. 457-468; G. Malcolm Lewis, "Changing Emphases in the Description of the Natural Environment of the American Great Plains Area," Transactions of the Institute of British Geographers, 30 (1962), pp. 75-90 and numerous other publications by Lewis; also Martyn J. Bowden, "The Perception of the Western Interior of the United States, 1800-1870: A Problem in Historical Geosophy," Proceedings of the Association of American Geographers, I (1969), pp. 16-21.

[14]Earl Pomeroy, In Search of the Golden West. New York: Alfred A. Knopf, 1957.

[15]Edwin James, Account of an Expedition from Pittsburgh to the Rocky Mountains, Performed in the Years 1819, 1820. London, 1823.

[16]Josiah Gregg, Commerce of the Prairies or the Journal of a Santa Fe Trader during the Eight Expeditions Across the Great Western Prairies and a Residence of Nearly Nine Years in Northern Mexico. New York: J. & H. G. Langley, 1945.

[17]Charles Morley, editor & translator, Portrait of America: Letters of Henry Sienkiewicz. New York: Columbia University Press, 1959.

[18]W. F. Rae, Westward by Rail: The New Route to the West. New York: D. Appleton & Co., 1871.

[19]F. Trench Townsend, Ten Thousand Miles of Travel, Sport, and Adventure. London: Hurst and Blackett, 1869.

[20]Horace Greeley, An Overland Journey from New York to San Francisco in the Summer of 1859. New York: C. M. Saxton, Barker & Co., 1860.

[21]Randall H. Hewitt, Across the Plains and Over the Divide. New York: Broadway Publishing Co., 1906.

[22]J. W. Boddam-Whetham, Western Wanderings: A Record of Travel in the Evening Land. London: Richard Bentley & Son, 1874.

[23]Donald Jackson and Mary Lee Spence, editors. The Expeditions of John Charles Fremont. Urbana: University of Illinois Press, 1970.

[24]Gregg, op. cit., p. 71.

[25]Walker D. Wyman, "Western Folklore and History," The American Wet, I (1), Winter, 1964, p. 44.

[26]Carle Hodge, Aridity and Man. Baltimore: Horn-Shafer Company, 1965, p. 2.

PRIMARY SOURCE MATERIALS AND THE STUDY OF THE LOCAL REGION

James W. Scott

The comment of the eminent British geographer, Professor S. W. Wooldridge, that in seeking a suitable research topic "only a fool looks to the ends of the earth," has been variously interpreted. It is wise, however, to examine the statement as Wooldridge intended it. Speaking of the study of geomorphology, he insisted that it is the local region that provides the ready-made laboratory to be visited and worked in over and over again. In the field of historical geography, no less than that of geomorphology, there is much to be said for the detailed study of the local region, as Jean Mitchell so ably illustrates in her pioneer text, Historical Geography.[1]

Yet is is only in the past decade or so that the study of the local region has achieved a measure of academic respectibility in the United States. Parenthetically, it might be noted that American geologists and botanists have long used the local region for their research projects; also, that in France and Britain the local region became an important, if not a major field of study for the professional historian at a much earlier date.

The lamentable neglect of the local region by American professional historians has been commented on by a number of scholars, most recently by Kathleen Neils Conzen.[2] Revival of academic interest in local historical matters is the result of many interacting factors, among them the rise of historical demography in France,[3] and the foundation in England of the Cambridge Group for the History of Population and social structure;[4] the arrival on the historical scene of the quantitative revolution and the initiation of the "new social history";[5] and the boost given to all American historical studies by the American Bicentennial.[6] In consequence, the progress made in local historical studies during the past decade has been considerable, and it is safe to assert that much of the success has derived from the skillful use of abundant archival records and other primary source materials.

Documentation of this upsurge of interest is not the primary thrust of the present paper. Rather its purpose is first to appraise the meager contribution of American historical geographers to the study of the local region, and second—and more importantly—to review the archival and other primary source materials available for such historical study, especially that of the Pacific Northwest Region.

THE HISTORICAL GEOGRAPHER & LOCAL HISTORICAL STUDIES

Lester Cappon's statement that:

> Local records—of towns and counties, churches and social organizations—have held a stronger attraction for historians in recent years than hitherto because the study of government and society in microcosm, seen through specific actions of identifiable

> individuals, provides a relatively sound basis on which to make generalizations of broader significance concerning the state or region.[7]

could almost equally well apply to the historical geographer--almost but not quite, as we shall see. What passed for historical geography a half-century--even a quarter-century--ago placed slight emphasis on the primary source materials, and showed little or no evidence of these having been looked at, let alone used, in the specific research paper or monograph. Vaughan Cornish's well-known work The Great Capitals: An Historical Geography,[8] excellent though it is in some respects, may be taken as a representative historical geographical work of the first half of the present century.

Thanks in large part to the important pioneering efforts of such scholars as H. C. Darby in England, Roger Dion in France, and Carl O. Sauer and Andrew Hill Clark in the United States, the position is radically changed today as archival records have become increasingly a major tool of the historical geographer. Darby's five-volume magnum opus, The Domesday Geography of England,[9] more than any other single work in the field of historical geography, stands out as a monument of careful, archivally-based scholarship.

To be sure, there are problems in the use of original records--and not a few pitfalls--as Alan Baker and his co-editors emphasize in their Geographical Interpretation of Historical Sources.[10] In their words:

> As the geographer is essentially concerned with spatial patterns and relationships, among the main problems taxing the historical geographer is the location and size of the areal units to which his data is (sic) applicable.[11]

Be that as it may, the problems have been addressed convincingly and the pitfalls avoided by virtually all twenty authors of the papers included in the volume. And although less dependent on primary source materials, a number of the papers included in Geographical Perspectives on America's Past,[12] edited by David Ward--notably those of Jordan, Lemon and Mitchell--show some of the same ability to use archival materials and solve, more or less successfully, the problems inherent in them.

Although the use of records has increased notably in historical geographical, as well as historical studies, the awareness of the local region as a proper unit of study appears to have been seized more convincingly by the American historian than the American historical geographer. There may be good reasons for this, although I have not discovered any worthy of note.

Long neglected by the professional historian and almost disdainfully relegated to the enthusiastic--and generally untrailed--amateur,[13] local history in the past few decades has attained a respectable place among the sub-fields of the discipline, first in France,[14] then in England,[15] and most recently in the United States.[16] As Goubert noted in 1971:

> Only in the last twenty years has a new kind of local history become possible. The return to the unexploited archives of a given region or a given period was brought back into fashion by historians who generally were not born in the region studied and were not therefore expressing filial piety.[17]

Many important monographs on local themes by American historians have appeared in the past twenty years, among which should be mentioned Sumner Chilton Powell's study of Sudbury, Massachusetts, Puritan Village;[18] Kenneth A. Lockridge's A New England Town: The First Hundred Years, Dedham, Massachusetts, 1636-1736;[19] Sam Bass Warner's Streetcar Suburbs: The Process of Growth in Boston, 1870-1900;[20] and Merle Curti's The Making of an American Community: A Case Study of Democracy in a Frontier County.[21]

Recent American historical geographical scholarship has been less concerned with local themes, although its practitioners seldom have overlooked the relevant source materials. The efforts of Andrew Hill Clark of the University of Wisconsin, more than those of any other geographer, led to the primary source materials becoming the sine qua non of American historical geography. Clark's own works on New Zealand, Prince Edward Island and Nova Scotia in the colonial period have been widely recognized as splendid markers along the path of increasingly thorough archival research.[22] However, among Clark's students, interest in regional rathr than local themes appears to have prevailed.[23] Of the nineteen doctoral dissertations in historical geography supervised by Clark at the University of Wisconsin, Madison, eleven have since been published as scholarly monographs of rare distinction. Only one of them, however, Robert D. Mitchell's study of the Upper Shenandoah Valley in the Eighteenth Century,[24] is concerned with a somewhat local theme. The other American topics covered are of regional significance: North Carolina in the Eighteenth Century (Merrens);[25] Southeastern Pennsylvania in the Eighteenth Century (Lemon);[26] German Settlement in Nineteenth Century Texas (Jordan);[27] and Food Supply in the Old South, 1840-1860 (Hilliard).[28] Likewise with the various Canadian and other topics. And among the remaining eight, as yet unpublished, dissertations, only one strikes a local note--David Ward's study of Urban Growth in Nineteenth Century Boston.[29]

Yet with such local historical studies as those of Sumner, Lockridge, Warner and Curti as models, the possibilities for similar historical geographical studies would appear to be almost limitless. To the present time relatively few theses and dissertations, in addition to those noted above--and even fewer research papers and monographs-have appeared that deal with local topics. In the Pacific Northwest, which has not hitherto been noted for its historical geographical studies, apart from the works of Donald W. Meinig,[30] perhaps a half dozen studies can be counted that have been undertaken at the University of Oregon, the University of Washington and Western Washington University. Among them are Thomas Walter Pohl's 1970 University of Washington dissertation, "Seattle, 1851-1861: A Frontier Community," and two M.A. theses completed at Western Washington University: David G. Tremaine's study, "Indian and Pioneer Settlement of the Nooksack Basin, Washington, to 1890," and that of Daniel E. Turbeville, "The Electric Railway Era in Northwest Washington 1890-1930." Both the WWU theses, those of Tremaine and Turbeville, have been published as monographs in the Occasional Papers series of the Center for Pacific Northwest Studies.

With such active interest as there has been in the local region in virtually every part of the United States, it seems a foregone conclusion that eventually all the major themes--and many of the minor ones--of the historical geography of the Pacific Northwest will come under the scrutiny of scholars casting around for suitable research topics. Hence, with such a likelihood in mind, an attempt is made in the remainder of this paper to provide a guide to many of the archival and other primary sources likely to be of value to the historical geographer. In addition to comments on sources that will be of general value to the American

historical geographer, information is provided on archival materials held in the Pacific Northwest of more restricted regional and local significance.

THE ARCHIVAL SOURCES

Defined by the Oxford English Dictionary as "a place in which public records and other important historic documents are kept,"[31] and by Duckett as "the non-current records of an organization or institution preserved because of their continuing value,"[32] the archives is an obvious, but frequently overlooked, source of information for the historical geographer. Among archival materials may be found governmental, institutional and business reocrds of every kind--manuscripts, typescripts, printed records, ledgers and cash books, invoices, way bills and vouchers, and much else; maps, sketches and charts; and drawings and photographs. No archival collection is quite like any other collection in its layout and organization, although certain well-established principles have been developed to organize the materials--principles, be it noted, that are widely accepted today in all archives. Schellenberg's books on The Management of Archives,[33] and Modern Archives: Principles and Techniques[34] are standard works that should be consulted by the serious scholar.

Unfortunately, little help is given to researchers in the standard geographical reference works on the subject of archives. Wright and Platt's Aids to Geographical Research[35] all but ignores the archival materials, and the more recent works of Durrenberger[36] and of Haring and Lounsbury[37] are of no greater help. A couple of papers with more promising titles: H. Roy Merrens, "Source Materials for the Geography of Colonial America,"[38] and Ralph H. Brown's, "Materials Bearing upon the Geography of the Atlantic Seaboard, 1790 to 1810,"[39] are only slightly more helpful.

The one geographical work of significance, Michael Morgan's Historical Sources in Geography,[40] is, unfortunately, devoted almost exclusively to the British Isles. The American researcher, therefore, is forced to rely solely on the historical reference works, although so far as local history is concerned it is the British historians who have prepared the most useful guides for the "local" researcher.[41] The Harvard Guide to American History provides a brief introduction to the major reference works and guides on archives,[42] but Helen J. Poulton's section on manuscripts and archives in The Historian's Handbook[43] may provide a more helpful introduction for the beginner. Local history sources are briefly reviewed in Thomas E. Felt, Researching, Writing and Publishing Local History.[44] Most valuable of all, however is Philip C. Brook's standard work, Research in Archives: The Use of Unpublished Primary Sources,[45] which is confined to American archives.

The following sections review, in turn, public records, business records, institutional records, other private records and manuscripts, cartographic records and photographic collections.

The Public Records

For many historical geographers the public records will provide most of the source materials needed for research. These public records comprise a huge and varied collection of papers: the archives of federal, state and local governments, and of a number of regional and other government agencies. Their scope is vast as they take in virtually every aspect of cultural, demographic, economic, political, scientific and social activity. Ironically, perhaps, the most significant local research may depend more on the federal and state record than

the local one. For example, matters concerning land ownership and settlement may require research in the records of the Bureau of Land Management (the successor to the General Land Office set up in the 1790s), the records of which include material on Donation Land Claims and Homestead Claims; the records of the Bureau of Indian Affairs; and the records of the Federal and State courts. It is important, therefore, that both federal and state records as well a local records be considered here.

(1) Federal Government Archives: The vast majority of the federal records of historical importance are now administered by the National Archives and Records Service and the materials held either in the National Archives, Washington, D.C., or at one of eleven regional centers plus the various Presidential Libraries. The records held are the most extensive and almost certainly the best organized and arranged of all public records in the country.

Their value to the historical geographer was widely recognized when a special Conference on The National Archives and Research in Historical Geography, directed by A. P. Muntz--Andrew Clark's first Ph.D. student at Wisconsin, and Ralph E. Ehrenberg, was held in Washington, D.C., in November 1971. Papers presented at that conference have since been edited and published under the title Pattern and Process: Research in Historical Geography,[46] a volume that deserves to be more widely known.

The main guide to the collections of the National Archives is the Guide to the National Archives of the United States,[47] a weighty tome of close to a thousand pages. More specialized information is provided in the many hundreds of Reference Information Papers, Special Lists and Preliminary Inventories published by the National Archives. Of particular value to the historical geographer will be Ralph E. Ehrenberg's "Bibliography to Resources on Historical Geography in the National Archives," published as Appendix A of the volume of papers presented at the Conference on the National Archives and Research in Historical Geography.[48] Important also to the historical geographer will be a number of Resource Papers specially prepared for distribution at the conference by members of the staff of the National Archives. Included among them are the following: "Textual Records of the Geological Survey in the National Archives"--important because of the major geographical surveys undertaken during the later 19th century; "Records and Policies of the Post Office Department Relating to Place-Names"; "Federal Census Schedules, 1850-1880: Primary Sources for Historical Research"; and "Land Use U.S.A.: An Archival Profile."

Four brief guides prepared for an earlier National Archives Conference on Statistical Research, held in May 1968, are also of great value to the historical geographer: "Major Sources in Customs Bureau Records for Statistical Data on Exports and Imports of the United States to 1900"; "Vital Statistics Relating to the American Indian in the National Archives"; "Commerce Data Among State Department Records"; and, perhaps most valuable of all, for the student of the local region, "The Public Land Records of the Federal Government, 1800-1950 and Their Statistical Significance." Some of these special papers have since been issued as Reference Information Papers.

A most valuable example of the use of federal records in local history is provided by Jane F. Smith in her paper, "The Use of Federal Records in Writing Local History,"[49] which is a case study of a township of Iowa County, Wisconsin. Of use also to the historical geographer is Samuel P. Hay's article, "The Use of Archives in Historical Statistical Inquiry."[50]

Among the series of Reference Information Papers issued by the National Archives and likely to be of value are Major Sources on Exports and Imports of

the United States to 1900 (#49) and Population Data and Other Records of the Department of State (#47). The Special Lists series includes such publications as Federal Population and Mortality Census Schedules 1790-1890 in the National Archives and the States (#24, 1971) and Population Schedules, 1800-1870: Volume Index to Counties and Major Cities (#8, 1971), and among Preliminary Inventories are such items as Records of the Coast and Geodetic Survey (#104, 1958); Records of the Bureau of Agricultural Economics (#104, 1958); and Records Relating to International Boundaries (#170, 1968). A free booklet, Select List of Publications of the National Archives and Record Service, which provides a wealth of information on the vast array of public records that have been organized, arranged and inventoried by the National Archives, is periodically updated. Another publication, National Archives Microfilm Publications, lists the tens of thousands of reels of microfilm available for use at the Regional Centers of the National Archives, as well as for sale to libraries and individuals. The microfilms include items from virtually every branch of the federal government. Although the largest volume of materials available on microfilm relates to the Department of State--no fewer than 85 pages are closely printed with details of these particular records--it is likely that the historical geographer, especially one concerned with the local region, will be more interested in the microfilmed records of other departments and agencies--Commerce, Agriculture, U.S.G.S. and the Bureau of the Census. A few examples only can be given to indicate the wealth of materials now available in this form.

The records of the Bureau of the Census that have been microfilmed include extensive materials on each of the first eleven censuses, 1790-1890, although due to a disastrous fire the records of the 1890 census are very limited. A special publication, Federal Population Censuses, 1790-1890: A Catalog of the Microfilm Copies of the Schedules, issued in 1971, gives detailed descriptions of these census records. Among the records of the General Land Office (now the Bureau of Land Management) are Abstracts of Oregon Donation Land Claims, 1852-1903, and Washington Donation Land Claims, 1855-1902, as well as 228 rolls of miscellaneous letters sent to the General Land Office between 1796 and 1889. The records of the Geological Survey include records of the Hayden and King Surveys, and ten rolls of letters received by John Wesley Powell when he was Director of the United States Geological Survey. As a final example it might be mentioned that the climatological records of the Weather Bureau for the years 1819 through 1892 occupy 564 rolls of film.

As noted earlier, not all the archival materials in the custody of the National Archives are in Washington, D.C. Large volumes of records, including a good deal of archival material, are held at the eleven regional centers of the National Archives in Boston, New York, Philadelphia, Atlanta, Chicago, Kansas City, Fort Worth, Denver, San Francisco, Los Angeles and Seattle. The Seattle center serves the states of Alaska, Idaho, Oregon and Washington, and its holdings include much original material, as well as microfilm copies of many of the archival records housed in Washington, D.C. A Guide to the Seattle Archives Branch has been compiled by Richard Hobbs.[51] Also available are a number of Preliminary Inventories to important record groups and series, including Records of the Collector of Customs, Puget Sound District (1960), and Records of the Bureau of Indian Affairs: Colville Agency Records (1865-1943 (1966). Similar publications are available for many of the other regional centers.

(2) State Archives: The organization and arrangement of state archives is under way in most but not all states of the United States, although the progress made in some has been appallingly slow. In general, the use of state

archives is a more difficult undertaking than the use of the federal archives, even though in a number of states valuable comprehensive guides now exist, as well as various finding aids such as Preliminary Inventories and Special Lists.

The standard work on state archives is Ernest Possner's American State Archives.[52] This is a survey rather than a guide, but it is of great value nonetheless. For the state of Washington there is the General Guide to the Washington State Archives,[53] issued in a revised edition in 1969, and a number of the Preliminary Inventories, including the following: Guide to the Governors' Papers, 1853-1976,[54] and Judicial Records I,[55] which covers the Third Territorial Court Records from 1852 through 1889, and the records of King County Probate Court and King County Superior Court. Finding aids of various sorts are available for the state of Oregon, but the position in Idaho is less satisfactory. The Idaho Historical Society, in addition to its regular duties, fills in for an as yet unformed state archives.

Nearing completion is a major reference work that will bring to a culmination the first successful attempt to survey the records—both public and private—of a single state, although attempts were made by the W.P.A. projects in the 1930s to do this in a number of states including Washington. Sponsored by the Washington State Historical Records Advisory Board and funded by the National Historical Publications and Records Commission (NHPRC), the Washington State Historical Records Survey began in 1977 its search of all the public records of state, county and city levels, as well as private records in custody and out of custody in every county in the state. Directed by John Burns, the scope of, and the problems associated with the carrying out of the survey are considered in a recent article in Prologue.[56] The volumes to be issued are: (1) "State Archives Regional Depositories Guide," (2) "State Archives Guide," (3) "Guide to Private Depositories," (4) "Guide to Public Records out of Custody," and (5) "Guide to Private Records out of Custody." The five volumes are estimated to comprise a total of well over two thousand pages. The detailed information on more than 10,000 record series and collections has been entered on computer cards suitable for inclusion in a national data base. The first volume is scheduled for publication in the Fall of 1980 and the remaining volumes in the ensuing six to nine months.

(3) County and Municipal Records: Although considerable progress has been made in many parts of the country in the organization and arrangement of the multifarious records of local government units, the overall situation will probably appear to the researcher as little better than chaotic.[57] With approximately 81,000 units of local government in the United States,[57] it is difficult if not impossible to generalize.

The best advice that can be given to the local researcher who must consult local government records is to make friendly contact with the requisite county or city official—clerk, assessor, auditor, treasurer, planner or engineer—and to make whatever arrangements can be made to use the specific records required. Some local governments, such as the City of Portland, Oregon, have excellent records programs and well-organized and arranged archives; others have no organization whatsoever, and archival materials—if they can still be located—may be found serving all sorts of strange purposes.

In the state of Washington, the State Archives has been instrumental in providing help to counties and municipalities in organizing their records, setting up schedules and taking into custody a great volume of archival materials and non-current records. Regional archival centers have now been established at the

three regional universities in the state: Central Washington University at Ellensburg, Eastern Washington University at Cheney, and Western Washington University at Bellingham. A fourth regional archival center has recently been established in Seattle that will deal solely with public records of King County and the municipalities within the county. Such regional archives are helping to cope with costly centralized storage problems in the state capital, but more importantly they are making more accessible regional records to the citizesn of the region. The Regional Archives at Western Washington University, for example, has responsibility for seven northwestern counties--Clallam, Island, Jefferson, San Juan, Skagit, Snohomish and Whatcom, as well as for th various cities within these counties. Shelf lists are available for most of the records accessioned, although as yet only a few Preliminary Inventories have been issued, such as Records of San Juan County, compiled by David W. Hastings in 1977. Covered in the inventory are the records of county assessor, county auditor, county clerk and county treasurer.

Business Records

Generally speaking, business records are some of the more difficult records to track down and then obtain permission to consult, even when such records have been transferred to the custody of an archival center, library or museum. For example, in a small archives like the Center for Pacific Northwest Studies at Western Washington University the records of more than three score companies are deposited, but few of them are comprehensive, none of them complete, and all of them of companies no longer in business under that name: among them the Bellingham Bay and British Columbia Railroad, the Bellingham Coal Company, and Pacific American Fisheries.

The location of many business records can be ascertained from a number of sources. Philip M. Hamer's Guide to Archives and Manuscripts in the United States,[58] covers 1,300 depositories and some 20,000 collections contained therein. The National Union Catalog of Manuscripts[59] (NUCMC) is an ongoing series that provides details on a large number of major collections from information submitted by participating libraries and archives. And the Directory of Archives and Manuscript Repositories,[60] published by the National Historical Publications and Records Commission, lists centers with archives and manuscripts by state and then city. The repositories are also classified by type, among which are "corporate archives." Forty-six such archives are listed, most of them banks, major manufacturing companies and service companies.

Business records, it need hardly be emphasized, are private records to which public access is not assured—as it to public records--by law. Permission is required to consult them, and very frequently permission is denied or may be extremely difficult to obtain. Nevertheless, some major companies with valuable records that extend back into the nineteenth century and even earlier have established excellent archives, which are usually open for scholarly use. As it is impossible in this short paper to deal with every sort of business archive, only a few examples will be given.

Of great importance for th study of the early exploration and settlement of the Pacific Northwest are the archives of the Hudson's Bay Company, the scope of which, and their value to the historical geographer have been considered in a valuable paper by D. W. Moody of the University of Manitoba.[61] Housed until a few years ago in the company's headquarters in London, England, the North American records have now been transferred to Winnipeg, where they are in the custody of the Provincial Archives of Manitoba. It should be noted also

that over the past forty years more than thirty volumes of historically important records have been published by the Hudson's Bay Record Society. Meticulously edited by eminent historians, the series included three volumes of Letters of John McLoughlin from Fort Vancouver.

Another major source of information for historical geographers are the records of the railroad companies, including the Northern Pacific, the Great Northern, the Union Pacific and others. For the Pacific Northwest region the James J. Hill Collection housed in the James J. Hill Reference Library in St. Paul, Minnesota, is a particularly important group of papers, while the Newberry Library, Chicago, has assembled one of the world's largest collections of railroad materials. These and other sources of railroad history are considered in the works of Albro Martin,[62] Richard C. Overton,[63] Robert G. Ahearn,[64] John F. Stover,[65] and other historians of American railroads.

Institutional Records

This varied class of records includes both public and private groups. Some institutions, such as schools, universities and museums, include both public and private sectors, and although the records of the former are in a strict sense public records, like those of any government office, in most instances their records are organized in various ways and are seldom included in the public archives. Other institutional records, such as those of hospitals and churches, are frequently restricted and made available to relatively few persons, although the records, particularly the early records, of some religious groups have been centralized and organized for wider use. The latter include a number of important sources for the early history of the Pacific Northwest--for instance, the Roman Catholic, Methodist and American Board (Presbyterian/ Congregational) records covering the missionary era of the mid-19th century. Gonzaga University, Spokane, houses the Oregon Province Records of the Roman Catholic Church and the Houghton Library at Harvard the records of the American Board of Commissioners of Foreign Missions, the missionary body that despatched Marcus Whitman and Henry Spalding to the Oregon Country.

More than three hundred archival repositories associated with religious institutions are listed in the NHPRC's Directory of Archives and Manuscript Repositories.

Other Private Records and Manuscript Collections

These comprise perhaps the most varied of all records, both in terms of their varied size and range, and in the variety of their organization and arrangement. At one end of the scale are the huge university archival and manuscript collections—Harvard, Yale, Berkeley, and in the Pacific Northwest the University of Washington, the University of Oregon and Washington State University—and the equally important collections of major museums and historical societies--those of Wisconsin, Minnesota and Oregon are particularly impressive. At the other end of the scale are the small county and city museums and libraries with a small sheaf of pioneer letters or a few boxes of miscellaneous papers.

On the topic of the use of manuscript collections the recent work of Kenneth W. Duckett, Modern Manuscripts: A Practical Manual for their Management, Care and Use,[66] is especially useful.

A number of important guides are available that list archival centers and provide information on the size and scope of collections. The most important

are the three already referred to in the section on business records: those of Hamer, the Library of Congress and N.H.P.R.C.

Many archival centers, particularly the university centers, have issued guides to their collections, as well as detailed or preliminary inventories for major collections. In the Pacific Northwest the University of Washington and Washington State University have issued a number of important finding aids over the years. A recent publication of Washington State University might be mentioned as one example: Northwest Botanical Manuscripts[67] which is an indexed register of the botanical papers of four collections in the Holland Library, Pullman. Occasionally a finding aid of wider use is issued. One such is Washington State University's A Union List of the Papers of Members of Congress from the Pacific Northwest.[68]

Cartographic Records

For the historical geographer, as for all geographers, the cartographic records available for research are particularly valuable. Fortunately, so far as national cartographic collections are concerned there is a considerable list of finding aids.

One of the world's largest collections of maps and serial photographs is housed in the National Archives, Washingto, D.C. Close to two million maps and more than two and one-half million aerial photographs comprise the collections. Created and assembled over more than 200 years, the collections of many agencies of the federal government, past and present, have been systematically organized for research purposes.

A valuable brief introduction to these collections is the article by A. Philip Muntz, "Federal Cartographic Archives: A Profile."[69] A free National Archives publication, "General Information Leaflet" #26, briefly describes the holdings and provides a list of National Archives publications dealing with maps and aerial photographs. Principal among these is the Guide to Cartographic Records in the National Archives.[70] Excellent finding aids are the published Preliminary Inventories and Special Lists which deal with special subjects and classes of materials. Especially useful ones are Cartographic Records of the Bureau of Indian Affairs (Special List #13); List of Cartographic Records of the General Land Office (Special List #19); Cartographic Records of the Bureau of Agricultural Economics (Special List #28); Aerial Photographs in the National Archives (Special List #25); United States Hydrographic Office Manuscript Charts in the National Archives, 1838-1908 (Special List #43) and Cartographic Records of the National Resources Planning Board (Special List #41). Among the Preliminary Inventories are those of the Forest Service (#167); the Federal Housing Administration (#45), the Office of the Secretary of the Interior (#81) and the Bureau of the Census (#103).

A number of papers specially prepared for the conferences organized by the National Archives provide excellent appraisals of particular topics. For the 1970 Conference on the National Archives and Urban Research, Ralph E. Ehrenberg prepared "Cartographic Records in the National Archives Useful for Urban Studies," and for the 1971 Conference on the National Archives and Research in Historical Geography, the following papers were prepared: "Indians in the United States" (Laura E. Kelsey); "Exploration, Survey and Mapping" (Ralph E. Ehrenberg); "Transportation in Nineteenth Century America" (Patrick D. McLaughlin); an "Pre-1930 Agricultural and Related Maps" (William J. Haynes).

Cartographic records exist in many state agencies and in county and city departments. Details of these are provided occasionally in general finding aids such as guides and inventories, but the reportage is extremely spotty. For such records in other repositories the main finding aids will likely be the general guides if they exist. Individual inquiry is generally necessary.

Photographic Collections

The photographic record is rapidly becoming as important for historical research as the manuscript or the map, and during the past decade or so great strides have been made in the upgrading of the photographic archives of major universities, museums and historical societies.

A useful brief introduction to photographs is provided in Duckett's Modern Manuscripts,[71] and a much fuller treatment in Weinstein and Booth's Collection, Use and Care of Historical Photographs."[72] Of great value for the Pacific Northwest is the Union Guide to Photographic Collections in the Pacific Northwest,[73] issued recently by the Oregon Historical Society.

A Final Word

Not included in this paper is any discussion of such sources as contemporary newspapers, other printed materials such as travel guides, directories, gazetteers and such like, and oral history materials. Strictly these are not primary sources although they may be based largely on the primary sources. Hence they have been omitted.

NOTES

[1]J. B. Mitchell, Historical Geography. London: English Univeristies Press, 1954.

[2]Kathleen Neils Conzen, "Community Studies, Urban History and American Local History," in The Past Before Us: Contemporary Historical Writing in the United States, Michael Kammen, editor. Ithaca: Cornell University Press, 1980, pp. 270-291.

[3]Pierre Goubert, "Local History," Daedalus, Winter, 1971, pp. 113-127. Issue on Historical Studies Today.

[4]E. A. Wrigley, editor, Introduction to English Historical Demography. London, 1966; and Kenneth A. Lockridge, "Historical Demography" in The Future of History, Charles F. Delzell, editor. Nashville, 1977, pp. 53-64.

[5]A recent appraisal of the field is to be found in J. Morgan Kousser, "Quantitative Social and Economic History," in The Past Before Us, pp. 433-456.

[6]A useful study is Michael Kammen, "The American Revolution Bicentennial and the Writing of Local History," History News, XXX (August 1975), pp. 179-190.

[7]Lester Cappon, "'The Historian's Day'—From Archives to History," in The Reinterpretation of Early American History: Essays in Honor of John Edwin Pomfret, Ray Allen Billington, editor. New York: W. W. Norton, 1968, p. 241.

[8]Vaughan Cornish, The Great Capitals: An Historical Geography. London, Methuen,

[9]H. C. Darby, The Domesday Geography of England. 5 volumes. Cambridge: Cambridge University Press, 1952-1967. Volume I, Eastern England, was written entirely by Darby. The other volumes have contributions by various scholars. Two further volumes have been added to the series: H. C. Darby, Domesday England. Cambridge: Cambridge University Press, 1977--a background work—and H. C. Darby & G. R. Vesey, Domesday Gazetteer. Cambridge: Cambridge University Press, 1975.

[10]Alan R. H. Baker, John D. Hamshere & John Langton, editors, Geographical Interpretation of Historical Sources. Newton Abbott, Devon: David & Charles, 1970.

[11]Ibid., p. 16.

[12]David Ward, editor, Geographical Perspective on America's Past: Readings on the Historical Geography of the United States. New York: Oxford University Press, 1979.

[13]Goubert, op. cit., p. 115 and Lawrence Stone, "English and United States Local History," Daedalus, Winter, 1971, p. 128. Issue on Historical Studies Today.

[14]Goubert, op. cit., pp. 114-115.

[15]H. P. R. Finberg, The Local Historian and His Theme. Leicester: Leicester University Press, 1952; W. G. Hoskins, Local History in England and Wales. 2nd edition. London: Longman, 1972.

[16]Kathleen Neils Conzen, op. cit., p. 116.

[17]Goubert, op. cit., p. 116.

[18]Sumner Chilton Powell, Puritan Village: The Formation of a New England Town. Anchor Books edition. New York: Doubleday & Company, 1965.

[19]Kenneth A. Lockridge, A New England Town: The First Hundred Years, Dedham, Massachusetts, 1636-1736. New York: Norton, 1976.

[20]Sam Bass Warner, Street-Car Suburbs: The Process of Growth in Boston, 1870-1900. Cambridge: Harvard University Press, 1969.

[21]Merle Curti, The Making of an American Community: A Case Study of Democracy in a Frontier County. Stanford: Stanford University Press, 1969.

[22]Among Andrew Clark's major contributions are his three monographs: The Invasion of New Zealand by People, Plants and Animals: The South Island. New Brunswick: Rutgers University Press, 1949; Three Centuries and the Island: A Historical Geography of Settlement and Agriculture in Prince Edward Island, Canada. Toronto: University of Toronto Press, 1959; and Acadia: The Geography of Early Nova Scotia to 1760. Madison: University of Wiscosin Press, 1968. The latter work received the Beveridge Award of the American Historical Association in 1968.

[23]John Warkenton's "Epilogue" in European Settlement and Development in North America: Essays on Geographical Change in Honour and Memory of Andrew Hill Clark, James R. Gibson, editor. Toronto: University of Toronto Press, 1978, pp. 208-220, assesses the contributions made by Clark's students.

[24]Robert D. Mitchell, Commercialism and Frontier: Perspectives on the Early Shenandoah Valley. Charlottesville: University Press of Virginia, 1977.

[25]H. Roy Merrens, Colonial North Carolina in the Eighteenth Century. Chapel Hill: University of North Carolina Press, 1964.

[26]James T. Lemon, The Best Poor Man's Country: A Geographical Study of Early Southeastern Pennsylvania. Baltimore: The Johns Hopkins University Press, 1972.

[27]Terry G. Jordan, German Seed in Texas Soil: Immigrant Farmers in Nineteenth Century Texas. Austin: University of Texas Press, 1966.

[28]Sam B. Hilliard, Hog Meat and Hoecake: A Geographical View of Food Supply in the Heart of the Old South. Carbondale: Southern Illinois University Press, 1972.

[29]David Ward, "Nineteenth Century Boston: A Study in the Role of Antecedent and Adjacent Conditions in the Spatial Aspects of Urban Growth." Unpublished Ph.D. dissertation, University of Wisconsin, 1963.

[30]In addition to an M.A. Thesis and a Ph.D. dissertation, both on the historical geography of the Palouse Region of Eastern Washington, Meinig has completed a major work on the historical geography of the Pacific Northwest, in addition to works on South Australia, the Mormon Culture Region and the American Southwest. Donald W. Meinig, The Great Columbia Plain: A Historical Geography, 1805-1910. Seattle: University of Washington Press, 1968.

[31]The Compact Edition of the Oxford English Dictionary. 2 volumes. New York: Oxford University Press, I, p. 435.

[32]Kenneth W. Duckett, Modern Manuscripts. Nashville: American Association for State and Local History, 1975, p. 337.

[33]Theodore R. Schellenberg, The Management of Archives. New York: Columbia University Press, 1965.

[34]Theodore R. Schellenberg, Modern Archives: Principles and Techniques. Chicago: University of Chicago Press, 1956.

[35]John Kirtland Wright and Elizabeth T. Platt, Aids to Geographical Research. 2nd edition. New York: American Geographical Society, 1947. Research Series #22.

[36]Robert W. Durrenburger, Geographical Research and Writing. New York: Thomas Y. Crowell, 1971.

[37]L. Lloyd Haring & John F. Lounsbury, Introduction to Scientific Geographic Research. 2nd. edition. Dubuque: William C. Brown Company, 1975.

[38]H. Roy Merrens, "Source Materials for the Geography of Colonia America," Professional Geographer, 15 (1063), pp. 8-11.

[39]Ralph H. Brown, "Materials Bearing upon the Geography of the Atlantic Seaboard, 1790 to 1810," Annals of the Association of American Geographers, 28 (1938), pp. 201-231.

[40]Michael Morgan, Historical Sources in Geography. London: Butterworths, 1979.

[41]See especially F. G. Emmison, Archives and Local History. 2nd. edition. Chichester: Phillimore, 1974, and W. G. Hoskins, Local History in England 2nd edition. London: Longman, 1972.

[42]Frank Freidel, editor, The Harvard Guide to American History. 2 volumes. Cambridge: Harvard University Press, 1974, I, pp. 94-106.

[43]Helen J. Poulton, The Historian's Handbook. Norman: University of Oklahoma Press, 1972, pp. 177-191.

[44]Thomas E. Felt, Researching, Writing and Publishing Local History. Nashville: American Association for State and Local History, 1976.

[45]Philip C. Brook, Research in Archives: The Use of Unpublished Primary Sources. Chicago: University of Chicago Press, 1969.

[46]Ralph E. Ehrenberg, editor. Patterns and Process: Research in HIstorical Geography. Washington, D.C., Howard University Press, 1975 (National Archives Conferences, #9).

[47]National Archives, Guide to the National Archives of the United States. Washington, D.C., Government Printing Office, 1974, 1976.

[48]Ehrenberg, op. cit., pp. 315-349.

[49]Jane F. Smith, "The Use of Federal Records in Writing Local History: A Case Study," Prologue, Spring 1969, pp. 29-51.

[50]Samuel P. Hays, "The Use of Archives for Historical Statistical Inquiry," Prologue, Fall 1969, pp. 7-35.

[51]Federal Archives and Records Center, Seattle, Guide to the Seattle Archives Branch, Richard Hobbs, compiler. Seattle: National Archives & Records Service, 1977.

[52]Ernst Possner, American State Archives, Chicago, University of Chicago Press, 1964.

[53]Washington State Archives, General Guide to the Washington State Archives. Olympia: State Archives & Records, 1969.

[54]Washington State Archives, Guide to the Governors' Papers, 1853-1976. Olympia: State Archives & Records, 1977.

[55]Washington State Archives, Judicial Records I. Olympia: State Archives & Records, 1977.

[56]John F. Burns, "The NHPRC and the State of Washington's Historical Records," Prologue XI (Spring 1979), pp. 57-63.

[57]Felt, op. cit., p. 45.

[58]Philip M. Hamer, editor, Guide to Archives and Manuscripts in the United States.

[59]National Union Catalog of Manuscript Collections. Washington: Library of Congress, 1962—.

[60]Directory of Archival and Manuscript Repositories. Washington: National Historical Publications and Records Commission, 1978.

[61]D. W. Moody, "The Hudson's Bay Company's Archives: A Resource for Historical Geography," The Canadian Geographer, XXI (1977), pp. 268-274.

[62]Albro Martin, James J. Hill: The Opening of the Northwest. New York: Oxford University Press, 1976.

[63]Richard C. Overton, Burlington Route: A History of the Burlington Lines. Lincoln: University of Nebraska Press, 1976.

[64]Robert G. Aheard, Union Pacific Country, Lincoln: University of Nebraska Press, 1976.

[65]John F. Stover, American Railroads. Chicago: University of Chicago Press, 1961.

[66]Duckett, op. cit.

[67]Washington State University Library, Northwest Botanical Manuscripts. Pullman: Washington State University, 1976.

[68]Wshington State University Library, A Union List of the Papers of Members of Congress from the Pacific Northwest, Terry Abraham, compiler. Pullman: Washington State University, 1976.

[69]A. Philip Muntz, "Federal Cartographic Archives: A Profile," Prologue, Spring 1969, pp. 3-8.

[70]Guide to Cartographic Records in the National Archives. Washington: National Archives, 1971.

[71]Duckett, op. cit., pp. 169-200.

[72]Robert A. Weinstein & Larry Booth, Collection, Use and Care of Historical Photographs. Nashville: American Association for State and Local History, 1977.

[73]Union Catalog to Photographic Collections in the Pacific Northwest. Portland: Oregon Historical Society, 1978.

In completing the final version of my paper I inadvertently overlooked two important sources of information, and I am grateful to James D. Moore, Northwest Regional Archivist, Washington State Archives, for drawing them to my attention. In 1975 the Society of American Archivists issued a Directory of Business Archives in the United States, a volume I have not yet inspected personally. And a few months ago the American Association for State and Local History issued Local Government Records: An Introduction to Their Management and Preservation by H. G. Jones. This is an excellent volume in every respect and will prove invaluable to researchers. Included are brief assessments of the programs recently undertaken in a number of county and city archives, among them those of two Pacific Northwest cities—Portland and Bellingham.

APPENDICES

I

THE PUBLISHED WRITINGS OF

HOWARD J. CRITCHFIELD

The bibliography of Dr. Critchfield's published writings is arranged in chronological order. Complete bibliographical citations are given for all items except reviews, for which page numbers are omitted.

The bibliography is restricted to books, articles, bibliographies and book reviews. Other writings--newspaper articles, articles in encyclopedias, etc.,—are not included.

J.W.S.

1948

"Land Use Levels in Boundary County, Idaho," Economic Geography, 24, 3 (July), 201-208.

"The Seward Peninsula of Alaska," Yearbook Association of Pacific Coast Geographers, 10, 49. (Abstract)

1949

"Water as a Resource in the United States Pacific Northwest," Proceedings Seventh Pacific Science Congress of the Pacific Science Association, Auckland and Christchurch, New Zealand, 2nd February to 4th March, Vol. VII, Anthropology, Public Health and Nutrition, and Social Sciences, pp. 480-481. (Abstract)

"Climatic Aspects of Soil Erosion in the Palouse Region," Bulletin American Meteorological Society, 30, 3 (March), 106.

"Seward Peninsula, Threshold of the Hemisphere," Economic Geographer, 25, 4 (October), 275-284.

Review: "An American Textbook of Geography," New Zealand Geographer, 5 (2) October, 1949. (Review of College Geography by Case and Bergsmark)

1950

"New Zealand Phormium Fiber," Foreign Agriculture, 24, 2 (February), 4-43.

1951

"Pastoral Murihiku," New Zealand Geographer, 7, 1 (April), 1-20.

"Phormium Tenax—New Zealand's Native Hard Fiber," Economic Botany, 5, 2 (April-June), 172-184.

1952

"Fiordland: New Zealand's Empty Southwest," Yearbook Association of Pacific Coast Geographers, 14, 40-48.

1953

"New Zealand in American Eyes: A Review," New Zealand Geographer, 9, 1 (April), 72-78.

1954

"Specialty and Forage Crops," Chapter 20, pages 347-357, of The Pacific Northwest, edited by Otis W. Freeman and Howard H. Martin. New York: John Wiley & Sons.

"The Growth of Pastoralism in Southland, New Zealand," Economic Geography, 30, 4 (October), 283-300.

1957

Weather and Climate. Bellingham: Western Washington State College, 3 vols., Mimeographed.

1959

"Conservation and Controversy," New Zealand Geographical Society Record, 27 (January-June), 15-16.

"The Pacific Northwest," New Zealand Geographical Society Record, 27 (January-June), 20-21.

"The Changing Climate," Canterbury Chamber of Commerce Agricultural Bulletin, No. 363 (September), 6 pp.

"The Changing Climate," Lincoln College Rural Education Bulletin, 14, 10 (November), 149-158.

1960

General Climatology. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 465 pp. (Also published London: Prentice Hall International, 1961)

Review: "World Geography by Otis W. Freeman and John Morris," New Zealand Geographer, 16 (1) April, 1960.

"Spartina Townsendii: A Significant Plant in Coastal Geography," Annals Association of American Geographers, 50, 3 (September), 312. (Abstract)

1961

Review: "A History of the United States Weather Bureau by Donald R. Whitnah," The Professional Geographer, 13 (5) September, 1961.

Review: "The Blizzard of '88 by Irving Werstein," The Professional Geographer, 13 (6) November, 1961.

1962

Review: "Anglo-America, A Regional Geography of the United States and Canada by Griffin, Young, and Chatham," Pacific Northwest Geographer, 1 (1) Autumn, 1962.

Review: "Land and Livelihood, edited by M. McCaskill," Pacific Affairs, 35, 1962.

1963

"A New Comprehensive Soil Classification: Its Implications for Geography," Geographical Review of India, 25, 3 (September), 153-163.

Review: "Power in New Zealand by Bryan H. Farrell," Journal of Geography, 62 (7), October, 1963.

"The New Comprehensive Soil Classification: Its Implications for Geography," Annals Association of American Geographers, 53, 4 (December), 584. (Abstract)

1964

"The Climatic Factor in Agricultural Typology," Abstracts of Papers. London: 20th International Geographical Congress, pp. 213-214.

"Problems of High Country Pastoralism," Abstracts of Papers. London: 20th International Geographical Congress, p. 214.

1966

General Climatology. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 2nd ed., 420 pp.

"Water Balance Analogues in the Marine Climates of New Zealand and North America," New Zealand Geographer, 22, 2 (October), 111-124.

Review: "Traffic in a New Zealand City, W. B. Johnson, ed." The Professional Geographer, 18 (6) November, 1966.

1968

"Resources of Australia, New Zealand, and Oceania," Chapter 6 in World Resources, Eastern Hemisphere by Robert N. Saveland. Boston: Ginn and Company, pp. 209-258.

"Graphic Determination of Maritimity and Continentality from Potential Evapotranspiration Data," Abstracts of Papers, 21st International Geographical Congress, New Delhi, 1968, pp. 60-61.

"Geography and Its Relation to the Sciences," Chapter 26 in Methods of Geographic Instruction, edited by John W. Morris. Waltham, MA: Blaisdell Publishing Company, pp. 301-313.

"The Climatic Factor in Agricultural Land Classification," Ochanomizu University Studies in Arts and Culture, 21, 20-26.

General Climatology, Eastern Economy Edition. New Delhi: Prentice-Hall of India, 420 pp.

1969

"Pastoral High Country, South Island, New Zealand: The Second Century," Yearbook Association of Pacific Coast Geographers, 31, 51-68.

1971

"Graphic Determination of Maritimity and Continentality from Potential Evapotranspiration Data," in S. P. Chatterjee and S. P. Das Gupta, 21st International Geographical Congress, New Delhi, 1968, Selected Papers. Vol. I, Physical Geography. Calcutta: Indian National Committee for Geography, pp. 187-191.

Review: "New Zealand by Kenneth B. Cumberland and James S. Whitelaw," The Professional Geographer, 23 (2) April, 1971.

1972

Review: "Climate: Present, Past and Future. Vol. 1, Fundamentals and Climate Now, by H. H. Lamb," South African Geographer, 4 (1) September, 1972.

1974

General Climatology. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 3rd Ed., 446 pp.

"Seattle to the Border: Shorelines, Floodplains, and Foothills," in Views of Washington, edited by Douglas K. Fleming. Seattle: Association of American Geographers, 70th Annual Convention, 31, 1 (April), 80-82.

1975

"International Geographical Union Regional Conference, Palmerston North December 1974," New Zealand Geographer, 31, 1 (April), 80-82.

"Climatic Maritimity of Mid-Latitude Pacific Littorals: A Mirror for Perception," Proceedings International Geographical Union Regional Conference, Palmerston North, New Zealand, December 1974. Christchurch: New Zealand Geographical Society, Conference Series No. 8, 241-246.

General Climatology, Eastern Economy Edition. New Delhi: Prentice-Hall of Indian Private Limited, 3rd Edition, 446 pp.

"Climate and Energy Policy in the Pacific Region," Thirteenth Pacific Science Congress Record of Proceedings, Vol. 1, p. 148. (Abstract)

1976

Sources of Climatic Data—Northern Puget Lowland. Bellingham: Department of Geography and Regional Planning, Western Washington State College, 9 pp.

1977

Guide to Climatic Information—Washington State. Bellingham: Office of the State Climatologist, 16 pp.

Review: "Applied Climatology: An Introduction, 2nd Edition, by John F. Griffiths, Journal of Geography 77 (5), September 1976.

1978

Bibliography and Index, Weather and Climate Studies—Washington State. Bellingham: Office of the State Climatologist, 17 pp.

"Climatology in a Comprehensive Energy Policy," Conference on Climate and Energy: Climatological Aspects and Industrial Operations, Asheville, NC: American Meteorological Society, May 8-12, 1978 pp. 146-149.

Sunshine and Solar Radiation in Washington State. Bellingham: Office of the State Climatologist, 39 pp.

1979

Guide to Climatic Information—Washington State. Bellingham: Office of the State Climatologist, 19 pp., revised January 1979.

II

THE CONTRIBUTING AUTHORS

James W. BOSCH, a graduate of San Francisco State University, was awarded his Ph.D. at Stanford University. He is presently Chairman of the Department of Anthropology at Western Washington University.

Theodore R. BOSS majored in Geography and Biology at Western Washington University where he also obtained his M.S. degree. For a year he was a Research Associate in the Department of Geography and Regional Planning working on a project funded by the Bonneville Power Administration. He is now a doctoral candidate in Biogeography at Oregon State University.

William J. BROCKIE is Senior Lecturer in Geography at the University of Otago, Dunedin, New Zealand. He was awarded honors degrees in Geography at the University of Edinburgh, Scotland. In 1970 he was Visiting Lecturer in the Department of Geography at Western Washington University.

Charles J. FLORA graduated from Purdue University and took his doctorate at the University of Florida. After serving as Academic Dean, he was appointed President of Western Washington State College (now University) in 1967 and served in that capacity until 1975. A marine biologist, he is presently Professor of Biology and Director of the Sundquist Laboratory, Western Washington University. With Dr. Eugene Fairbanks he has written The Sound and the Sea.

Patrick S. GRANT, recipient of a Patrick L. Monahan Memorial Scholarship for two successive years, was given the Department of Geography & Regional Planning's Outstanding Senior Award when he graduated in 1979. He is now Graduate Teaching Assistant in the same department and a candidate for the M.S. degree.

Eugene A. HOERAUF, a graduate of the University of Oregon, has an M.A. in Geography from the same university and a M.Libr. from the University of Washington. He is now Staff Cartographer, Department of Geography & Regional Planning, Western Washington University.

Samuel P. KELLY, an alumnus of Western Washington University, was awarded his Ph.D. at the University of Chicago. Professor of Education at Western Washington University, he is currently Dean for Graduate Affairs and Research.

Ralph E. LEWIS graduated in Geography at Washington State University and took his M.A. in Geography at Western Washington University before going on to the University of Minnesota for his Ph.D. He is an Associate Professor of Geography at Eastern Oregon State University.

Michael P. McINTYRE is Professor of Geography at San Jose State University and a former President of the Association of Pacific Coast Geographers. He is a graduate of the University of Washington and completed his Ph.D. at The Ohio State University. Among his publications is a well-known textbook, Physical Geography.

Robert L. MONAHAN graduated at the University of Washington and was awarded his Ph.D. at McGill University, Montreal. Since 1955 he has been on the faculty of Western Washington University, where he is presently Professor of Geography and Director of the Canadian-American Studies Center.

Debnath MOOKHERJEE graduated from the University of Calcutta with B.A. and M.S. degrees, and took his Ph.D. at the University of Florida. He is Professor of Geography and Director of Urban/Regional Planning at Western Washington University. Among his many publications is a monograph Urbanization in a Developing Economy: Indian Perspectives and Patterns.

George A. RHEUMER is an alumnus of the University of British Columbia and was awarded his Ph.D. at the University of Illinois. He is an Associate Professor of Geography at Simon Fraser University, Burnaby, Canada. In 1971 he was Visiting Lecturer in Geography at Western Washington University.

Maurice L. SCHWARTZ took his B.S., M.A., and Ph.D. degrees at Columbia University. Since 1968 he has been on the faculty of the Department of Geology, Western Washington University, where he is Professor of Geology and Education. His publications include two volumes in the "Benchmarks of Geology" series: Spits and Bars (1972) and Barrier Islands (1973).

James W. SCOTT is an honors graduate of the University of Cambridge and he completed his Ph.D. at Indiana University. Since 1966 he has been on the faculty of Western Washington University where he is currently Chairman of the Department of Geography & Regional Planning and Director of the Center for Pacific Northwest Studies. He is a member of the Washington State Historical Records Advisory Board and the Editor of the Yearbook of the Association of Pacific Coast Geographers. His publications include Social Science Research Handbook (with R. G. McInnis), various edited volumes of the Occasional Papers series of the Center for Pacific Northwest Studies, and a forthcoming book, Early Industries of Bellingham Bay and Whatcom County (with Daniel E. Turbeville).

Herbert C. TAYLOR, Jr., a graduate of the University of Texas, was awarded his Ph.D. at the University of Chicago. A former Dean of Research at Western Washington University, Dr. Taylor is now Professor of Anthropology. His many papers have appeared in a number of professional journals and in the volume Man Across the Sea: Problems in Pre-Columbian Contacts.

Thomas A. TERICH, a graduate of California State University/Los Angeles, received his Ph.D. at Oregon State University. He is currently an Associate Professor of Geography at Western Washington Univerity. The author of numerous papers on coastal topics, Dr. Terich has been the recipient of numerous research grants from government agencies and foundations.

Daniel E. TURBEVILLE III, a graduate of the University of South Carolina, took his M.A. in Geography at Western Washingto University. After serving as Map Curator in the Department of Geography & Regional Planning for three years, he entered the Ph.D. program in Geography at Simon Fraser University, where he is now a Ph.D. Candidate. His publications include An Illustrated Inventory of Historic Bellingham Buildings, 1852-1915; The Electric Railway Era in Northwest Washington, 1890-1930; and the forthcoming Early Industries of Bellingham Bay and Whatcom County (with James W. Scott).

H. L. (Larry) ZIETSMAN graduated in Geography at the University of Stellenbosch, South Africa, where he recently completed his Ph.D. In between the two degrees he spent a year at Western Washington University as a Graduate Teaching Assistant and was awarded his M.A. degree in Geography. He is presently Senior Research Associate of the Institute of Cartographic Studies at the University of Stellenbosch.

III

LIST OF SPONSORS

The following—students and former students, colleagues and former colleagues, and other friends—have in large part made possible the publication of this volume. On behalf of the Department of Geography and Regional Planning and the Center for Pacific Northwest Studies, I would like to thank them for their generous contributions.

J.W.S.

Henry L. Adams
Western Washington University

Burton W. Adkinson
Washington, D.C.

Jeremy Anderson
Eastern Washington University

L. Dean Bark
Kansas State University

Carl F. Batchelor
Western Washington University (student)

Daniel P. Beard
Columbia, Maryland

Richard H. Berg
Western Washington University

Andrejs L. Berkis
Portland, Oregon

Eric Bird
University of Melbourne, Australia

H. W. Bockemuehl
University of Montana

James W. Bosch
Western Washington University

Theodore R. Boss
Oregon State University

Bernard L. Boylan
Western Washington University

John and Cathy (Rippell) Bradshaw
Bellingham, Washington

Ron Bradshaw
Bellingham, Washington

Theodore R. Brandt
Western Washington University (student)

William H. Brown, Jr.
The Evergreen State College, Olympia

Roscoe L. Buckland
Western Washington University

William C. Budd
Western Washington University

Anne Buttimer
Clark University, Massachusetts

Henry H. Caldwell
University of Idaho

S. R. Carlile
Western Washington University

J. D. Chapman
University of British Columbia

Robert Christman
Western Washington University

Jane Clark
Western Washington University

Joseph W. Clough
Western Washington University

Chester F. Cole
California State University, Fresno

Donald H. Cole
Western Washington University

Janet Collins
Western Washington University

Arnold Court
California State University/Northridge

Clark L. Cross
University of Florida

Frank L. Cunningham
Simon Fraser University

Stanley Daugert
Western Washington University

Gordon L. Davies
University of Dublin, Ireland

James W. Davis
Western Washington University

Robert Davis
Bellevue, Washington

Larry and Cheryl DeHaan
Lynden, Washington

Craig Duncan
University of Waikato, New Zealand

D. R. Eberhart
Central Washington University

Jane Ehemann
Shippensburg State College, Pennsylvania

L. J. Evenden
Simon Fraser University

Astvaldur Eydal
San Francisco State University, Emeritus

John D. Eyre
University of North Carolina

Doug Fleming
University of Washington

Charles J. Flora
Western Washington University

Harold D. Foster
University of Victoria, British Columbia

James Fox
University of New England, Australia

Albert J. Froderberg
Western Washington University

Robert E. Gabler
Western Illinois University

Merle and Marion Gallman
Bellingham, Washington

Deborah A. Gannaway
Ferndale, Washington

Harvey M. Gelder
Western Washington University

H. A. "Barney" Goltz
Western Washington University

J. D. Goodridge
Sacramento, California

Frederick Graham
San Jose State University, Emeritus

Patrick S. Grant
Western Washington University (student)

John F. Griffiths
Texas A&M University

Kenneth A. Hammond
Central Washington University

Joseph Fraser Hart
University of Minnesota

Nicholas Helburn
University of Colorado

Dick Highsmith
Oregon State University

Dr. & Mrs. John Hiltner
Bowling Green University, Ohio

Oscar H. Horst
Western Washington University

G. Donald Hudson
University of Washington, Emeritus

W. A. Douglas Jackson
University of Washington

Johannes Jansen
University of Stellenbosch, South Africa

J. Granvill Jensen
Oregon State University

W. B. Johnston
Univerity of Canterbury, New Zealand

Martin Kaatz
Central Washington University

Samuel Kelly
Western Washington University

Fred W. Knapman
Western Washington University, Emeritus

Moses P. Lai
Fort Steilacoom Community College

Kenneth J. Langran
Western Washingto University

David W. Lantis
California State University/Chico

W. Robert Lawyer
Western Washington University

Ralph and Merry Beth Lewis
Eastern Oregon State College

Ron G. Lister
University of Otago, New Zealand

Calvin L. Longstreth
Lynden, Washington

Joan C. Longstreth
Lynden, Washington

Jonathan J. Lu
University of Northern Iowa

D. B. Luten
University of California/Berkeley

George Macinko
Central Washington University

Archie MacPherson
Simon Fraser University

Melvin G. Marcus
Arizona State University

Marion Marts
University of Washington

Evelyn P. Mason
Western Washington University

John R. Mather
University of Delaware

Erwin S. Mayer
Western Washington University

Shannon McCune
University of Florida

Michael P. McIntyre
San Jose State University, California

Tom McKnight
University of California/Los Angeles

Myron Molnau
University of Idaho

Robert L. and Marilyn Monahan
Western Washington University

Debnath Mookherjee
Western Washington University

Andries Nel
University of Stellenbosch, South Africa

Darlene F. Nelson
Western Washington University

W. A. Nieman
University of Stellenbosch, South Africa

Fred A. Olsen
Western Washington University

Gil Peterson
Western Washington University

Forrest R. Pitts
University of Hawaii

Dorothy Ramsland
Western Washington University

J. Lewis Robinson
University of British Columbia

J. R. Romanowski
University of Manitoba

Charles R. Ryan
Seattle, Washington

David A. and Meera (Guha) Schoen
Ball State University, Indiana

Maurice L. Schwartz
Western Washington University

James W. Scott
Western Washington University

Wm. H. O. Scott
Western Washington University

Vincent K. Shaudys
California State University/Hayward

John C. Sherman
University of Washington

Dorothy Shireman
Puyallup, Washington

Curtis R. Smelser
Longview, Washington

David R. Smith
Longview, Washington

Eileen R. Smith
Western Washington University

Richard G. Smith
Western Washington University

Rodney Steiner
California State University/Long Beach

Orman E. Street
Beltsville, Maryland

James L. Talbot
Western Washington University

Thomas A. Terich
Western Washington University

Robert W. Teshera
Western Washingto University

Gary L. Thompson
University of Oklahoma

Keith W. Thomson
Massey University, New Zealand

Alan D. Tweedie
University of New Castle, Australia

Joseph Velikonja
University of Washington

Manfred C. Vernon
Western Washington University (Emeritus)

Paul Waite
Iowa Weather Service

Hal Williams
Maple Valley, Washington

James L. Wise
Anchorage, Alaska