THE LANDSCAPE OF

SOUTHWESTERN ALBERTA

by

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ABSTRACT

THE LANDSCAPE OF SOUTHWESTERN ALBERTA

This study of Southwestern Alberta is an attempt to focus attention on the landscape, as a fundamental approach to geographic variation and regionality. It is also an attempt to depart from the marketing region and mathematical approaches, which are at present gaining wide favour in geographic work.

The area studied, Southwestern Alberta, was selected for its contrast and diversity. Few other sections of North America offer the same degree of variety in so small an area.

The method of investigation had two aspects, library research and field study. The former consisted of consulting written works, analysing climatic data, interpreting air photos and maps, together with some reference to census statistics. The field work involved several traverses of the area under study, by automobile, aeroplane and foot. Work in the field was conducted not only to check the accuracy of information gathered in the library research, but also to obtain original data and to fill gaps in the published material.

It is the purpose of the thesis to (a) clarify the meaning of "landscape" as interpreted in this geographic study, (b) describe the landscape and its "spheres" in detail, and (c) arrive at a broad classification of landscape regions for Southwestern Alberta. Above all else, it is desired to present and give an appreciation of Southwestern Alberta's landscape character.
"The Landscape of Southwestern Alberta", treats the landscape as being composed of a number of "layers" or "spheres". These are the lithosphere, hydrosphere, atmosphere and biosphere, making up the physical (natural) landscape segments and the cultosphere which is the cultural (man-made) landscape segment. In reality these are all interdependent and can not exist alone.

In conclusion, the southwestern corner of the province has been subdivided into a number of landscape regions. These regions are as follows:

(1) The Southern Rockies, composed of a block-like Precambrian mass, lie south of the Carbondale River valley. Smooth, forested, lower slopes give way to glacially-sculptured, alpine peaks. The chief human activities here, tourism, forestry and watershed-conservation have left little mark on the wild rugged landscape.

(2) The Northern Rockies are made up of long, bare, Palaeozoic ranges rising above grassy or forested, subdued, Cretaceous lands. Here the human activities of coal mining, limestone quarrying, forestry and grazing have altered the landscape more than in the south. Population is concentrated in a narrow band of mining nucleations along the Crowsnest Pass.

(3) Of the three foothills regions, the Northern High Foothills presents the most rugged and forested appearance. The ridges tend to be parallel and are often herring-bone shaped supporting grass on southern exposures while the remainder is forested. Ranching is the predominant industry.

(4) East and south from the High Foothills stretches the Subdued Foothills region. This land is gently rolling, much grassier and with some cultivation toward the eastern margin.

(5) South of Mountain View and Cardston lie the Rolling Foothills. This region is a "sandpapered" hill-land mantled
in range -grass, but broken by long, rocky ridge-scarps. The foothills are all underlain by soft Cretaceous rocks which have been faulted and folded by the Rocky Mountain, building movements.

(6) Eastward from the northern foothills rise the Porcupine Hills. Geologically a part of the Alberta syncline, these high, rounded and brokenly-forested hills stand in isolated splendor above the adjacent plains. Forestry and grazing have both left their marks on the vegetation.

(7) The Porcupine Transition region, to the east of the high hills, is a grassy rangeland zone with a low population density.

(8) The Peigan and Blood Indian Reserves are physically similar to the adjacent plains, but are culturally distinct. Much of the reserves are devoted to rangeland, but some cultivation is also practiced.

(9) The Dry-Farming Plains focus on the trade center of Pincher Creek. These great, sweeping plains are cut by steep-sided river valleys and coulees, and broken by the very occasional erosion remnant. Over the wide, dusty land spreads the seemingly endless pattern of golden wheat and black fallow strips. Natural trees are found only in sheltered, well-watered valleys.

(10) In the vicinity of the Belly and St. Mary's Rivers stretches the horse-shoe shaped, Mormon Irrigated Belt. This land is characterized by level terrain, irrigation cultivation and nucleated, Mormon (L.D.S.) settlement. Cardston, with its gleaming white temple is both the religious "Mecca" and trade center for the region.

(11) Near the Montana border stand the somewhat elevated Milk River Plateaux. High plains and ridges with old meltwater gaps characterize the physical landscape. Grazing, dry-land wheat and petroleum represent human activities in this outlying region.
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Date Sept. 25, 1959.
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INTRODUCTION

This study of Southwestern Alberta is an attempt to focus attention on the landscape, as a fundamental approach to geographic variation and regionality. It is also an attempt to depart from the marketing region and mathematical approaches which are at present gaining wide favour in geographic work. The landscape shows actual patterns of geology, soil hydrography, vegetation, economy, settlement, and so forth. Its analysis is therefore close to the heart of geography, which studies earth patterns and their interrelationships.

Southwestern Alberta was selected for its contrast and diversity. There are few other areas in North America which offer the same degree of variety in so small and compact an area. The fundamental change is topographic from rugged mountain to level plain, which influences the climate, soil and vegetation to vary also. This natural diversity has in turn encouraged a diversity of economic pursuits and settlement characteristics. The latter however, are also partially the result of a varied historical heritage.

Despite the diversity in Southwestern Alberta, the contrasting mountains and plains form a harmonious whole. The foothills belt lies as a unifying link between the two, being in virtually every respect a transition zone.
In delimiting Southwestern Alberta regionally, only general borders were taken. The continental divide forms a natural (and political) divide to the west. The eastern border on the Great Plains is difficult to draw, but a less densely inhabited, largely rangeland zone delimits the area west of the main north-south Alberta "core" (which, in the southern part of the province, is the Lethbridge Fort MacLeod area along highways two and four). The densely settled "core" area is somewhat different both naturally and economically from Southwestern Alberta. This limits the area to be studied to the foothills belt and the adjacent, high, western Great Plains, and eastern "rain-shadow", Rocky Mountains. The southern border is taken to be the Alberta-Montana boundary, although the Chief Mountain portion of Glacier National Park (part of an international peace park) is considered also. Its scenery and its drainage lines are intimately associated with Southwestern Alberta. In the north the border used follows the high forested divides and summits near parallel 50⁰N. Between the Porcupine Hills and the Rocky Mountains this separates the more forested and parkland covered northern area from the warmer, grassier, southern section (known as the North Fork Country). The Porcupine Hills are included with the foothills and western plains in "Southwestern Alberta".
Landscape

Philosophy
LANDSCAPE PHILOSOPHY

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III. THE PLACE OF LANDSCAPE IN GEOGRAPHY
I. PAST GEOGRAPHIC PHILOSOPHY OF "LANDSCAPE"

The meaning of the word "landscape" in the English language varies somewhat from person to person, but its real meaning is no more confused or obscure than most words. However, for geographic purposes a clear cut understanding of the term is essential, even if a hard and fast dictionary definition is not established.

As a geographic term, "landscape" apparently came into English from the German where it had been extensively used and misused for centuries. Some of the confusion present in the German word "landschaft" (landscape) has crept into the usage of the English term. Landschaft has a dual meaning. It may denote an area, not as large as Land but larger than Gegend, or it may refer to the visual, aesthetic character of an area.\(^1\)

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During the past centuries geographers have arrived at various concepts of the term "landscape", as applied to geographic thinking. Waibel claimed it was, "the section of the earth surface and sky that lies in our field of vision as seen in perspective from a particular point." This is certainly an aspect of the landscape, but does not seem to be a fully inclusive definition of it. The landscape as seen in perspective is a limited view, although it is undoubtably the one most frequently considered in evaluating earth patterns. Broek, Granö, and Hellpach have definitions similar to those of Waibel. The latter two however, include sound, smell, and feeling sensations, or in other words, "the total impression aroused .... by a piece of the earth's surface...." This, however, appears to include too much which is not directly concerned with earth patterns.

Penck included those things which were in one's field of vision. As this definition stands it is little more helpful than the others. However, man was not included in this landscape, though his effect on the earth's surface was. This seems reasonable since man and the other animals are usually transient, and are capable of moving under their own power, at will. The ability of the higher animals particularly, to think and reason, makes them quite different from other things in nature which quite automatically follow

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3 *Loc. cit.*
natural environmental patterns. There have been other geographers however who have not only included man in the landscape, but have made him the focus of attention. This is true of Schlüter. On the other extreme, Passarge excludes all animal life, largely in order to simplify the scene. In addition, no effect on the land by man or other animals is included in the study. Only the natural vegetation, for instance, is recognized, even if long extinct. This point of view may have some merits, but it is really not a realistic approach to landscape as a complete study.

Lautensach includes linguistic and racial conditions in the landscape. This again seems to include too much. However, visible linguistic characters (as in signs) are a part of the landscape. The spoken language and human appearance give an area "atmosphere", but are not part of the earth surface pattern itself. If one includes these characteristics there is danger of making a landscape study into a regional analysis.

Added to these varied and conflicting points of view is the second meaning of landschaft. If landschaft can also mean a political area or region including its population, confusion is bound to occur. A landscape study is then literally a regional study. Krebs, however, suggested that rather than meaning a spatial area, landschaft means certain

elements of it that give it character and which is typical of similar areas. For example, the Alps possess an alpine landschaft. Obviously only a few basic characteristics can be included. Sauer in "The Morphology of Landscape" apparently treats landscape as an area. He defines it as, "an area made up of a distinct association of forms", as well as natural features. If the definition is taken literally this appears to be an attempt to regionalize landscapes. This may be quite valuable if it can be made workable since the landscape reflects geographic conditions far better than almost anything else. Usually it is itself the bulk of geography, since nearly all aspects of geography are mirrored in the landscape. However, despite these sidelights and all the previous arguments, geographers in Germany and America now seem to make landscape equal to region. In English this is superfluous since the word region is already well established, even if not well defined.

Broek has pointed out another aspect of a geographic landscape study. In viewing the landscape, important invisible factors such as the purpose for production, rotation systems and farm units must be searched out and kept in mind. Although rather obvious, this is a significant point.

Hartshorne, in "The Nature of Geography" enters into a lengthy discussion of landscape. Hartshorne feels that landscape suggests "some objective single reality outside our sensations," and uses the word landscape as referring to the visual aspect of the "face of the earth". One sees only the outer surface which is an expression of underlying geographic forces. Movable objects cannot be eliminated. For example, the landscape of New York has not been seen devoid of automobiles and boats. Hartshorne claims his definition represents "a certain distinct and real aspect of an area", and goes on to say, "If... we are interested in the landscape as a manifestation of something else -- the complex of related factors in the area -- then we are merely using it as a means of studying a different object, whether defined as that total complex, or as the area itself."7

Dickenson has said that geography's object is to study landscape and society plus their association and variation in area ("generic development" and "dynamic relation"). The emphasis on society is unappealing since it focuses attention on mankind, in a subject which deals with spatial relationships between nearly all things on the earth's surface. However, the emphasis on landscape in geographic study is significant.

7 Ibid., p. 165.
Lautensach likewise said that geography starts with a picture of the land. This in a sense emphasizes both landscape and the pictorial aspect of the landscape, so fundamental to geography.\footnote{Richard Hartshorne, \textit{The Nature of Geography}, p. 166.}

Consequently Hartshorne has suggested that visual landscape may be the "fundamental approach" to geography. This is the underlying philosophy of this thesis.
II. "LANDSCAPE" AS DEFINED IN THIS STUDY

A. LANDSCAPE CONCEPTS

"Landscape" as used in this study refers to the visual appearance of the earth's surface. This scene reflects the underlying geology, the climatic regime, the human culture and the location (with respect to land areas, oceans and latitude). The forms and patterns of the earth's skin are the result of these factors. Specifically the landscape may be said to be composed of geologic landforms, soil mantle, hydrographic pattern, vegetation cover and any alterations brought about by animal life (especially Homo sapiens). In addition, atmospheric conditions with cloud and mist should also be considered. Without these the scene is fragmented and incomplete.9

The landscape is a combination of myriads of elements in a great pattern. A lone house or a grove of trees are not landscapes by themselves. This epidermal pattern on the earth should not be considered a thrown-together mixture of pieces which landed adjacent to one another by chance. Rather,

9 Cloud effects and purity of the air have much to do with regional character. The Great Plains of Alberta are an example, where much of the scenery is in the sky.
the landscape panorama should be viewed like a French impressionist painting. The numerous colored dots, like the individual rocks, trees and houses in the landscape melt together to form complete harmonious impressions, several of which build up the overall picture or pattern. For example, blue and yellow dots viewed together from a distance appear as a green mass. Likewise the individual elements of a landscape may appear separate, small, and insignificant, but when added together, a completely meaningful pattern comes into view, to which each tiny element has given its particular contribution.

The meaningfulness of the landscape pattern is ensured by the natural and cultural forces which shaped it. These forces have obeyed certain universal laws and interacted with each other to produce the landscape. No force acts entirely independently from the others in modifying the planet. (The human force also relies on the other natural forces for its development). Therefore, the processes behind the formation of a pattern on the earth's surface not only explain why the landscape is as it is, but also help tie the elements of the landscape together into a harmonious unity.

The landscape is not static. It varies continuously, spatially. Nowhere are there clear cut regional boundaries enclosing one landscape type. The landscape changes gradually in all directions like a rainbow. The human eye can of course pick out landscape types and "zone-off" areas dominated by a similar or related pattern. As the landscape pattern
varies continuously spatially, it also changes continuously through time. Neither nature nor human culture are static. Both reflect their progress in the landscape. The landscape reflects the environment, perhaps better than anything else. If the chief interest in geography is difference from place to place, landscape is truly at the heart of geography, for it is very largely the difference from place to place.

Ideally the landscape should be viewed obliquely from the air. This combines both the important geographic relative locations (as shown by maps), and the commonly seen, identifying side view. A vivid understanding of an area's configuration can be obtained from oblique diagrams and photographs. However, this is not the only point of view. All angles of view and varying viewing distances may be made use of in reaching an appreciation of the visual landscape pattern and its components.

B. COMPOSITION OF THE LANDSCAPE PATTERN

Two basic segments comprise the landscape. These are the cultural or man-made and the natural or physical segments. The two cannot be separated into distinct physical and cultural landscapes, but are merely interdependent portions of the whole. For example, the
cultural elements in the landscape have largely evolved in harmony with the physical elements and could not be completely accounted for without the latter.\textsuperscript{10} Since the parts are interrelated and bound to each other by bonds of dependency, one might say that the whole landscape is more than the sum of its parts.

A truly "natural landscape" can only be found where man has not disturbed it. This is virtually impossible to find now. Even areas populated by primitive peoples have been quite significantly altered. Thus the natural landscape ceases to exist when man comes "on the scene". If an area is thoroughly man-controlled the landscape cover is ordered and arranged in definite units, each rather sharply separated from the other, irregardless of the changing underlying natural conditions. In other areas which are not man-dominated and where the landscape may be termed wild, man may still have had a strong effect on the appearance of the countryside, (by grazing for example). This landscape is not produced by a conscious human plan. It is "wild" as opposed to "tame" or man-dominated. In addition, since nature is not static but in a continuous cycle of change the present theoretical natural landscape would not be the same as the original primaeval natural landscape.

\textsuperscript{10} For example, sawmills are located near forest, and wheat fields occupy relatively level tracts of ground.
Consequently four types of landscape may be recognized:

(1) primaeval, the original landscape before man came on the scene;

(2) natural, a landscape not affected by man;

(3) wild, a landscape not produced by a conscious plan of man;

(4) tame or domesticated, a landscape produced by a conscious plan of man. A countryside patterned by cultivated fields is an example.

Obviously there is some overlap among these categories. The primaeval landscape when it existed was natural for example. The same landscape pattern may contain several types as ingredients. Thus wild forest patches and tame wheat fields combine to produce a kind of parkland. In Southwestern Alberta, outlying portions of Waterton Lakes National Park come the closest to having natural landscapes. However, Indian movement in the area during past centuries has probably affected it slightly. Wild landscapes are found in portions of the forest reserve which have not been exposed to forestry. The irrigated United Irrigation District offers a good example of tamed landscapes, with its numerous fields, irrigation canals, dams, and reservoirs and its small villages. Obviously tame and wild landscapes grade into one another and should only be separated theoretically. The landscape forms a full flowing symphony changing in space and altering with time.

For convenience the earth's epidermis is considered to be composed of a number of "layers" or "spheres" as follows: (1) lithosphere; (2) hydrosphere; (3) atmosphere; (4) biosphere; (5) cultosphere. The first four make up the physical landscape segment, while the fifth is the cultural landscape segment. This is the fundamental breakdown of the earth's surface (or landscape pattern) followed in this study.

The Physical Landscape Segment

(1) Lithosphere

The underlying foundation of the landscape is the geology which expresses itself in the surface landforms. The landform pattern is the result of two opposing forces, the orogenic, up-building force and the erosional wearing-down force. The former is usually responsible for macro-relief features, such as mountain ranges, while the latter is especially significant in the formation of micro-relief details, such as ravines, hoo-doos, and moraines. The geologic theme in this study is geologic structure (build-up) and hydrography-glaciation (erosion), followed by regional details.
At the lithosphere's contact surface with the hydrosphere and atmosphere, weathering produces a soil mantle. This special covering which supports most of the plant life is treated as a separate unit. Each soil color zone is considered and is then subdivided into areas of loam, clay, sand and so forth.

(2) Hydrosphere

The hydrosphere forms a patchy film between the lithosphere and the atmosphere. This is the liquid portion of the landscape and is consequently restricted to the lower portions on the lithosphere's wrinkled face. There are two basic divisions of the hydrosphere. These are the oceans and "water on the land" (or the land drainage patterns). Since Alberta lies hundreds of miles from the ocean only the drainage pattern is of concern in this study. The approach here is to subdivide the drainage pattern into water (streams and lakes), and glaciers (mountain glaciers and ice sheets). The difference is chiefly that the glaciers are solid. This introduces a contradiction to the statement that the hydrosphere is liquid. In many respects glaciers are "landforms" and can be treated together with the adjacent lithosphere. However, since ice is the frozen stage of water and since glaciers flow in a manner similar to streams and lakes, glacial activity can conveniently be considered an aspect of the drainage pattern.
Aside from water's mere physical presence, its role in the air (precipitation, cloud effects, etc.) and in or on the land (erosion of valleys and caves) is also very significant. On the land it is the chief tool in landscape carving and sculpturing.

(3) Atmosphere

The gaseous envelope around the earth's surface is considered a part of the "landscape picture" in this study. Without it, light diffusion, weathering and many climatic details would be absent. Often major characteristics of an area are associated with light and cloud effects. Temperature, precipitation and wind are the chief climatic elements of concern in Southwestern Alberta.

(4) Biosphere

The living garment of vegetation which clothes the land, and its animal inhabitants, forms the last physical landscape layer. By definition the animals themselves are not included in the landscape. The vegetation cover, however, is one of the most obvious features of the landscape. It is more strikingly the result of interrelations between the various natural factors (such as soil and climate) than any other landscape feature. In the vegetation chapter the basic physical influences affecting the vegetation cover are first considered. This is followed by a more detailed examination of the different vegetation zones.
The Cultural Landscape Segment

(5) Cultosphere

If the natural physical forces construct the stage for the drama of mankind, man himself constructs the props around which the action revolves. As an agent in altering the landscape man is unsurpassed by any other animal. Although all the parts of the landscape which are willfully constructed, and are thus second-hand creations, should be grouped together, the efforts of animals below Homo sapiens level have been relegated to the physical group. They are often a rather primitive and almost an instinctive response to the environment, and thus like the truly physical landscape, serve to indicate environmental influences. (For example, coral reefs and water may be compared to a vegetative cover of poplar and grass. Coral like poplar growth develops where the local environment is favourable. Otherwise the area is watery or grassy respectively).

Man's effect on the landscape varies with the stage of his culture. Primitive man is close to the animals just below him on the ladder of biological development. Thus primitive landscape alterations will often more closely reflect the natural physical environmental forces than will later ones when technology can make adjustments to suit the need. As an example, a primitive adobe hut on
the desert is more significant physically than a standardized air-conditioned home. Eventually crops may be grown with artificial heating, irrigation watering and manufactured fertilizer nourishment. This sort of man-made landscape may be of relatively little significance physically when it spreads around the earth from pole to equator.

As man advances upward from the most primitive stage his effect on the environment changes more and more from displacement to replacement, and in a sense, even to addition, finally. At first, objects are removed without any replacement. Hunting and gathering are examples of this. Next, one part of the environment is replaced by another part, such as wheat replacing wild grass in cultivation. Finally something from another environment may be added to the environment in question. Irrigation water, date palms and cotton may be added to the desert, as an example. However, it should be stressed that since the sum total of matter in the universe is always the same, man is only changing the landscape by change of form (through manufacturing, consumption, etc.) and change of location. (For example, rock from the mountains makes a highway on the plains).12

Primitive man first utilizes other parts of the biosphere for food, clothing and shelter (as for example berry gathering). Next the soil is used to grow crops. After this the hydrosphere may be used for irrigating the crops. As culture develops rock is used more and more until metals are discovered and used. Thus the physical landscape becomes progressively altered by having bare bushes, plowed soil, channeled water, and rock quarries. The chain starts nearest man (biosphere) and finally ends up in the foundation material (lithosphere). Lastly, in societies of high technology, the all-enveloping atmosphere may also be tampered with. Cloud seeding for artificial rain production not only changes the atmospheric portion of the landscape but by adding moisture to the land, upsets the erosive, and floral equilibria. This is not a case of man adding culture to the landscape, but of him tampering with landscape-producing forces.

Man's attitude to the physical landscape also changes from the primitive to the highly technological levels. The first attitude is one of defense against the environment. Numerous examples of towns in protected locations such as dyked areas, and so forth, exist. The second attitude which develops is one of regulated use. An example might be the use of water for irrigation from
a nearby stream. Thirdly, the exploitation attitude sets in. "Nature exists for man" is now the philosophy. An example is the highly developed petroleum and chemical industries where as much use as possible is made of the raw material, in order to make a myriad of products.¹³

Man's actions in the landscape may very roughly be grouped in three large categories.

**Exploitive Type** - Man may remove part of the physical landscape as in quarrying.

**Cultivative Type** - Man may substitute one part of the natural for another part, such as in agricultural cultivation where the crop replaces the native vegetation.

**Constructive Type** - Man may erect cultural objects in the physical landscape, such as buildings.

An extreme case of (3) results when the physical landscape is completely covered up, as in the downtown areas of many large cities, or when the physical landscape is removed as in the case of leveling land for an airport or by an atomic bombing.

In this study of Southwestern Alberta the cultosphere is treated in five chapters. The first gives the historical background as it quickly traces man's pattern of occupancy through the years. This accounts somewhat for the present cultural landscape pattern. The second chapter

¹³ E. A. Gutkind, *Our World from the Air.*
presents the present population pattern. People are significant in the landscape only as far as they modify it by adding to the cultosphere or altering the physical portions. The third and fourth chapters deal with the economy and settlement. These two closely related landscape features largely comprise the cultosphere. The fifth and last chapter summarizes the cultosphere.

III. THE PLACE OF LANDSCAPE IN GEOGRAPHY

If it is the purpose of geography to study the earth's spatial relationships, as it is the purpose of history to study the time relationships, then these integrating studies which tie other studies together may be diagramatically symbolized in the following manner. History is a great trunk (or rod) growing out of the misty past. Time changes in the dimension along the trunk. History, is of course made up of the chronological changes in the various components of the world and their interrelated effects. The same components when studies spatially and with different emphasis compose geography. Thus, if space is represented by planes cutting the time dimension at right angles one can have a cross-section of geography at any moment in time. If the cut occurs in the past it represents
GEOGRAPHIC CROSS SECTION
AT A MOMENT IN TIME

REGIONAL GEOGRAPHY
LANDSCAPE GEOGRAPHY (The visible reflection of the region or its part)
historical geography, but if it is at the present end of the trunk it is merely present or standard geography. (Which, in essence, is historical geography, too.)

The components on the plane of geography, which continue through history, might be placed in an organized symbolic pattern. Basically geography may be subdivided into physical and human (cultural) segments. This division is somewhat artificial but as in the case of landscape (previously discussed) it does possess simplifying merits. Half of the circle may be divided off from the human, leaving the other half for the physical and their internal subjects arranged like the segments of an orange. Another, perhaps more realistic method is to divide the circular plane as is done in the accompanying diagram. Except for the outside peripheral fringe the area is subdivided like an orange into the various physical components which basically fall into four spheres, sections of which may be studied separately. There are, starting from the foundation, the lithosphere (geology and soil), the hydrosphere (oceanography and water on the land), the atmosphere (climatology), and the biosphere (flora and fauna including Homo Sapiens when studied as an animal such as in racial studies). "Human" or cultural geography occupies the periphery, since the cultosphere is a secondary manufacture and entirely dependent upon the physical foundation. Economy and settlement largely make up the cultosphere with population as a border
subject with the physical segment. Population refers to numbers of Homo sapiens animals and is therefore largely physical in itself. However, human population is so intimately tied in with, and directly dependent upon, economics and settlement that it is unrealistic to divorce population studies from the cultosphere. Each ring of the cultosphere has a wedge connecting it with the core. A study of all the components of an area at this core comprises regional geography. Likewise, the visible reflection of a place is the landscape, which as a study forms a ring-like visible "halo" reflection around the regional study, thus including all that the regional study includes, only limiting itself to the visible aspects on the earth's surface.
With Southwestern Alberta Examples

**LITHOSPHERE**

- **Igneous origin**
  - Extrusive
    - volcano, etc.
    - extinct -- largely eroded away or covered up.
  - Intrusive
    - plain
    - mountain
    - none -- closest are the Columbia Mountains and the Canadian Shield.

- **Metamorphic origin**
  - mountain
  - Precambrian Rockies -- Waterton Lakes to Beaver Mines -- overall block-like -- shows lack of parallelism.

- **Sedimentary origin**
  - plain
  - Rockies (probably including the Precambrian Rockies before metamorphism) strong parallelism -- long block ranges and peaks.

**Landscape Breakdown**

- Foothills -- strong parallelism.

- Porcupine Hills -- rounded, forested -- no parallel structure.

- Great Plains -- sweeping to level.

**Soil Mantle**

- Bare rock
  - mountain tops of the Rockies.

- Weathered in place
  - portions here and there, but nearly affected by glaciers or glacio lacustrine clay basins in the western Great Plains bottoms, plus most of the area in a general way.

- Alluvial
  - in valleys in the mountains, and entrenched courses in the foothills and much of the plains.

- Extinct -- some in Glacier National Park.

**HYDROSphere**

- Water network on the land
  - river
    - glaciers

- lakes
  - ice-sheets

- Ocean pools

**ATMOSPHERE**

- Atmospheric conditions (including sunsets)

- Clouds

- High and clear -- only mist in the mountains at times.

- Brilliant sunsets, especially on the plains.

**Vegetative Cover (Flora)**

- Barren
  - coniferous draped mountain slopes.

- Lichen & moss
  - scattered upper levels forest.

- Forest
  - forest in the outer mountains and inner foothills especially.

- Parkland
  - extensive belt in the foothills, parts of the mountains especially (basins).

- Deciduous
  - extensive from mountain-basin pockets to "endless oceans" of grass in the eastern part.

**BIOSPHERE**

- Grass
  - eastward beyond the area, in coulees, badlands and on sun scorched plains.

- Xerophilic
  - only in limited evidence, except for the effects of Homo sapiens.

- Community (eg. coral reef)

- Mixed c. & d.

- both com. & ind.

**Animal Alterations (Fauna)**

- Individual (eg. badger burrow)

- Extensive belt in the foothills, parts of the mountains especially (basins).
Exploitation

- Ex. of lithosphere
- Ex. of hydrosphere
- Ex. of atmosphere
- Ex. of biosphere

Mining

- coal mining in Crowsnest, Beaver Mines area.

Exploitation

- Ex. of lithosphere
- Ex. of hydrosphere
- Ex. of atmosphere
- Ex. of biosphere

Forestry

- sawmills and cutting in the Crowsnest Forest Reserve. Because this is in a forest reserve and a conservation area, forestry almost falls into the replacement group. (Tree farming).

CULTOSPHERE

- Replacement
  - Rep. of lithosphere
  - Rep. of hydrosphere
  - Rep. of atmosphere
  - Rep. of biosphere

Cultivation

- dry-land and irrigated cultivation on the plains and in the foothills.

CULTOSPHERE

- Addition
  - Add. to lithosphere
  - Add. to hydrosphere
  - Add. to atmosphere
  - Add. to biosphere

Addition

- Protection
  - some old Indian campsites, farms and ranches are in lee of hills or banks to protect them from the wind.

Addition

- Settlement
  - Utilization
    - irrigation canals, dams, reservoirs and so forth.

Addition

- Domination
  - towns built without regard to topography, their grid networks thrown out over the entire site.
GEOLOGICAL FOUNDATION

I. GEOLOGY'S ROLE IN THE LANDSCAPE

II. GENERAL GEOLOGICAL STRUCTURE AND PHYSIOGRAPHY

III. GENERAL GEOLOGICAL HISTORY

IV. GEOMORPHOLOGY

ROCKY MOUNTAINS

1. Southern Precambrian Region of the Rocky Mountains

2. Northern Palaeozoic-Cretaceous Region of the Rocky Mountains

FOOTHILLS

1. Southern Rolling Plains and Ridges

2. Northern Parallel Hills and Valleys

PORCUPINE HILLS

GREAT PLAINS

1. Erosion Remnants
   a. Milk River Plateau
   b. Mokowan Buttes
   c. Peigan Sweeping Hills

2. Lower Level Plain

V. CONCLUSION
Geology is literally and figuratively the foundation of the landscape. On it rest the other parts which together with the geologic "skeleton" comprise the "landscape". These other sections owe much of their character to the geology. When the foundation varies the character of the superficial material tends to change also. Mountains and plains influence the climatic patterns which in turn has a fundamental effect upon vegetation and soil development. Topography combined with climate largely determine the drainage. Relative relief is of fundamental importance to human occupancy of the land, especially settlement and agriculture, which is humanity's most vital industry. Mining is dependent directly on the underlying rock. But these are only a few basic examples.

Geology from a geographic point of view has two fundamental themes in building the landscape foundation. These are up-building (or the formation of geological structure) and wearing-down (or erosion, notably by water and ice).
The general pattern for this chapter on geology is:

(a) Overall description
(b) Geologic history
   1. Geologic structure and its formation
   2. Erosion
      a. Glaciation
      b. Hydrography
(c) Regional description.

II. GENERAL GEOLOGICAL STRUCTURE AND PHYSIOGRAPHY

Southwestern Alberta rests upon three broad parallel geological zones, trending northwest to southeast. In the west lies an area of disturbed Palaeozoic or older rock bounded by a central disturbed Mesozoic belt, which in turn gives way eastward to the Alberta syncline's Mesozoic strata. This varying geology is well expressed by the surface configuration. Four main physiographic divisions mirror the underlying rock structures. These are the Rocky Mountains, Foothills, Porcupine Hills, and western Great Plains. The Rocky Mountains proper are composed of the disturbed, relatively hard and resistant Palaeozoic and older rocks. The Foothills are underlain by disturbed Mesozoic (largely Cretaceous) beds which by comparison are relatively soft. The Porcupine Hills and western Great Plains have the
Legend

Scale 1: 506,880
1 inch to 8 miles

- Mountain Basin
- Isolated Peak
- Stream Flowing Into Lake
- Hills
- Elevated Plain
- Delta
- Mountain Ranges (with gap)
- Badland Butte
- Entrenched Meanders
- Foothill Ridges
- Gullying
- Water

Source: Air Photos, Topo. Maps, Field
Southwestern Alberta

Legend

Scale 1:506,880  inch to 8 miles

Rocky Mountains
- Precambrian - High mountain, and adjacent slope.
- Paleozoic etc.
- Cretaceous Infold
- Cretaceous Rounded mountain
- Hilly Rolling to level

Foothills
- High ridge & valley
- Average broken foothills
- Rough sandpapered
- Rolling to level
- Sweeping piedmont zone
- Rocky scarp-ridge belt
- Major morainal area
- Disturbed belt edge

Porcupine Hills
- Western cuesta
- Core
- Eastern broken zone
- Southern slope
- Low level plain
- Rolling
- Badland buttes
- Milk River plateaux, ridges
- Plain

Great Plains

Source: Topo. Maps, Air Photos, Geol. Rep., Field
Alberta syncline of Mesozoic strata as their structural base. The Milk River Plateau of the southern plains area constitutes a striking erosional remnant. Eastward the Alberta syncline gives way to the Sweet Grass Arch where the same sedimentary beds have been bent upward around an igneous core which is exposed in the Sweet Grass Hills. Otherwise, except for the volcanics of the mountains, which are notably in the Crowsnest area, sedimentary strata underlie Southwestern Alberta. The landforms consequently show corresponding characteristics.

III. GENERAL GEOLOGICAL HISTORY

In the distant geological past, quantities of sediment were deposited in a great geosyncline, running from the Arctic to Arizona and possibly California.

Toward the end of Cretaceous time great crustal forces, largely from the west in the eastern Rockies, caused the geosyncline to be compressed and uplifted. This was the Laramide or Rocky Mountain revolution. The old sea became a mountain belt.

Continued force over millions of years caused the rocks to squeeze into great folds. One immense fold toward the east dominated. Eventually this fold, having been overturned eastward by the pressure, broke along a low-angle thrust fault. The great rock mass of the western arm of the
FORMATION OF THE EASTERN ROCKIES

ADAPTED FROM DYSON 1953

CROSS SECTIONS

LEWIS OVERTHRUST

INFOLD OF SOFTER ROCKS POSSIBLE

OLDER HARDER ROCKS (BROWN)

YOUNGER SOFTER SHALES & SANDSTONES WHICH LIE UNDER THE PLAINS (FLESH)

NUMBERS INDICATE SEQUENCE FROM OLDEST TO YOUNGEST
fold was driven upward and eastward more than 15 miles as a huge slab over the eastern limb. The result was a reversal of bedding, with older beds on top and younger below. This fault is referred to as the Lewis overthrust. Numerous other faults and fractures occurred as well, but the Lewis fault is the dominant one.\textsuperscript{14}

Water and ice, as streams and glaciers, carved and sculptured ragged mountains from the great block of older harder rock. This process of sculpturing went on even while the mountain blocks were uplifted and deformed.

The pressure which caused the Lewis fault and the other folding and faulting in the Rockies, also caused virtually as much faulting in the adjacent parallel belt of softer, younger (largely Cretaceous) rocks on the plains eastward. It was especially the western part of the flat-lying soft Mesozoic rocks which were crumpled, fractured and distorted by the tremendous pressure transmitted from the mountain building immediately to the west. This is the disturbed belt of Mesozoic rocks commonly referred to as the foothills. East of this belt the adjacent beds were turned up slightly near the edge but remained generally level. This is the Alberta syncline.

Erosion has carved the land during three great periods of denudation and landform change. These are the pre-glacial, glacial and post-glacial periods.\footnote{Details of the erosion history will be found in the foothills discussion.}

IV. GEOMORPHOLOGY

A regional analysis of Southwestern Alberta's landform pattern follows. First the Rocky Mountains will be examined from south to north, then the foothills likewise from south to north, followed by the Porcupine Hills and the Great Plains. Like Southwestern Alberta as a whole, each region is first briefly located and described. Following this, the up-building (geologic structure) and wearing-down (erosion) are discussed. Lastly the various sub regions are described.

ROCKY MOUNTAINS

The Rocky Mountains in the western portion of the area studied form a high, rugged, rocky section of country. These great cliff-sided, ice-sculptured mountains lie in more or less sweeping parallel ranges, trending northwest. The evenness and parallelism of the ranges reflect
the pattern of great forces and their resulting faults which built the mountains. Viewed from the undulating, usually-golden plains the mountains rise westward as a jagged blue-grey wall of almost bare rock possessing majestic and austere beauty.

The Rocky Mountains in this part of Alberta may be divided into two broad sections: (a) from beyond the southern limit of the area to immediately southwest of Beaver Mines; (b) the mountain area northward from Beaver Mines to the edge of the area under consideration, (and further yet). In the southern section the underlying rock is of Precambrian (Proterozoic) age. This area contains no infolds of Cretaceous rock and possesses less regular parallelism than the land northward. In the northern area, parallelism of ranges and drainage lines is very striking. Here great infolds of softer, younger (overlying) beds occur between the front range and the continental divide range, and connect with the foothills by broad belts (embayments through the front range) of the same soft beds. This has produced large areas of subdued rounded topography.

1. Southern Precambrian Region of the Rocky Mountains

The southern or Precambrian Rocky Mountains present a rather block-like mass without exceptionally clear parallel range development. Since there is no infold of weaker Mesozoic rocks the entire area is high and rugged, showing spectacular glacial sculpturing in the hard rock.
Nevertheless much of the Precambrian area may be subdivided into a number of adjacent but distinct ranges.  

The Waterton Lakes area is especially irregular, giving the appearance of a block which has been gouged through along zones of weakness and chisled by forceful mountain glaciation. Individual blocks, ranges, and massifs stand above low sweeping U-valleys. The chief valley is the deep trench occupied by Waterton Lakes. It isolates the Lewis Range (front range), which terminates east of the lakes, from the west-side Clarke Range, which continues northward as the front range. Westward the mountain ranges, spurs and blocks tend to show east-west alignment, but the grain of individual crests, scarpis, and geologic contacts is still northwest to southeast. On the Waterton Lakes, Castle River divide the mountains show a tendency to form a node. North of this three parallel ranges separated by tributaries of the Castle River, stretch northwestward like fingers terminating abruptly at the first Cretaceous embayment near Beaver Mines. The most westerly or continental divide range however changes from Precambrian to Palaeozoic rock and continues directly north as a cirque-bitten wall of grey rock.

The Alberta Rocky Mountain area south of the Castle River-Waterton Lakes divide is all included in Waterton Lakes National Park, which together with adjoining

16 However, these ranges frequently do not have well known names, or have no names at all.
Glacier National Park in Montana forms Waterton-Glacier International Peace Park. This portion of the Precambrian Rockies is thus somewhat set aside both by physiography and administration. The geological phenomena which encouraged the formation of a park include finely developed glacial features and strikingly colored rock banding.

Structurally the Waterton Lakes area of the Rocky Mountains is made up of rocks folded into three broad undulations, trending northwesterly. The axis of the central broad anticline is followed by the lower portion of Cameron Creek. At Cameron Falls, adjacent to Waterton townsite, erosion into the fold exposes the oldest rocks found in this entire district of the Rocky Mountains. Younger overlying Precambrian beds are found east and west of this anticline in the two broad synclines flanking it.

All the mountains near Waterton Lakes are made up almost entirely of Precambrian rocks, which are among the earth's oldest exposed sediments. A thickness of over 13,000 feet is exposed in the Waterton National Park area.17

The Precambrian sediments contain lens-like injections (sills) of volcanic rock, here and there. These are, for example, exposed on the northward facing cliff-side of Mt. Richards above Bertha Lake.18

18 Ibid., p. 165.
Mention should also be made of a limestone series termed D by Dawson\(^1\) which frequently forms portions of the rugged mountain tops. This limestone weathers light brown or fawn. When it makes up the crests of ridges and peaks the disintegration process is most rapid and effective along the vertical jointage lines. This gives rise to wonderfully picturesque, rugged skylines. However, should the D series limestone be exposed in a mountainside with other beds above, they will form steep terraced slopes or perpendicular cliffs. These give a rather different appearance. An example is Mount Blakiston (see photo) which contains the whole D series topped at the summit by series E which is the contemporary trap. Another example is Chief Mountain to the south which is largely composed of D series limestone. Hence its magnificent outline.

The vivid coloration of the sedimentary bands of rock in the mountains of Waterton district give this part of the Rockies a bright warm aspect not shared by other sections. Blue limestone in massive form, which weathers brownish, cap most of the ridges. Beneath this lie sandstone, quartzite and slate, which are usually somewhat reddish and greenish-grey but weathering to an assortment of other shades as well. Flaming red rock bands of varying

thickness are also found. Underneath all this, but frequently up-thrust into sharp summits lie hard, richly magnesian limestones, which weather white. In turn these rest upon a dolomitic series which frequently runs up into high anticlinal flexures. This series shows alternations of thick bright reddish and yellow bands plus dull purple and occasionally pale greyish pink beds. Freshly broken rock has less color than the weathered material.

Nestled in the lower forested slopes of the seemingly barren-crested range north of Mount Blakiston is a narrow defile known as Red Rock Canyon. This deep, dark, sinuous scar in the earth's crust has been carved by stream action through flaming red rock beds. Water-rounded lobes of strata protrude from the vertical walls. Literally one of Alberta's most colorful spots, its appeal has been sufficient to have a road constructed to it.

Within the Waterton Lakes area the Rockies show some variation. From the forested slopes and bare peaks overlooking the plains to the alpine horns and hanging valleys westward, the different ranges present changing aspects. A brief traverse emphasizing individual landforms from southeast to northwest follows.

An echelon or spur range lies almost exactly on the 49th parallel. At the eastern end Chief Mountain rises as a dominant point, isolated from the main mass of the
mountains and towering majestically above the plains. Palliser, in his West Canadian survey, placed this peak on the 49th parallel. This line however, strikes into the foothills and abrupt ridges around the mountains' base, five miles north of the summit. Chief Mountain is a remnant of hard Precambrian rock which resisted erosion when the surrounding mountains were reduced to debris and transported away, pushing the mountain front back several miles from its original position. From the east the peak resembles the base of a broken column. Limestones in nearby horizontal attitude, which break at the jointage planes giving perpendicular cliffs, make up Chief Mountain. This accounts for its striking appearance. The vertical sombre walls of rock contrast vividly with the tawny plains stretching eastward. 

The counterfront range east of Waterton Lakes is termed the Wilson Range. Sofa Mountain (formerly Kaiser Peak) is the highest summit, being 8,268 feet above sea level. Viewed from the north the range is chiefly composed of series C rocks, which underlie the D series previously mentioned.

Wimy Peak and Ridge (formerly Sheep Mountain), adjacent to Waterton Lakes offers an almost naked rocky wall showing cross-sections of a long series of sedimentary beds.

20 George M. Dawson, Rocky Mountains, 1886, p. 42B.
This banding is especially striking from the north and west. The mountain is largely made up of limestone with one strong unconformity indicating a period of erosion between C and D deposition times.\textsuperscript{21}

The mountains and valleys of Waterton-Glacier and immediately northward owe their shapes and forms largely to glacial sculpturing and deposition. Waterton Lakes itself is a fjord-lake chain, its bed carved by a valley glacier issuing from the mountain area onto the Interior Plain. This waterfilled valley is U-shaped in profile as are most of the valleys near their cirque headwaters. Downstream, the longer and more active period of post-glacial stream cutting has often etched V-shaped bottoms in the formerly U-shaped valleys. Glacial stairways have also been formed in some places, especially where tilted strata favour this development, such as the east side of the Lewis Range. Crypt Lake and Hell Roaring Creek are an example of a glacial stairway with a cirque at its head. Cameron Valley above Waterton Lakes is the best example of a hanging valley. Cameron Brook descends to the lake by Cameron Falls. Cirques are to be found almost everywhere near the range crests. Some of the more notable glacial amphitheaters or cirques possessing tarns or larger lakes, contain Cameron Lake, Bertha Lake, Rowe Lakes, Lineham Lakes, Carthew Lake,

\textsuperscript{21} George M. Dawson, \textit{Rocky Mountains}, 1886, pp. 41B-42B.
Twin Lakes, Crypt Lake and Alderson Lake.

As mentioned, Waterton Lakes is a fjord-like chain of lakes beginning in the high Rockies and spilling out onto the open, grassy plains. Upper Waterton Lake, which crosses the 49th parallel into Montana lies in a northward trending fault trench which separates the Lewis Range from the Clarke Range. This trench has been over-deepened and widened into a huge U-shaped valley by mountain glaciation. The higher and colder the valley the greater the work of the glaciers. Consequently the upper portion was over-deepened and subsequently filled with water. Towards the plains the valley glacier had lost some of its power, with the result that the shallower lake bottom could more readily be blocked by alluvial fans of streams flowing in from the side. Beyond the mountain front great level fans at the mouths of Blakiston Brook from the west, and Sofa Creek from the east, have separated Upper from Lower Waterton Lakes. Other level fans have been built along the mountainous shores of Upper Waterton Lake but have done little to fill in the lake which is here 400 feet deep. One of the largest and most notable of these fans supports the town of Waterton at the mouth of Cameron Creek. Immediately northeast lie the "Dardanelles" or narrows where the lake makes a right-angle.

bend. Here an irregular, low anticlinal flexure crosses the lake northwest to southeast. Both lake shores are composed of dolomitic rocks which weather to colored bands of reddish and yellowish brown. Thin flaggy beds alternate with massive compact layers. Of these layers, which are several feet in thickness, erosion has more markedly attacked the softer ones. On the western shore, morainal material has accumulated into a hill, further emphasizing the break in the lake.

From the morainic hill, on which the Prince of Wales Hotel is built, one of the most majestic and grand views in the Rockies is to be seen. On either side of the long narrow wind-blown lake which stretches away from the viewer, rise great rows of towering peaks culminating in a rocky snow-hung mountain wall across the 49th parallel in Glacier Park. The high ridges separated by deep valleys abutt almost at right angles on the lake.

Much of northern Waterton Lakes Park and the country to the north exhibit a type of topography which is not too far removed from that of "biscuit-board" landforms. Great glacial amphitheaters have been "bitten" out of the upland areas, in some cases leaving narrow cliff-like ridges of rock running in and out from amphitheater to amphitheater

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23 George M. Dawson, *Rocky Mountains*, 1886, p. 40B.
24 C.G.J., February, 1933, p. 70.
in long, virtually unbroken lines. Usually the northeastern sides show the long cliff face while the southwestern sides display smooth longer slopes. This is a reflection of the faulted, tilted underlying beds of rock. From the air this country looks like great tilted sandwiches bitten by some prehistoric giant, the teethmarks being the grooves in the amphitheater walls. Aretes and horns are numerous also. Among the pyramid shaped peaks are Mount Alderson, Mount Lineham, Mount Carthew, Sofa Mountain and Cameron South. A col is located between Cameron South and Mount Carthew. Uplands show quarrying by frost, snow, and ice. Snow-water channels in the rock, are in fact, very striking here.25

In the northern part of Waterton Lakes National Park rises 9,600-foot Mount Blakiston, the highest peak in Alberta's Precambrian Rockies.26 Part of its ruggedness has already been attributed to the D limestone series (previously mentioned). In addition, ice and snow having taken advantage of the lines of weakness have sculptured the sides with a series of steep organlike grooves. At Mount Blakiston's foot lies a broad U-valley sweeping westward to the base of South Kootanie Pass, an old Indian trans-mountain route. The mountain crests adjacent to this pass

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26 Only 10,169-foot Tornado Mountain on the continental divide north of Crowsnest Pass, is higher in all Southwestern Alberta.
are also largely composed of D limestone, giving majestic silhouettes etched against the sky above the passage.

The second or Castle River portion of the Precambrian, Alberta Rockies stretches its three scrawny, rocky fingers northward from the Waterton "palm". The fact that three such distinct parallel ranges exist in this part of the older Rockies may be partly explained by the infold of softer Cretaceous beds northward, leaving the cut ends of the old Precambrian strata so exposed that stream erosion parallel to its grain was more effective. (i.e. Headward erosion from the Cretaceous infold may have been significant.)

The edge of the mountains tends to be very definite and follows the Lewis overthrust. The mountains rise rather abruptly from the sweeping plains, without true, intervening foothills.

Structurally, the Rocky Mountains between South Kootenay Pass (northern Waterton Lakes National Park) and North Kootenay Pass (west of Beaver Mines) do not show marked regularity as compared to adjacent areas, especially northward. Dawson has suggested that the geological uplift which brought great masses of Cambrian rocks to the surface, was partially responsible for this, in the southern Rockies generally, and in the Castle area especially. Parallel folding in these mountains is at any rate not very extreme,
and the beds generally rest at very low angles. The eastern edge of this mountain area, although rising majestically from the plains with foothills reduced to a minimum, shows an anomalous character. The mountain front is sharp, but cut into very deeply by several small streams which flow out almost at right angles to the range.  

As in the Waterton area to the south, glacial action is rather marked in the Castle drainage. This is especially true in the higher southern portion near Mount Glendowran where some of the most magnificent giant cirques and amphitheaters in the Rocky Mountains are to be found. The semi-biscuit-board topography already mentioned to the south is especially in evidence, largely because of the tilted rocky blocks and ridges which lend themselves to this type of glacial sculpturing. Northward the area is lower, more broken up, and shows the effects of glacial action less strikingly. There are also no major lakes of glacial origin in the section of the Rockies drained by the Castle and its tributaries.

Examining this part in greater detail, one finds progressive change from south to north, especially in the Clarke or front range. Adjacent to the Waterton area the Clarke Range contains deep "fjord-like" embayments reaching

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27 George M. Dawson, *Rocky Mountains*, 1886, p. 22B.
in from the eastern subdued foothills zone. The main water divide ridge is thus far back from the mountain front and relatively inconspicuous. Beside the great U-shaped valleys and their amphitheater heads rise snowy or barren, mountain-domes and ridges. Tributary amphitheaters are cut into the valley sides in many places leaving the interstream ranges looking like chewed bones from the air. In addition, each of these "rib ranges" from the "backbone Clarke range" have a number of pyramid-like or dome summits, thus contributing further complexity to the scene.

Pyramid peaks are rather common in the southern Precambrian area. They largely owe their origin to glacial amphitheater development on all sides which leaves a horn when adjacent parts of the range have been heavily eroded.

Northward the Clarke Range looses some of its glaciated character and presents a more jumbled, stream gullied aspect. Large glacial amphitheaters and horns are still in evidence, especially in the higher levels, but V-shaped stream carved gullies give a different character to many mountains here. Windsor and Table Mountains are two summits which deserve special mention in this area. Windsor Mountain is a long, regular ridge with a steep cliff on the northeastern side. It is unique in this area since Palaeozoic sediments cap the Precambrian. Table Mountain rises immediately above the Lewis Thrust as it bends westward toward Flathead Range. Its horseshoe shape and flat
top make it one of the most picturesque landmarks west of Beaver Mines.

West of the Clarke Range flows the Castle River in a wide parallel valley. Beyond, between the Castle and the West Castle, rise a number of long ridges, scarred by cirques in the north and south but generally presenting stream modified topography. To the south, and isolated from the rest, rises South Castle Mountain, an outstanding, T-bone shaped peak (from above). Its summit is capped with massive, almost horizontal, limestone beds.

Towering westward, above the Castle River's West Branch, is the glacially sculptured and indented rocky wall of the Flathead Range. This range forms the Columbia-Saskatchewan drainage divide and continues northward composed of Palaeozoic instead of Precambrian rock. The tilted wedge shaped type of mountain mass jutting forward beyond adjacent parts of the mountain wall is typical here, as it is further south near the continental divide in Waterton Park. (See photo). An outlier, Syncline Mountain marks the infold of the Lewis Thrust, which follows the eastern base of the Palaeozoic Flathead Range as it continues northward.

In summary, the southern portion of the Rocky Mountains may be described as a block-like area of elevated Precambrian rock resting eastward on the Lewis
Thrust and overlooking the gentle relief of the southern foothills zone. Regular parallel range structure is not strikingly in evidence. Instead the area is cut through or indented by deep valleys in many directions, leaving tilted sandwich-like and block-like segments. Mountain glaciers have been very active in this high, hard, southern area with a resulting preponderance of "biscuit-board" topography, cirques, hanging valleys, U-valleys, fjord-lakes, plus wedge, and pyramid horns. Seen from the wide country to the east, some pyramid peaks and domes jut above the bulk of the mountain mass giving these southern Rockies a different character from the ranges further north.

2. Northern Palaeozoic-Cretaceous Region of the Rocky Mountains

North of Table Mountain, where the Lewis Thrust bends westward to follow the continental divide range, the Rocky Mountains are structurally and geomorphologically different. The mountains proper are here composed of Palaeozoic rather than Precambrian rocks, which have been folded up and thrust forward into long regular parallel ranges with infolds of overlying softer Cretaceous beds. The resulting geomorphic landscape presents high sharp wall-like rock ranges paralleling each other but separated by areas of rounded forest mantled hill country and the occasional grassy basins, or valleys.
FORMATION OF CRETACEOUS INFOLDS AMONG THE PALAEOZOIC ROCKIES

(A) Mesozoic (Chiefly Cretaceous)

(B) Erosion has worn down the higher Cretaceous areas exposing the more resistant Palaeozoic rock.
Escarpet-like mountains tend to be typical for much of Southwestern Alberta's mountain area. This is especially striking in the northern region where parallel thrust faults have pushed up great Palaeozoic blocks. One side (NE) of the mountain shows an escarpment face while the other side, if the gentle slope is incidental with the dip of the underlying rocks, exposes even bare sloping rock surfaces. Horizontal strata result in mountains of the Chief Mountain type, which, when they decay, leave chimney-like spires such as those north of Crowsnest Mountain. If, however, the rock (especially limestone) has been completely turned on end it loses its massiveness and presents a serrated but straight skyline. 28

With respect to glacial effects, the northern Rocky Mountain region also shows fine glacial sculpturing in many of the ranges, and magnificent meltwater channels, but generally speaking, glacially caused or modified landforms are less striking than in the higher southern region.

Internally, the northern region of the Rockies may be subdivided into three zones. Adjacent to the westward bend of the Lewis Fault lies a broad embayment of very subdued Cretaceous hill-country, flanked westward by the Glathead Range. To the north the hills rise higher before

28 George M. Dawson, *Rocky Mountains*, 1886, p. 25B.
dropping down into the Crowsnest basin. The Crowsnest Pass country forms a second zone, containing a broad basin-valley protected on the east by broken front mountains and on the west by a pierced segment of the continental divide range. North of this area rises isolated Crowsnest Mountain and higher rougher Cretaceous country. The third zone is composed of the rough northern Cretaceous infold between a shielding wall-like front range (Livingstone Range) and the thrust up guarding backbone of the divide range (High Rock Range).

Where the Precambrian rock gives way to the Palaeozoic in the Flathead Range, lies historic North Kootenay Pass. This 6,774-foot high passageway was one of the ancient Indian routes across the mountains, since it can be approached directly from the foothills (without first crossing a front range) and also because tree growth was less thick than on some parts of the Crowsnest Pass route.

The Flathead Range changes its direction to due north after it passes North Kootenay Pass. This sinuous, cirque-scarred range which forms the continental divide, presents great limestone cliffs to the east (Alberta side) as it runs towards the Crowsnest Pass. Its eastern base rests on the Lewis thrust from North Kootenay Pass northward, which here follows the divide range instead of the front range.
West of Beaver Mines, north of the Lewis Thrust in-bend to the west, the country is underlain by relatively soft Cretaceous rocks showing high foothills type of topography. As mentioned above, only the central (Flathead) range exists here. There is no eastern front range.

Northward this Cretaceous infold continues shut in from the eastern foothills by bold regular front ranges such as Turtle Mountain and the Livingstone Range. These are thrust ranges separated from the remainder of the Paleozoic Rockies by an infold of softer Cretaceous rocks. In the vicinity of the Crowsnest River, erosion has left a moderately level, relatively wide valley basin.

The coal-bearing beds lie in the soft Mesozoic (Cretaceous) strata, not in the Precambrian or Palaeozoic strata. Thus the coal mining economy of the Crowsnest Pass exists because of the Cretaceous infold which contains long bands of coal-bearing rock lying near the surface in this area.

Volcanics of some importance are found in the Crowsnest area as well as sedimentary beds. However, their physiographic expression is not especially noteworthy.

The mountains adjacent to these Cretaceous infolds tend to be lower in actual altitude than more solidly
massive, harder rock areas of the Rockies. (Compare Livingstone and Clarke ranges). Nevertheless, their relative contrast to the softer more rounded, subdued Cretaceous hills tends to give them an even more spectacular appearance. The reason for the inferior altitude is apparently that being surrounded by so much easily eroded softer rock these harder ranges themselves are more exposed and subject to erosional wear and the entire area is more quickly reduced in altitude. 29

The Crowsnest area may be divided into about five or six subdivisions. First, there is the subdued Cretaceous hill-country west of the central Rocky Mountain range. Secondly, there is the central range itself cut through by the Crowsnest Pass proper. Eastward, with higher Cretaceous hills north and south, stretches the Crowsnest basin, a somewhat undulating valley pocket along the Crowsnest River which ends abruptly at the foot of the front range (Turtle Mountain). Towering above the basin is isolated Crowsnest Mountain, the fifth subdivision. East of the Crowsnest River gap at Turtle Mountain's base lies a piedmont zone partially protected on the northeast by low mountains and the Livingstone Range.

29 George M. Dawson, Rocky Mountains, 1886, p. 21B.
Three special features in the Crowsnest area merit detailed descriptions. These are the pass itself, an ancient meltwater channel, and Crowsnest Mountain, a Lewis Thrust erosion remnant and also the Frank Slide, a great bergsturz land slip. These three landmarks dominate the area.

The Crowsnest Pass is one of the most picturesquely colorful passes in the Rocky Mountains. A necklace of glittering mountain lakes winds between almost bare limestone cliffs at the pass proper. At either end stretch areas of subdued heaving topography resting on soft Cretaceous beds. The range through which the pass has been cut is composed of hard Palaeozoic rock driven up and over the softer material by the Lewis Thrust. 30

The source of Crowsnest River is a spring issuing from a cave or overhung grotto in the limestone cliffs of the pass just above the north shore of Corwsnest Lake. The spring water fills a deep clear pool at the grotto mouth and then overflows as a brook falling 20 feet to join the lake. Immediately north of the mountain containing this cave lies a more or less dry valley containing a small pool of water in its centre. Apparently water from this valley has worked along a horizontal crack or jointage plane in the limestone

30 The unusually thick limestone masses at the Crowsnest Pass may be due to limestone beds being repeated by folding. There appears to be no repetition by faulting. - From George M. Dawson, *Rocky Mountains*, 1886, p. 71B.
to flow out through the cave. This explains the source of the spring. It might be added that the limestone mountains in the vicinity are strikingly bare and naked looking. Quick underground drainage will not be beneficial to tree and grass growth.

The glacial and post-glacial history of the Crowsnest Pass is worthy of comment. During the glacial period an ice centre lay immediately to the west around the present Fernie-Natal area. This area shows little glacial sculpturing today since it was buried by great masses of accumulating ice which tended to flow out from there. Ice gouging by glaciers helped deepen the Crowsnest Pass which probably already existed due to the fracture or weakness lines through this area. Later as the great ice masses began to melt, the greater weight of ice bowing down the Fernie-Natal area caused the Crowsnest Pass to be somewhat lowered also so that meltwater from the west, its normal western outlet blocked by ice, flowed eastward through the Pass. Even so, the area west of the pass was lower still. Consequently a lake developed between the pass and the ice front. Cliffs of erosion gullied lacustrian sediments near Natal and Michel, B. C. are evidence of this ancient lake. Eventually when the western passage had become unblocked the pre-glacial drainage lines were again followed more or less. However, the Crowsnest Pass had been so overdeepened
GLACIAL HISTORY - CROWSNEST PASS

A
ICE ADVANCE

GLACIAL CENTER

CENTRAL RANGE OF THE ROCKIES

B
ICE MELTING

ICE DAMMED LAKE

MELT-WATER STREAMS

C
PRESENT

COMMUNICATIONS

MELT-WATER CHANNEL

EROSION INTO OLD LAKE SEDIMENTS

CONTINENTAL DIVIDE

AXIS OF CENTRAL RANGE

ALUVIAL FANS DAMMING LAKES
that some water from west of the central range (which is usually the divide range) flowed eastward to the Crowsnest River through the pass. The continental divide today follows hills west of the Crowsnest Pass proper. After the great meltwater stream which had deepened the pass disappeared, its deep, broad valley with the great sweeping meanders was occupied by a much smaller stream which was unable to remove all the sediment deposited by mountain tributaries. Great alluvial fans spread out over the Crowsnest Pass valley were major tributaries flowing into it. These fans tended to block drainage so that a string of lakes developed filling the valley from one limestone cliff to the opposite limestone cliff. 31

East of the Crowsnest Pass, the central range of the Rockies abruptly gives way to a broad sweeping tract of land which may be described as a plain or basin. Soft, relatively easily eroded, Cretaceous rocks underlie this area.

Immediately northward towers the 9,280-foot high, dominating mass of limestone known as Crowsnest Mountain (Kah-ka-too-wut-tshis-tun in Cree). This peak rises in isolated splendor above its level grassy surroundings.

31 Authority -- Dr. Mathews, Department of Geology, University of British Columbia.
Like Chief Mountain further south, Crowsnest Mountain is a remnant of hard old rock pushed eastward over softer younger rock, which has been left when erosional forces reduced the nearby mountains to rubble and pushed the range front back westward. The summit above the thrust fault, which underlies the rocky part of the peak, is composed entirely of Devonio-Carboniferous limestone rocks in more or less horizontal attitude. The type of rock and its attitude are responsible for the almost vertical cliffs which surround the peak below the bluntly conical summit. Erosion along vertical jointage lines formed the cliffs. Soft Cretaceous rocks supporting the peak have been protected from erosion by the overlying hard limestone. Viewed from the south the mountain may be said to resemble a great beehive of Palaeozoic rock resting on a flaring pedestal of soft Cretaceous rock. However, if the mountain is seen from the side its dragon resemblance is more striking since a long rocky hunched "tail" extends northward from the head ("beehive"). This long spur is crested by a row of low vertical chimney-like columns of Devonio-Carboniferous limestone, not unlike a dragon's back or a skeleton backbone.

The Frank Slide on the northeastern flank of Turtle Mountain spreads out in gray desolation at the entrance to the Rockies along the Crowsnest River. A huge limestone slab slid down the mountainside on the morning of April 29th,
1903. This 400 to 500-foot thick, one-half mile square block shattered into boulders as it fell 3,000 feet into the placid, pastoral valley forever blotting out these tranquille characteristics. The great force carried the broken rock 400 feet up the opposite terraced slope. On the valley floor a three to 150 foot mantle of rock debris obscured the old landscape, even damming the river and creating a small lake. A portion of the town of Frank and the railroad were wiped out leaving about 70 people dead.

The Frank Slide falls into the bergsturz class of large land slips, because the rock has broken across rather than along the bedding planes. Turtle Mountain is a great westerly dipping thrust fault block, its crest composed of Palaeozoic limestones cut by several jointing planes. The part of Turtle Mountain which broke away was on the over-steepened front of the thrust block mountain, the base of which had recently been drilled into by coal miners. Thus the scene was ideally set for the slide which followed.

The slide itself shows a very lumpy surface, with hollows surrounded by rocks, heaped into mounds and ridges.

32 Two of the jointing planes intersect at 97°. Salient and re-entrant angles of rock vertically line the mountain face, vividly showing erosion's effect on these jointing planes. Slickensides indicate past movement and show how unstable the mountain is. A number of fissures along the western side of the crest were opened by the slide. Water flowing into such fissures and freezing probably helped cause the slide. Water itself has some solvent power, especially in limestone.
This moraine-like topography indicates the rock material travelled in waves. A rocky knoll's protecting influence was probably responsible for a depression crossing the slide not far from the railway. The rocks apparently tended to be flung across this area. The new railroad follows this depression through the slide. The six to 30-foot high slide edge is very sharp, being rimlike here and there. Apparently the slide moved as a mass without flinging boulders everywhere. This fact saved much of Frank Town which was located directly on the edge of the slide. In addition to rock, mud was splashed ahead also. It now forms level areas between the rocks. At the time of the slide escaping gases from the mud formed miniature volcanoes. It might be added that a source for the mud was the valley floor itself. For example, the newly created lake bottom is a number of feet lower than the old river bed.33

The third zone of the northern Rocky Mountains is perhaps the most typical for this region and is certainly the largest subdivision. The geomorphological pattern is quite simple and is a direct result of the underlying structure. Two long parallel wall-like ranges are underlain by thrust faults and anticlinal structures. These are separated by the subdued but rough Cretaceous infold. The three north-

south belts are from west to east, the High Rock Range forming the continental divide, the Cretaceous trough, and the Livingstone Range which is the front range.

The High Rock Range is the central divide range of the Rockies north of the Crowsnest Pass. Like many of the ranges in Southwestern Alberta it is underlain by a thrust fault from the west, and presents a steep unbroken wall of rock to the east. The more gentle British Columbia (western) side shows many great amphitheatres, separated by long narrow spur ridges. On the Alberta side there are also a number of steepsided Cretaceous spurs reaching out from the mountain base at various angles. Deep V-valleys have been cut by post-glacial streams between these spurs. The mountains are not extremely rugged but varied, their pale limestone summits rising above light green, sun-filled, alpine meadows and sombre forests in valleys and hollows, making a Swiss-like, alpine landscape. 34

Although the High Rock Range generally is a formidable rocky barrier, there are a few places where forested valley-passes extend through the range. The most notable is perhaps North Fork Pass, which was once an Indian trans-mountain route. It was approached along the

34 George M. Dawson, Rocky Mountains, 1886, p. 81B.
Oldman River through the Gap in the Livingstone Range.
North Fork Pass lies west of the headwaters of Dutch Creek in a bold 8,000-foot high portion of the mountains, where one of the adjacent peaks culminates in organ-like vertical columns.

Between the main range along the continental divide and a spur range two miles in front of it lies the headwaters valley of Dutch Creek. Structurally this area is worthy of comment. The spur range made up by Tornado Mountain and Gould Dome is composed of a slight syncline in the Palaeozoic rocks which has withstood erosion better than the adjacent anticlines.35 The anticline between the spur and the main ranges has been deeply eroded by Dutch Creek. This erosion has exposed the softer Cretaceous rocks beneath the Lewis Thrust and its overlying hard Palaeozoic rock. Consequently two stark rocky barren ranges, one set off in front of the other, rise above the subdued rolling forest land and are separated by a low emerald tongue of forested valley. Ten thousand, one hundred and sixty-nine foot Tornado Mountain is Southwestern Alberta's highest peak, while Gould Dome's claim to fame is its semi-isolated, round-topped, beehive shape. Further erosion may leave Gould Dome as an isolated rocky peak similar to Crowsnest Mountain. The process

35 Synclines usually resist erosion better than anticlines since the latter expose their fold-fractured side to the elements.
is already well under way.36

East of the High Rock Range lies the Cretaceous trough, which is bounded eastward by the Livingstone (front) Range. The subdued topography is here of the high irregular foothills type, which in places may be best described as low, rounded, mountain country. The two great thrust ranges on either side protected this area from excessive parallel folding and faulting. Consequently little of the striking regularity of ridge and valley caused by parallel folding and faulting, so characteristic east of the Livingstone Range, is met with here. Main drainage lines are frequently transverse to structural lines. There is somewhat of an exception, however, immediately behind the Livingstone Range where the Oldman and Livingstone Rivers follow a broad subsequent valley and adjacent to which lie extremely regular parallel ridges.

With respect to relative relief the Cretaceous trough is exceptionally subdued, almost gently sweeping at the foot of the High Rock Range, but becoming very hilly in the center and cut and dissected eastward. The semi-level piedmont zone by the High Rock Range may be attributed to the range having been eroded back leaving relatively

undisturbed Cretaceous strata which had originally been protected from excessive warping by the overlying Palaeozoic mountains. This is also part of the explanation for the extensive tract of undulating land in the Crowsnest area immediately east of the central range. To the east of the smooth piedmont the low Cretaceous hills are almost plateau-like, but closer to the Gap the rivers make narrow cuts through high north-south sandstone ridges. The relative relief in general is 1,500 to 2,000 feet.

The drainage pattern tends to converge toward the Gap, the only east-west passage through the Livingstone Range for many tens of miles. Radiating upstream from the Gap are a number of wide level valleys, which at their convergence (just before entering the Gap) broaden into a small grassy basin area. Northward along the Livingstone River the level grassy valley also widens out to form an extensive open basin. The constricting Gap outlet, in glacial and post-glacial times, was largely responsible for the formation of these level stretches upstream. Erosion worked faster broadening the valleys in the soft material upstream than it did in the hard Gap "threshold". Morainal and outwash material were deposited in all these valleys by the Pleistocene glaciers occupying them. At the present
time the rivers have entrenched themselves and flow partly in long, narrow, 150-foot deep bedrock canyons. 37

The Livingstone Range is the easternmost or front range. It rises in the south (just north of the Crowsnest River) as an even rock wall extending unbroken northward for 30 miles to the Gap, and then continuing north as a less formidable barrier. This huge ridge is composed of resistant Palaeozoic limestone and dolomite, and reaches a height of just over 8,000 feet in the south. The altitude decreases northward, reflecting a structural plunge, until the foothills on either side surpass the range in height.

Structurally the Livingstone Range varies from very simple to quite complex. From the north the underlying structure is first that of a rising anticline which as one goes southward becomes broken by faults -- largely west dipping faults on the eastern face. Eventually the range becomes a faulted distorted arch resting on a thrust fault. It is this southern wall-like area pushed upward and over-steepened on the east which forms the most spectacular part of the Livingstones. North of the Gap, although still striking, the range is lower, less steep and cut by a number of lesser streams (three) flowing through the range to

join the Oldman River. South of this, only the Oldman River has cut through, and this is a narrow S-gorge between towering limestone walls. All these streams rising from the west or High Rock Range and crossing the Livingstone Range, appear to be superimposed. The Gap itself lies where a number of anticlinal and synclinal folds, together with faults, follow the range. One of the faults crosses from the western to eastern limbs of the range near the Gap. These zones of weakness are related to the development of the S-like Gap "notch". Thus in summary, the barren grey-blue Livingstones with their rounded, somewhat lobed, gentle, backside and towering cliff-front overlooking the North Fork country, may be described as a huge anticline, faulted and turned up sideways by breakage along a thrust.\[38\]

Delicate glacial sculpturing is not a trademark of the Livingstone Range, but the area as a whole has been more or less run over or skirted by glaciers. (See glaciation discussion in the foothills section). The high wall-like range south of the Gap has been the center for a number of small alpine glaciers on both eastern and western flanks. The Gap itself has been much deepened and eroded by mountain glaciers from the High Rock Range crossing through it to the foothills eastward.

\[38\] For details see R.J.W. Douglas, Memoir 255, pp.68-71.
FOOTHILLS

East of the Rocky Mountains, in a broad parallel zone, lie the foothills. In the north the high forest-crowned Porcupine Hills hem in the foothills on the other side, but southward the broad expanse of the western Great Plains rise gently to and merge with the foothills belt.

The foothills are generally much lower in altitude than the Rocky Mountains and have much more subdued rounded outlines. Typically they are also clothed in forest and grass, while the higher, ragged mountain ranges, towering above them to the west, have sharp naked crests surmounting rocky cliffs and precipices. Generally the foothills are long sweeping parallel ridges with occasional bands of rocky outcrops. Toward the north and west they are higher and more forested, while in the southeast, only long, low, rock-crested ridges rise above the rolling steppe.

With respect to geological structure the foothills show relationships to both the plains and the mountains on either side. The rocks are the same as that of the plains, relatively soft Mesozoic sedimentary strata. However, the building of the Rocky Mountains caused forces to be transmitted to the western (adjacent part of the level

39 The more prominent foothills may be from 5,200 feet to 6,000 feet in altitude.
Mesozoic beds), folding, faulting and distorting them into the foothills belt. The disturbance in the foothills was as great or in some cases greater than that of the mountains. Difference in outline and height may be attributed to the relative softness of the foothills strata as compared to the mountain beds.

A great sweeping band of parallel folds and faults underlie the foothills. The surface configuration mirrors this well with numerous long ridges paralleling the grain of the land. Thrust faulting especially has helped bring softer and harder rock into juxtaposition at the surface. Erosion has then carved out the weaker rocks more rapidly leaving the long bands of more resistant rock as higher ridges and hills.  

Ridge crests are usually underlain by resistant basal Belly River beds, while valleys tend to be formed on the softer upper Belly River beds, or Alberta and Bearpaw marine shales. The ridges are generally steep with as much as 30° slopes, and because of the westward dip of the strata tend to present a steeper eastern side. These alternating slices of hard and soft strata are however not

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40 The original folding and faulting of course resulted in considerable surface irregularity to start with. Erosion completed the formation of the foothills.

necessarily the only reasons for relief in the foothills zone. Some of the long strike ridges are associated with folds. Synclinal rather than anticlinal structures tend to resist erosion better, because the exposed strata is compressed rather than stretched and fractured. Hence many of the higher buttes show syncline structure.\(^{42}\)

The degree of disturbance and varying resistance further cause differences in height among the foothills, some hills being considerably more prominent than others.

The erosional cycles in the foothills as in Southwestern Alberta generally (but especially noteworthy here), may be divided into three periods. First the pre-glacial, then the glacial and finally the post-glacial.

The pre-glacial period has not left a great deal of evidence in Southwestern Alberta. However, it is thought that an old upper level peneplain once existed over most of the area, but that extensive denudation must have reduced it until now only remnants remain near the southern border and in Montana. A fantastic amount of denudation must have taken place, for in the area from south of the Porcupine Hills to the high level remnants near the border there are no upper peneplain remnants left.\(^{43}\)


\(^{43}\) The erosion should have taken place largely between the end of the Laramide and early Miocene times.
greater denudation in this area was the result of greater initial uplift according to one geologic authority.\textsuperscript{44} At any rate, today this portion of the foothills is unusually subdued, sweeping away from the base of the towering mountain mass (the Clarke Range) without great extremes in relief. Much of the countryside is in fact rolling rather than hilly in character.\textsuperscript{45}

The glacial period is of rather special interest in the foothills since this is the meeting zone of mountain and continental glaciation. Ice from the great Keewatin Sheet swept in from the northeast across the open plains, while glaciers poured out of the Cordilleran valleys to the west. They may have met and coalesced, or there may have been an non-glaciated corridor along part of the foothills. The front moraines and debris obscure clear evidence of precisely what happened.\textsuperscript{46} In fact, continental moraines overlap those of the Cordillera.

\textsuperscript{44} J. S. Stewart, Memoir 112, p. 16.

\textsuperscript{45} Note that the open plains merge eastward with this area (without the intervening Porcupine Hills) giving rivers direct access from the higher Precambrian Rockies to the lower, level, Great Plains. Several large closely spaced streams parallel each other eastward from the Clarke Range. A good ice and water supply from the high mountains, perhaps combined with slightly less resistant rock may have been partly responsible for the excessive denudation.

\textsuperscript{46} J. S. Stewart, Memoir 112, p. 16. Alpine glacial effects have been traced 30 to 40 miles out from the mountain front in Montana. It has been assumed that mountain glaciation reached to the eastern side of the disturbed foothills belt in Alberta also.
Since the ice flows of the plains and of the mountains both culminated in the foothills zone, and must both be discussed in order to appreciate what happened in the foothills, a brief summary of Southwestern Alberta's glacial history follows.

Several glaciations, both Keewatin and Cordilleran, have affected Alberta. The earliest Cordilleran glaciation is the Albertan or pre-Wisconsin, drift from which has been identified a number of high, flat topped Cretaceous ridges near Glacier National Park. The Saskatchewan gravels, once considered to be from an even earlier glaciation are probably inter-glacial stream deposits from pre-Wisconsin drift. Their gravel-filled channels are cut by present day rivers. However, it was the relatively recent Wisconsin glaciation which was most important in modifying the landscape.

Alpine glaciers formed in the high ranges of the towering Rocky Mountains. In the south, where the mountains were highest and most massive, the ice developed extensively on the upper areas and then snaked down through the valleys, overdeepening and carving them, while the higher areas were

47 The Blackfoot peneplain, which in Canada is found only along the southern border and only as far as 40 miles from the front range.
left as ice and frost sculptured peaks. The glaciers flowed out onto the rolling foothills country leaving great moraine spurs projecting from the mountain base on either side of the deep valley mouths. However, rather than depositing debris, these alpine glaciers gouged out, sandpapered and chisled the old landforms of the countryside. It was continental glaciation which chiefly did the depositing of new landforms.

Mountain glacial deposits on the old landscape include morainic material, boulder clay, erratics and outwash gravels, plus stratified sands and silts laid down in moraine dammed lakes.

The resulting major landforms may be summarized as follows:

(1) lateral moraine spurs along the foot of Clarke Range;

(2) overdeepened U-shaped valleys filled with debris, such as the Waterton and Belly river valleys adjacent to the mountains, with Lower Waterton Lake the result of overdeepening;

(3) hanging valleys, such as Cameron Valley above Cameron Falls in the mountains;

(4) lakes, such as rock basined Waterton Lakes and some shallow drainage blocked ponds in the foothills. 48

The great Palaeozoic ranges northward were also the homes of numerous small mountain glaciers. At the Crowsnest Pass, ice poured through the central range and into the Cretaceous area. The higher, moister High Rock Range was especially a zone of glacial formation. The little glaciers descended the mountain sides, sculpturing great amphitheatres in the process, and spread out into the Cretaceous through where they coalesced and grew. The ice tended to follow the major valley lines eastward and converged in great lobes at the western entrance to the Gap in the Livingstone Range. The ice then snaked along the twisting narrow Gap passageway to the North Fork foothills area beyond the mountains. In the process the Gap was deepened and its rock walls polished smoothly up to 5,800 feet elevation.\(^49\) The ice continued down the Oldman valley, branching into low tributary valleys and filling these to their divides. These divides were later notched by meltwater which overflowed (being ice-blocked at the other end) spreading thin outwash deposits beyond.\(^50\) Meltwater flowed southward filling Todd Creek valley to approximately the 4,650 foot contour. This lake is now gone, but numerous sloughs remain to characterize the area. The ancient lake

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\(^49\) 5,800 feet was apparently the upper limit of the ice.

\(^50\) The notches may still be observed in the area.
may have resulted from damming by the southern lobe of the continental ice sheet reaching up the Oldman and Todd valley from the southeast. In addition, the Livingstone Range itself south of the Gap was a center for several small alpine glaciers. These were however not deeply incised and left little moraine. Some of the nearby hills also have cirques above 7,000 feet. Since all these were primarily eroding mountain glaciers, little debris was left. However, numerous drumlins and thin drift occur west of Whaleback Ridge, while recessional moraines and kettles (perhaps marking the eastern limit of alpine glaciation) are found tp. 10 rge. 3. Erratics, 75 feet square, are also found.\(^5\)

Continental ice advanced from the northeast pushing into the foothills zone in the south, but in the north the Porcupine Hills acted as a buttress opposing westward movement of the ice sheet. However, the northern valleys in the hills and the southern flanks were not high enough to hinder the ice advance. Consequently the ice swept across these areas and penetrated into the foothills to the west. Three major lobes invaded the Porcupine, eastern foothills area here. These were around Stimson Creek in the north, up Willow Creek valley and around the southern slopes of the Porcupines bending northward in a

\(^5\) The freshness of the deposits and poor drainage indicate the ice left recently. Memoir 255, pp.7-8.
tongue up Oldman River, Todd and Callum Creeks. It was this last southern lobe which left its marks in the area being considered. Besides damming the escape for glacial meltwater (previously mentioned) the ice sheet left its "calling cards", erratic rocks from the distant Canadian Shield. The Porcupine Hills escaped much glacial "rearranging" because of height and distance from ice sources.

South of the Porcupine Hills the ice from the Keewatin Sheet invaded the foothills zone which lay open and unprotected westward. Effects of continental glaciation are to be found almost to the base of the Clarke Range.

The drift in this southern area is made up of crystalline (largely granite and syenite) erratics from the Canadian Shield, pebbles from the Rocky Mountains, sedimentary rock material from the Great Plains plus a sand and clay matrix. Most of the finer material is apparently locally derived from underlying rock, since it changes color from place to place. Usually the drift is unstratified, often weathering along river-cliffs into columnar and prismatic forms, because it is so massive.

The Keewatin ice-sheet left a fairly striking morainal area north of the Montana border and west of Cardston.

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Ten miles north of the 49th parallel the sharp ridge of the terminal moraine crosses Belly River. Within this terminal ridge there is a good ground moraine, but the ridge has no valley train or outwash. Between Belly and St. Mary Rivers the edge of the drift is thin in places, and less clearly marked. The irregular, hummocky land is riddled with small pond-like lakes. Excellent kettles dot the moraine between Lee Creek and Belly River. Northwestward the terminal moraine sags and swells with many ponds and marshy patches as it parallels the mountain base to Pincher Creek.  

The different effects of mountain and continental glaciation in the southern foothills is best observed from the higher hill tops at the edge of the Keewatin drift west of Cardston. The numerous ponds and lakes in the continental-drift mantled country northward stand out in contrast to mountain-drift covered land at the mountain base, where lakes are few and far between. The local mountain glaciers were not depositing as was the continental ice-sheet, but were eroding and carving. Hence the land affected by them during the Pleistocene show few morainal depressions.

Near Glenwoodville, Standoff and further north erratics are striking features of the landscape. The erratic

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54 The world’s largest erratic is located near Okotoks, Alberta.
boulders are of varied origin, some coming from the Rocky Mountains, some from the Canadian Shield. On the broad soil mantled plains these rocks, occasionally as large as a fair sized house, stand out in splendid isolation.

In summary however, it must be said that glacially deposited landforms in the entire foothills, Porcupine Hills area are generally either lacking or rather under-developed. Striking terminal moraines, eskers and kames are almost entirely lacking. Exceptions however do exist. It might be noted that this area lies at the end of both continental and mountain glaciations, and in fact, also on the warmer southern fringes. The glacial effects on the pre-glacial landscape may have been minimized. Nevertheless some moraine and till have been deposited near the ends of the glaciers.

As the ice-sheet withdrew northeastward, from whence it came, meltwater deposited silt and also carved water gaps in an effort to escape. Ice blocking the escape northeast, and rising land of the foothills blocking the westward flow, a lake or lakes were apparently temporarily formed on the western plains below the gentle eastern edge of the foothills disturbed belt. Great meltwater channels cut coulees and gaps in the southern country, even in the
Milk River Ridge. Temporarily drainage was diverted to the Missouri and Gulf of Mexico. Dry coulees and wind-swept ridge-gaps now stand as mute evidence to ancient water-channels.

The third or post-glacial period of erosion is that of the present day streams. Their effect on the landscape is usually quite significant although the pre-glacial and glacial periods laid the foundations for these streams and lakes. Watercourse entrenchment is probably the single most striking feature about present day Alberta's drainage pattern.

Many of the larger streams flow in rock gorges cut in their old valleys. The Oldman River is an excellent example, but the Crowsnest and Castle Rivers also possess this characteristic. In many stream valleys, which rest in old glacially filled channel courses, bedrock is exposed only in meander cuts to the side of the old valley or where the present stream leaves the old channel.

In the south, where the foothills relief is most gentle, Waterton, Belly and St. Mary Rivers are generally consequent streams flowing northeastward. However, drift

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55 Note Whiskey Gap and Lonely Valley in the Milk River Ridge. Eastward, Chin Coulee is a famous, old, abandoned, water channel.
from the mountain glaciers has caused minor alterations in the drainage, while the Keewatin ice and drift caused extensive lake damming. Overflowing streams cut new channels through morainic deposits. The post-glacial streams tended to continue flowing in the same valleys but not in the same channels. Small tributaries frequently followed entirely new courses. Generally speaking, the old pre-glacial valleys were only followed in the upper courses. Further downstream the post-glacial streams merely stayed within their old divides.56

In the north the foothills are dissected in all parts by drainage lines. The long ridges tend to form divides for long regular basins drained by small, sometimes intermittent streams in the valley bottoms. In many cases the long valleys continue from one stream basin to the next, with small divides crossing the valleys.

These small streams flow into major "master" streams which tend to cross the ranges and ridges more or less at right angles in broad valleys, which however, tend to be constricted at the crossing point (i.e. water gaps). Apparently the master streams follow zones of structural weakness or ancient, pre-mountain drainage lines. (See "Drainage Network" chapter).

56 J. S. Stewart, Memoir 112, pp. 14-16.
Striking terraces are found along the larger streams such as the Castle, Corwsnest and Oldman Rivers. Sometimes the terraces rise in steplike fashion on both sides of the river. Five levels have been found on Oldman River and three on Crowsnest River. At Lundbreck on the Crowsnest, the highest terrace is 200 feet above the river. The terrace surface is usually covered by glacial till or gravel. Where exposed, the terraces are seen to be composed of steeply dipping beds of relatively resistant sandstone and relatively non-resistant shale, which has been bevelled off. This indicates that these are pre-glacial terraces of denudation. In other words they are river carved without glacial aid.\(^7\)

From the foregoing discussions it will be gathered that two broad subdivisions comprise the foothills. In the south from the base of Clarke Range a rolling, hill, plain-like area extends eastward where it is broken by long, low, rock crested ridges and mantled in hummocky moraine. In front of the northern Rockies zone the foothills are generally high, parallel, hill-ranges with stream carved flanks. Lower, more rolling tracts are also found here, especially southeastward.

1. Southern Rolling Plains and Ridges

South of the Porcupine Hills, where no higher lands lie eastward and the foothills merge gently with the plains, the disturbed belt arches outward to the east. This southern portion is therefore the broadest. However, it is also the least rugged.

Much of the southern part of the disturbed Cretaceous belt, for the first 24 to 25 miles north of the 49th parallel, shows rolling rather than hilly topography. Valleys of streams, rather than ridges, give relief to this area. However, from Waterton Lakes to the Lee Creek headwaters there is one belt of upland. Beyond this to the north a more or less even slope extends from the plains to the foot of the front range. Typical foothills do not herald the mountains, as they do in this same disturbed belt further north. Two flat-topped mesa-like remnants reaching 6,000 feet altitude, one between Belly River and Lower Waterton Lake, and the other parallel to the east bank of Belly River are apparently the remnants of an ancient peneplain which once covered much of this area and adjacent northern Montana. (This is Willis' Blackfoot peneplain capped by the Kennedy gravels). The terminal moraine of the Keewatin continental ice-sheet covers the forested upland at the Lee Creek headwaters. All this area is
masked by a mantle of glacial drift. Ponds lacking outlets dot some of the more level interstream areas.\textsuperscript{58}

The piedmont zone might first be considered in detail. Instead of long, parallel foothill ridges along the mountain front, a number of short spurs run down along the valleys descending from the Clarke Range (here the front range). These are lateral moraines of valley glaciers. Especially striking is the fact that although a few low ridges and hills occur about 19 miles from the front of the mountains, the closest seven miles or so tend to be unusually flat. The reason for this is that the underlying Cretaceous strata immediately adjacent to the mountains show unusually gentle dips. Immediately to the east of this belt the same rocks are extremely folded and faulted with resulting steep dips, expressed in somewhat hilly terrain. The explanation for this phenomena is that hard rocks of the mountains were originally pushed by the Lewis Thrust eastward several miles further than they are now. Apparently the break along this fault happened before the Cretaceous rocks to the east had been appreciably folded. After the break had occurred pressure was largely relieved along this fault-plane. The great mass of hard rock, which had overridden the soft Cretaceous beds, made

\textsuperscript{58} J. S. Stewart, Memoir 112, p. 14.
it possible for these to withstand stresses. If the friction and pressure became excessive and could not be relieved in any other way, they were transmitted to the area east of the overlying mountain rocks. Hence the intense folding, faulting and consequent greater relief further east. Stresses were relieved by folding and faulting within the hard mountain rocks of the overthrust also. Later erosion moved the mountain front back revealing the flat piedmont belt of land, which helps make the mountains even more imposing. Possible similar explanations account for the level areas at the foot of Crowsnest Mountain, the High Rock Range and even the south Livingstone Range.\(^{59}\)

An easterly zone marked by grassy hills and long scarplike rock ridges comprises the bulk of the remaining southern foothills. This zone coincides with the gentle eastward arch of the disturbed belt. The long low ridges of sandstone following the strike for mile upon mile are especially characteristic of this area. Resistant rock outcrops usually crown these ridges. West of Cardston the rocky outcrops along the crests resemble endlessly long rooster combs rising from the heaving countryside. Some, such as Dickey Ridge are surmounted by weird, cream hoodo-like forms. Closer to the mountains the ridges bear a striking coniferous plant association. These rocky ridges

\(^{59}\) J. S. Stewart, Memoir 112, p. 51.
extend northward to the area between Pincher Creek and Beaver Mines.

An unusually rolling hilly foothills country lies between Cardston and Chief Mountain. The great heaving uplands have a sandpapered look and are mantled by grass. Neither major rocky outcrops nor trees mar the smooth outlines until the mountains are fairly near.

2. Northern Parallel Hills and Valleys

Unlike the southern foothills which seem to just rise above the rolling surface like long sea serpents on the ocean waves, the more northerly foothills are high, forest crowned hill-ranges separated by grassy slopes and sweeping valleys. Along the northern border of the area studied the hills are high and close together, forming a forested highland bridge between the Rocky Mountains and the Porcupine Hills. Southeastward the country is rolling and grassy near the Oldman River. Most of the area however is between these two extremes.

The area between the Porcupine Hills and the front range of the Rocky Mountains may be divided somewhat arbitrarily into three broad zones. At the western Porcupine Hills base lies a broad valley-land, most of which might
technically be called beyond the true disturbed belt since
the rock strata dip with the Alberta syncline. West of
this valley lies a hilly belt of relatively smoothened,
dissected ridges. Northward, this hill zone widens and the
ridges become higher, more regular and range like. This,
the third zone, is most striking from near the Gap in
Livingstone Range northward.

The easily eroded Willow Creek formation underlies
the broad subsequent valley dividing the Porcupine Hills
from the eastern foothills. Glacial moraine, outwash, and
lake deposits have partially filled the valley. During the
Pleistocene ice ages it was the locus for south-flowing
meltwater streams.60

The hilly belt westward is typical foothills
country which has been exposed to considerable erosion. The
land rises in heaving hill, upon hill, with occasional rocky
outcrops. The underlying structure is the same fold and
fault pattern described previously. From the air, the north
south grain of the land is clearly evident.

At this point the role of slumping and associated
phenomena should be mentioned. It seems unreasonable to
attribute all erosion to streams, which may be entrenched

50 to 200 feet below the general surface of the land. Much of the swirling, rising and falling hill topography owes its configuration to soil creep, slumping and slipping. Terrace-marked hillsides are likewise to be found. Southwestern Alberta as a whole shows these features, but grassy hill lands have the best examples.

The truly high foothills zone is to the north and adjacent to some of the mountains. Here parallel structure is the best displayed in all Southwestern Alberta. Long, high parallel ridges rise in an even pattern. Their flanks are cut by series of evenly-spaced, stream valleys giving many of the ridges a characteristic, almost teeth-like, pattern. The outlines of these hill-ranges is further emphasized by forest growth on their crests and north-facing slopes. Whaleback Ridge is especially striking. (See photos.) The underlying rock is cut by numerous thrust faults and folded into anticlines and synclines in a very regular manner. These hills and valleys are topographic expressions of the regularly varying structure and hardness of the rock underneath.

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61 Grazing animals, wild or domesticated, have probably been instrumental in the formation of step-terraced hillsides. Ranching dominates the economy of the foothills today. In the past wild herds roamed the area.
PORCUPINE HILLS

The Porcupine Hills form a 20 mile wide, 60 mile long, hilly highland immediately east of the true foothills and northeast of the Oldman River. Following the edge of the disturbed belt, they overlook the lower parallel foothill ridges to the grey-blue wall of the Livingstone Range. The rounded crests of the Porcupines rise to 6,000 feet in elevation in the heart of the hilly area, but reach only 2,000 feet above the plains to the east and 1,500 feet above the valley at the western edge. Because of the difference in elevation of the surrounding areas, the drainage goes largely to the east.

Structurally the Porcupine Hills are very simple, being largely composed of upper Laramide sandstones bent into a mild synclinal form. These rocks are the youngest in Southwestern Alberta. The axis of the wide synclinal is along the heart of the Porcupine Hills. The beds dip east 10 to 15 degrees in the western part, but progressively flatten out until they are flat, or nearly so, in the eastern part. This same synclinal continues northward and southward. To the south the upper beds have been largely eroded away exposing softer rocks and the land, instead of being very hilly, is very level. This entire belt is the great Alberta syncline. The Porcupines are therefore structurally
a part of the plains, not a part of the foothills disturbed belt. They are an isolated pre-front range of hills rising from the wide plains.

Geomorphologically, the hills present a rough, cut-up surface with rather large valleys relative to the small streams present. The grass-covered, valley slopes indicate small denudation at the present time. It is therefore probable that these huge valleys were largely excavated at a time of greater erosion in the past. From an overall bird's eye view of the Porcupines one might say that they are the broken remnants of an eastward sloping plateau. Several small flat areas at different levels may be found, but they are generally the result of nearly horizontal bands of sandstone, with no evidence of any "accordance of summit level". 62

For simplification, the Porcupine Hills may be subdivided into about four general zones. The first of these is the broken west-facing cuesta. The high forested core of the hills rise to the east of this, followed by the dry terrace-like eastern side. In the south the deep wedge made into the hills by Beaver Creek valley has a landscape pattern, which, although similar to other parts of the Porcupines, is nevertheless rather distinct.

A west-facing cuesta forms the western edge of the Porcupine Hills above the Oldman River, Callum Creek valley. The Porcupine Hills formation, dipping east 15° to 25° comprises the bedrock. However, since there is a lack of laterally persistent and resistant beds, the crest is poorly defined. It is best developed in the northern part of the area under consideration where its elevation is 5,900 feet. At this point, short obsequent streams drain the cuesta area, but northward and southward the streams are longer making the cuesta front deeply "crenulated". Behind the front the streams are typically dendritic. In the area studied no valley cuts completely through the Porcupines, but further north Willow Creek severs the hills.  

The Porcupine Hills core is a high forested range with numerous spurs reaching out to the sides. From above, the central area appears to be a rugged but maturely dissected country without very sharp crests. Alternating ravines and ridges give the area its character.  

Beaver Creek valley extends from the core of the hills southward through the gently rising flanks to the Oldman River valley. Round domelike hills surmounted by forest patches stand guard above the valley's exit.  

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64 This valley is of some importance with respect to cultivation and grazing.
from the Porcupine Hills. Upstream long rows of hill-spurs follow the valley into the higher country where Beaver Creek has its source.

Broken plateau-like blocks and spurs give the eastern part of the Porcupine Hills their character. This area is virtually devoid of trees being in the extreme rain-shadow position (behind both the Porcupine crest and the Rockies). Slumping and soil movement is important here. Some of the spurs in the south present very steep sides to the plains eastward, and rather striking buttes are also in evidence. From west of Fort Macleod, tiers of dry-looking terraces appear to rise westward culminating in the rounded hill tops.

GREAT PLAINS

South of the Porcupine Hills, and resting on the same type of geological structure, lies a western part of the Great Plains. To the west the folding and faulting of the disturbed belt abruptly subsides, giving way eastward to the Alberta syncline, which further east again beyond the area being studied gives way to the Sweet Grass Arch, a vast dome of rock around an intrusive on the Alberta-Montana border. The contrast in relief between the Great
Plains and the Porcupine Hills is partly accounted for by the more resistant Laramide beds having been stripped off the plains, leaving easily erodible rock.

Nevertheless the Great Plains have various erosional remnants which break the wide, lonely monotony of the land. These are Milk River Plateaux, Mokowan Buttes, and the low rolling country comprising parts of the Peigan Indian Reserve. The primary subdivision is then between upper level erosional remnants and the lower level plain.

Besides the erosional remnants, entrenched stream valleys, cut into the plains, give sharply contrasting relief. In other words, the "scenery" is down, not up.

1. Erosion Remnants

   a. Peigan Area

      The low rolling hills of the Peigan Indian Reserve are underlain by a southern remnant of the same rock which underlies the Porcupine Hills north of the Oldman River. In the remainder of the plains area this rock has all been eroded away.

   b. Mokowan Buttes

      Mokowan Buttes, on the Blood Indian Reserve, resemble a great block merging gently with the plains to the east, but exposing high badland cliffs above the Belly
River to the west. The colorful Willow Creek rock has been eroded to form gully riddled, red stained, grey cliffs rising in arid desolation from steppe and lush green river flats.

c. **Milk River Plateau**

The Milk River Ridge is a six to 12 mile wide plateau extending for about 40 miles parallel to, and north of, the Milk River. In the west it ends near St. Mary River. Northward it presents a rather sharp drop (600 feet in places) to the Magrath plain below, but to the south, just north of Milk River, the edge is more subdued and irregular. Small streams flowing into Milk River have cut this less distinct edge into a number of deep bays. Lonely valley crosses completely through the plateau in the western central portion. Southeast of the south branch of the Milk River another plateau is a continuation of the same high surface.65

The Milk River valley area itself is at a somewhat higher level than the Magrath Plain. Apparently this whole area is an erosional remnant.

The Milk River high plains or plateaux, when viewed broadly, are more or less a great slightly tilted plateau block through which the Milk River drains. In

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the west it almost forms a continuous hilly upland with the disturbed foothills belt, separated slightly by the St. Mary River, which however, is canyon-like in places near the 49th parallel.

The Milk River Ridge country is remarkable with respect to geological structure. Actually this area lies where the Alberta syncline gives way to the Sweet Grass Arch. This partly accounts for the variety of beds exposed. The western portion with which this study is chiefly concerned is underlain by the Willow Creek division of the Laramie, in the Alberta syncline. Eastward the following outcrop because of a slight westerly dip (being bent up into the Sweet Grass Arch eastward):

(1) St. Mary River subdivision;
(2) Fox Hill;
(3) Pierre;
(4) Belly River

Their topographic effects are not striking, however.

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The Milk River Plateaux area gives the visual impression of being very level and dramatically lonely. Exceptions are the sides of the Milk River Ridge proper and some badly eroded banks around Milk River and Shanks Lake. The ridge-top however, is a high regular tract of land, grass clothed and windswept. A few blocks of rock-outcrops protrude from the hillsides here and there. Gullies and rill marks cut the slopes, while huge glacial meltwater gaps sever the ridge completely. (See glacial history).

2. Lower Level Plain

The edge of the disturbed belt is partly marked by a gradual rise in land, which although not escarpment-like is nevertheless rather prominent, forming a long upsweep of country to the west. From its top the brown, green and golden plains spread out to the horizon eastward. The disturbed Cretaceous belt is itself actually more plateau-like than foothill-like in this area. Without the land rise it would be difficult in places to tell the true plains from the "foothills belt".

Streams descending from the disturbed belt to the Alberta syncline plains will tend to be entrenched in the higher, disturbed belt, especially toward the steeper eastern edge. However, when the gradient decreases upon  

67 The emptiness is partly the result of large farms and ranches, big fields, much rangeland, few houses, and virtually no trees.
entry to the plains proper, stream-cutting will be less active and consequently, valleys less deep and streams more sluggish. Many excellent, broad, meandering streams without very high banks may be observed below the "land-rise". Eastward however, the streams again soon entrench themselves deeply. At Lethbridge, for instance, the valley is approximately 300 feet deep. Some river sections even have vertical ochre-brown cliffs plunging for almost 100 feet, directly to the water. 68

The retreating Keewatin ice-sheet to the east and the rise of land westward made parts of the Alberta syncline plains ideal sites for dammed meltwater lakes. The great clay deposits, such as on Halifax flats near Pincher Creek, and elsewhere along this zone, seem to indicate that this happened. (See glacial history.)

The tremendous erratics near Glenwoodville and Standoff, previously referred to, were left on the Great Plains portion of Southwestern Alberta, by the melting ice-sheet. Here they are set in deep soil on the limitless expanse of the plains, giving the landscape a dramatic, although somewhat incongruous, contrast.

67 An example is found opposite Mokowan Buttes at the junction of the Belly and Waterton Rivers.
V. CONCLUSION

A few concluding remarks are offered, in order to weave together some of the strands of geologic information, presented in the foregoing discussion.

Southwestern Alberta's landscape picture rests upon the geologic foundation. This same geology gives the basic form and shape to the landscape. From west to east the terrain changes from mountain to plain, and thereby influences the remaining geographic factors to vary accordingly. Where landforms are exceptionally dominant and varied they become the focus of attention, for few other elements in the landscape are more striking than the topography. Consequently, special emphasis is given to the geology of the Rocky Mountains in the western part of the thesis area. Here the other physical landscape elements show the closest dependence on topography, as do the limited human elements present. Geology is also very important in the foothills east of the mountains, but emphasis shifts from structure, which explains individual mountain forms, to erosional history, which accounts for the general character of the hill lands. The area underlain by the relatively smooth
Alberta syncline is chiefly marked by erosional remnants and entrenchment. Since there is little landform variety on the plains proper, they receive proportionately less comment. Here the soil mantle is generally the most significant part of the lithosphere.
ATMOSPHERIC

ENVELOPES
ATMOSPHERIC ENVELOPE

I. ATMOSPHERE'S ROLE IN THE LANDSCAPE

II. OVERALL CLIMATIC CHARACTER

III. CLIMATIC FACTORS

   TEMPERATURE
   Frost-Free Period

   PRECIPITATION
   Snowfall

   WIND
   Chinook

ATMOSPHERIC CONDITIONS AND CLOUDS

IV. THORNTHWAITE'S CLIMATIC CLASSIFICATION

V. CONCLUSION
I. ATMOSPHERE'S ROLE IN THE LANDSCAPE

The atmospheric envelope which shelters and modifies the land is, like the geologic foundation, one of the fundamental, basic ingredients in the landscape. Erosion, which chisels the landforms, relies on the atmosphere for its tools. Climate, including temperature, precipitation, and wind is usually the single most important influence in soil formation and vegetation growth. Together with geology it determines the drainage. Last but not least, it has an indirect effect on human life and sets certain occupational limits. It is these human occupations of an area, more than anything else, which give the cultural landscape segment its character.

II. OVERALL CLIMATIC CHARACTER

Southwestern Alberta is typically an area of continental climate. It is as far from the eastern (Atlantic) seaboard as it is possible to go without dropping down the moist warmer Pacific slope. The towering mountains
holding the continental divide shut off much of the Pacific influence. Although the bulk of the area drains to Hudson Bay it is on the furthest fringe of this drainage basin. Arctic and Gulf of Mexico waters are almost equidistant, many thousands of miles away. It is therefore no wonder that Southwestern Alberta possesses an extreme continental climate.

Being interior continental, considerable variation and "unpredictability" characterize Southwestern Alberta's climatic regimes. Temperatures vary from bitterly cold winters, broken by balmy chinook winds, to scorching summers. The high clear altitude, combined with windiness and dry conditions, gives the area a salubrius fresh atmosphere and cool nights. The temperature pattern is closely related to altitude, temperatures being much lower in the mountain and hill lands westward than on the lower plains at the eastern border. Latitude is not too significant since only one degree is involved. Unreliable temperature fluctuations often result in snow pocketed uplands late in the spring and early in the fall. Precipitation likewise is erratic and bears a close relation to topography. The amount of precipitation decreases progressively from the continental divide range eastward. Except for the higher, inner, ranges the area is characteristically sub-humid and

68 Alberta generally slopes from southwest to northeast thus minimizing latitudinal variation somewhat by compensating decrease in altitude.
rather subject to droughts. In addition to these factors, wind is of basic importance in Southwestern Alberta. Typically sweeping winds blow across the open parts of the land, through the valleys, gaps and basins and over the hilly tracts. The warm drying chinook wind descending the mountains is a trademark of Southwestern Alberta. The dry atmosphere, combined with the searing winds, tend to cure the range grass naturally. This in its turn affects the ranching and farming industries. But all the effects are not beneficial. Warm winter chinooks lure out delicate buds, which are later brutally killed by returning cold pouring down from the north once the chinook has lost its force.

III. CLIMATIC FACTORS

The chief climatic factors of concern in Southwestern Alberta are temperature, precipitation and wind. Frost-free period, snowfall, atmospheric conditions and so forth are a part of, or associated with, these basic factors.

TEMPERATURE

The yearly temperature fluctuation in Southwestern Alberta shows fairly strong continental characteristics.

69 All climatic data has been obtained from published and unpublished weather records of the Meteorological Division, Department of Transport, Toronto, Ontario.
Pincher Creek Annual Temperature Cycle
(Mean Monthly Values)
Cold winters and warm summers are typical. The Pincher Creek temperature-cycle graph shows this well. However, neither winter nor summer show up as extreme as they really are. Summer nights on the high plains near the mountain base are cool in contrast to the hot days. Consequently the average temperature for the summer period is relatively moderate. During the winter, the very cold weather is frequently broken by warm, dry chinook winds sweeping over the mountains down through the foothills to the plains. Temperatures may be raised several tens of degrees. If a warm chinook comes every ten days this will seriously change the average monthly figures during the winter. Actually, the average is a very untypical, misleading figure, since most of the period was either bitterly cold or basking in chinook warmth, the average figure having only been touched briefly as the temperature rose or fell quickly with the varying cycles. The rise and fall is usually very rapid.

As has been mentioned and as is to be expected, in a continental climate the diurnal temperature range is considerable. For example, the maximum during a July day in 1952 in Pincher Creek was 84°F. while the minimum was 44°F. The day and night temperatures are not always so extreme, but a wide variation is typical, not unusual.
CARDSTON
MEAN JULY TEMPERATURE VS.
ACTUAL JULY TEMPERATURES

TEMP. °F
Likewise the temperature varies considerably from year to year. An illustration of this variability is the accompanying graph of Cardston's mean monthly July temperatures plotted together with the actual July temperatures from 1933 to 1952. There is more than a ten degree range, approximately reaching to six degrees on either side of the all-time mean.

Temperature also varies spatially in Southwestern Alberta since the area presents almost the full assortment of topographic features. Generally speaking, the higher areas such as the mountains, Porcupine Hills and higher foothills have cooler summers and slightly cooler winters with less sharp continental variations. The lower foothills, plains and valleys are the stronghold of intense continental temperature variation through the seasons.

The January temperature map shows progressive warming from the high Rockies, through the foothills to the lower plains. A warmer tongue licks into the North Fork valley. Eastward however, with greater distance from the mountains and further for the warm chinook winds to travel (and cool, in the process) temperatures decrease again. The apparently warm zone just out from the mountains is largely the result of these warm, dry chinook winds which invade the area from time to time. The mountain piedmont and
Southwestern Alberta

MEAN APRIL TEMPERATURE (°F)
Southwestern Alberta
1 : 1,267,200

MEAN JULY TEMPERATURE (F)
Southwestern Alberta

Mean October Temperature (°F)
adjacent plains is of course the area closest to warmer Pacific air. The protecting influence of the Porcupine Hills to the north is also worthy of some note. Alberta generally lies in the path of cold arctic air sweeping south and eastward over much of North America. Protection northward can be very beneficial even if the area under consideration is not directly in the main arctic air path.

The April temperature map shows gradual warming with decrease in elevation northeastward. The Porcupine Hills and the North Fork valley are still relatively cool. In the southeast the Milk River Plateaux being higher than the other plains are also cooler.

The July temperature map shows the same pattern with the Rockies, foothills, Porcupines and Milk River elevated plains relatively cooler, suffering less from the extremely hot summer temperatures which by day often prevail on the lower plains. Northeastward temperatures again decrease. Normally temperatures decrease northward especially northeastward toward the Canadian Shield and Hudson Bay. However, this temperature fall-off is outside the area here being considered.

The October temperature map merely repeats the pattern of the previous map with lower autumnal temperatures. Temperatures may fall very rapidly in October, changing the
landscape from a sun drenched golden scene to one of snowy desolation — overnight. The higher areas such as the Milk River Plateaux, Rockies and so forth are the most vulnerable.

Frost-Free Period

As may be expected from the foregoing discussion, the frost-free period, like the temperature upon which it depends, is highly variable. The accompanying frost-free diagram for Pincher Creek shows that approximately one-half of the year may be frost-free, but also that no month has been without frost! On the average, which again is the result of extremes, one quarter of the year is frost-free. However, $28^\circ F.$ rather than $32^\circ F.$ is a limiting temperature for wheat and some other plants grown on the plains around Pincher Creek. Thus the "safe" season is longer. By comparison, Waterton, a mountain station, shows a shorter maximum frost-free season but a longer average, and a much longer minimum frost-free season. In other words, the frost-free season does not vary so immensely but is relatively steady. The reason for this is probably that only a three year record is available. However, the higher areas, including the mountains, generally show less continental variation. In addition to this, Waterton Town is built on a delta in a lake which has a "micro-marine" influence on the adjacent area. This may account partly for the more even, mild temperatures at Waterton.
Pincher Creek
FROST FREE SEASON
Waterton
FROST FREE SEASON
The map showing the frost-free period in days for Southwestern Alberta repeats in principle the patterns of the temperature maps to which it is of course closely related. The higher areas have shorter frost-free periods, while valleys, running into the mountains or hills, show longer frost-free periods than the surrounding country. The relatively warm tongue licking at Waterton Lakes may really be an isolated pocket under the lake's mild influence. If so, the frost-free period decreases slightly eastward ing the foothills, and then increases again. It is regrettable that data for the Crowsnest Pass and Crowsnest Forest Reserve is not available. However, areas above 6,000 feet have been indicated. Above this elevation the frost-free season might be expected to be largely nonexistent. This would suggest that these areas are not agriculturally significant, under present technology. The marking-in of the higher areas also serves a second purpose. The high Rockies are the source of cold air which occasionally flows down over the foothills and plains. The frost hazard in the inner foothills is very acute, prohibiting the growth of many crops on commercial scale. As far out on the plains as the Glenwoodville-Hillspring area, sugar beets cannot be successfully cultivated, on commercial scale, because of the mountain frost danger. 70

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70 From interviews in United Irrigation District.
The frost free period is shown in days annually.

Land above 6,000 feet in altitude is indicated by blue. It may be regarded as a source of cold and as agriculturally insignificant.

Source: Meteorological Division, Department of Transport, Toronto, and Topo. Maps.
Precipitation, like temperature, shows continental variability, especially in the year to year precipitation records. A glance at the graph will show the more or less annual zig-zag from above, to below average precipitation. In a sense Southern Alberta is at the "end of the line", being blocked off from moist Pacific air by the Rockies on the west, being toward the distant northern end of the land benefiting from the Gulf of Mexico's moisture-laden air, and receiving no moisture from the very distant east or off the frozen north. In other words, Southern Alberta is about as "continental" as any place in North America. If there is moisture left as the air reaches the "end", Southern Alberta receives bountiful precipitation, but if nothing is left over, there is no choice but drought. Annual precipitation at Pincher Creek has varied from just above nine inches to over 54 inches.

Rainfall is generally characterized by heavy showers or drought, but also at times by more moderate rain. As one approaches the Rockies the precipitation increases as the shower and drought pattern decreases. Thus at Beaver Mines, and in the mountains, the rainfall pattern is more even, and although still variable and continental in character it is strikingly less so.
CARDSTON
PRECIPITATION VARIABILITY
FROM THE MEAN
The annual precipitation cycle fluctuates with an early summer maximum overshadowing the rest of the year. June is by far the wettest month. (This is good for the growing crops and wild grasses). A summer (high sun) maximum is what one would expect. However, there is also an autumnal maximum which although much smaller, is nevertheless noticeable. September is here the peak month. Since this portion of Alberta lies at the edge of the Pacific divide it may be that marine influences from the west slightly affect the precipitation pattern.

The accompanying graph compares five Southwestern Alberta stations which are situated in different topographic settings. Waterton, located on a delta in a mountain-rimmed, fjord-lake has the highest precipitation record, (28.25 inches annually) for any official Alberta station. Heavy orographic rainfall, in a very rugged area, is responsible for this. Otherwise, Waterton is much like the other stations in Southwestern Alberta, except that its minimum is in late summer and that there is less fluctuation in amount from month to month. This indicates marine ties with the Pacific air masses, perhaps. Coleman, situated in the open basin-like area of the Crowsnest Pass country, and also in the Cordillera, is not very different from Waterton, except that its totals are less and the minimum is in mid-winter like
the rest of the stations. Beaver Mines, in the foothills adjacent to the mountain base, shows more fluctuation than the mountain stations but less fluctuation than the more open country stations eastward. This is what one would expect. Eastward, in an area of parallel ridges and wide sweeping valleys, lies Mountain View. Its precipitation pattern is not strikingly different. This is also a foothills station. Last, Pincher Creek near the edge of the disturbed belt, on the wide plains, shows a related pattern, but with greater extremes from month to month. Pincher Creek has the greatest monthly and also the lowest minimum. This is the most continental station. Dryness increases eastward, away from the mountains.

The precipitation map of Southwestern Alberta shows two things vividly. First and foremost, precipitation and relief are intimately tied together. The isohyets virtually reproduce the topography, though slightly offset to one side. One side (one aspect) of a range is usually wetter than the other, hence the "off-set". Secondly, altitude alone is not the only controlling factor, for proximity to the moist Pacific air masses is also highly important. The continental divide ranges receive the greatest precipitation, unofficially estimated at around 45 inches.\textsuperscript{71} The front ranges, such as the Livingstone,\textsuperscript{71} W. J7 Flemming, \textit{A Report on the Forest Inventory for the Forest Survey of Eastern Rockies Forest Conservation Board}, Calgary, Alberta, Eastern Rockies Forest Conservation Board, March, 1955.
Southwestern Alberta

Mean Annual Precipitation

Legend

Scale 1: 506,880
1 inch to 8 miles

Mean Annual Precipitation
in inches

50
45
40
35
30
25
20
15
10

Source: Data from -
Meteorological Division
Department of Transport,
Toronto, and Eastern
Rockies Forest Conservation
Board, Calgary.
only reach into the thirties in inches of annual precipitation.\textsuperscript{72}

Attempts to relate precipitation to altitude have been made on graphs. However, aspect, and valley versus crest site, are more important than mere altitude in feet. Consequently, only a most general impression can be gained. The mountainside rather than the crest may receive the greatest precipitation.\textsuperscript{73}

\textbf{Snowfall}

Snowfall being a part of precipitation follows the same pattern, except that it is only a winter phenomena and occurs at the period of minimum precipitation.

Toward the east and beyond, warm, dry, chinook winds often sublimate the snow, leaving the ground and grass bare for winter grazing.

\textbf{WIND}

Wind, unlike temperature and precipitation, is fairly consistent. Southwestern Alberta, except for some isolated, protected, mountain and hill valleys, may be described as continually windy.

\textsuperscript{72} Map Data -- Met. Toronto, and E.R.F.C.B., Calgary.

\textsuperscript{73} The graphs, for the reasons stated above, have not been reproduced here.
The Rocky Mountains form a barrier over which, and through the passes of which, the winds sweep to descend on the other side picking up momentum as they race across the plains. This piedmont belt and adjacent territory is ideally suited to wind development.

Only the emergency airfield at Cowley has wind data in the area under study. A wind rose at Cowley shows most of the winds come from (1) the Crowsnest Pass country (W), (2) down the North Fork valley (N), or (3) from over the Rockies (SW). The Crowsnest pass and North Fork valley are major valleys leading out or down from highlands. One would expect a place located at their mouth to be windy. A comparison for the entire year between direction of wind, wind speed and the months of the year reveals that west winds dominate followed by southwest winds and by northwest winds. During the spring there are some notable north, northeast and east winds. This somewhat coincides with the build-up peak of precipitation. Westerly winds are at their strongest during the winter, with the warm chinooks sweeping out over the mountains and down from the Crowsnest Pass area.

Chinook

As mentioned, the chinook winds are very prominent. The local physiography help make them so. Although pre-
### Wind Direction & Speed During Year

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**Average Wind Speed in Miles Per Hour**

- Above 4
- 5
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- 7
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- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- M.P.H.
ANNUAL PERCENTAGE FREQUENCY OF WINDS
cipitation and temperature may both be extreme, they are not as striking or unique as the chinook winds. The chinook wind, more than any other single climatic factor has given Southwestern Alberta its character. The precipitation is great enough to support much more forest and bush, but the warm, drying, chinook winds swallow up the moisture in both winter and summer. In winter the chinook effect in raising the temperature is most noticeable, but in the warmer part of the year serious droughts may result. Besides making the precipitation less effective, chinook winds encourage tender trees to bud, leaving them to be brutally killed by the rapid return to frigid winter as soon as the chinook lessens. It is for this reason that Lombardy Poplar cannot readily be grown in the area. Instead of this poplar, which is the trademark of Utah Mormon settlements, hardier poplars form the windbreaks around Alberta Mormon settlements. Likewise, extensive tree fruit orchards are hindered by this same "false spring".

ATMOSPHERIC CONDITIONS AND CLOUDS

Since the area being considered, like most of Alberta, is high and dry, the atmosphere is one of the clearest possible. The scenery is etched against the sky like a cameo. However, mist and smoke do also occur, but when they do they have an unusual freshenss because o
the air was pure immediately before their arrival. The wind is continually refreshening and circulating the air.

Cloud effects in most dry and semi-dry areas are spectacular, although radiantly clear skies are typical. Southwestern Alberta is no exception. Since this area has a moderate precipitation but is continental in character, one would expect it to have clouds fairly often -- but largely very temporary clouds of the more turbulent, convection shower or thunderstorm type. This is more or less true. A glance at the accompanying illustrations will show exactly what may be expected -- normally. Abnormally, anything can happen!

THORNTONWAITE'S 1948 CLIMATIC CLASSIFICATION

Thornthwaite's 1948 climatic classification has been worked out for Southern Alberta - Northern Montana. The maps illustrating average, dry and wet conditions are largely self-explanatory. They demonstrate the shift of the climatic belts across the land and further emphasize the transitional, variable character of the area under study.
"Chinook Belt"
Alberta Montana

THORNETHWAITE CLASSIFICATION
WATER SURPLUS
SCALE 1: 2,500,000

Surplus west of line
"Chinook Belt"
Alberta Montana

THORNETHWAITE CLASSIFICATION
HUMIDITY INDEX

SCALE 1: 2,500,000
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Much of Southwestern Alberta appears more moist than it should be. It should however, be noted that since Thornthwaite's formula does not include evaporation by wind and drying chinook wind effects, Southwestern Alberta cannot be accurately classified by it. All in all, vegetation (largely a result of climate) seems to be the best guide to the climate of this area, especially local "micro" climate.

V. CONCLUSION

In order to briefly sum up the highlights of the foregoing chapter a few fundamental points might be mentioned.

The gaseous envelope, in which the land surface rests, is of importance to the landscape in three ways: (a) through climate, which has far reaching effects; (b) in supplying to tools for landform sculpture; (c) as a part of the landscape picture directly, in clouds and so forth. It is the first of these which is of chief concern. In Southwestern Alberta the climatic pattern is profoundly influenced by the topographic configuration of the land. Although basically continental, it varies considerably from the high, cool and moist continental divide ranges to the lower, dry and warm plains. This climatic spectrum
is chiefly a result of two things, increasing altitude and increasing orographic precipitation. As a result of this progressive variation in topography and climate from east to west, the soil and vegetation patterns are directly influenced to show the same type of zonation. In fact, the whole landscape reflects it. The windiness, clear atmosphere, and striking cloud effects, which together with continentality characterize the area, are all partially the result of the high elevation and the guarding, obstructing mountaints. The only part of the climatic picture not influenced by these topographic controls is latitude, which in the final analysis is the basic factor of Southwestern Alberta's mid-latitude climate, with its striking seasonal fluctuations.
DRAINAGE NETWORK
DRAINAGE NETWORK

I. INTRODUCTION

II. DRAINAGE LINES AND DRAINAGE BASINS

III. DRAINAGE AREAS

IV. CONCLUSION
DRAINAGE NETWORK

I. INTRODUCTION

Basically, the study of the drainage network may be divided into two major sections: (1) drainage lines and basins or the network proper; (2) erosional landforms resulting from drainage. The latter has obviously been covered in some detail in the geologic chapter where it must receive priority. The first aspect of a drainage study, that of the drainage network, will be discussed here.

II. DRAINAGE LINES AND DRAINAGE BASINS

Referring to the drainage map it will be seen that the area may be subdivided, for convenience, into three zones:

(1) Oldman River and its northern tributaries, the Crowsnest, Castle and Livingstone Rivers flowing from the divide range through "gaps" in the front range;

(2) southern rivers (joining the Oldman later) flowing from the Precambrian Rockies, front range near Waterton Lakes, including St. Mary, Belly and Waterton Rivers;
Scale 1:506,880 linch to 8 miles
Regional numbers refer to the text
Superimposed or Antecedent
Consequent
Trellis-like
Extrinsic

Source: Topo. Maps, Air Photos, Geological Reports and Memoirs
(3) Milk River system draining to the Gulf of Mexico instead of Hudson Bay.

The main drainage lines, which cut across present structures, may be left over from pre-Rocky Mountain times, or may follow lines of structural weakness. Both explanations are probably correct.\(^74\)

III. DRAINAGE AREAS

Shifting the emphasis from the drainage basin to the type of drainage, a number of broad areas may be conveniently differentiated.

(1) Between the Livingstone and High Rock ranges lies an area with drainage lines crossing the grain of the land, without any special pattern. The grain, incidentally, is poorly developed here.

(2) Immediately behind the Livingstone Range lie subsequent rivers, drawing on a network of parallel, foothill streams.

\(^74\) George M. Dawson, *Rocky Mountains*, 1886, p. 19B.
(3) The entire drainage of (1) and (2) crosses the Livingstone Range via the Gap, an S-curved gorge through the range, apparently the result of faults and folds in the Livingstone Range.

(4) Northward from the Gap another stream crosses the northern, lower, Livingstone Range, but this time from east to west, contrary to the general slope of both land and beds further south. The Livingstone Range is here composed of a low anticline, however, with high foothills eastward. Erosion from either side may gain the upper hand and divert the drainage.

(5) The foot of Livingstone Range south of the Gap is etched with a band of parallel drainage scars. Their evenness is perhaps not so remarkable when one considers the even, towering limestone wall of the Livingstone Range, which gave rise to them. Increasing structural complexity and slope help account for the lack of typical parallel (to strata strike) drainage lines.75
(6) The North Fork country displays beautiful, developed, parallel, foothill drainage, with the odd cross-ridge, connecting stream. Parallel lines of fracture may explain the latter since the present streams are very small and have rather limited erosive power.76

(7) The western or cuesta side of the Porcupine Hills shows a kind of "obsequent" drainage, the streams cutting across the cuesta, to drain westward from the eastsloping side. Deep bays have been cut into the cuesta face by these streams.

76 George M. Dawson, Bow and Belly Rivers, 1884, p. 102C.
The part of the Crowsnest basin north of the Crowsnest River shows beautiful parallel drainage with the general strike of the land.

South of the Crowsnest River near Blairmore is another area showing "parallel to the strike" drainage, but perhaps not so obviously as (8), for here the beds begin to twist to a SE-NW position.

Just west of (9) lies an area with less conforming drainage lines. The waters from the central range cut across diagonally, although downslope, to join the Crowsnest River.

West of the central range lies a small segment of dendritic drainage which flows through the Crowsnest Pass instead of west, as one would expect on the western side of the main range.

Crowsnest River itself appears to follow an ancient fracture line or break. To the north the strike of the Rockies is N-S. Southward the Rockies strike NW-SE. [77]

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77 George M. Dawson, Bow and Belly Rivers, 1884, p. 100G.
(13) The dry valley, draining underground through a cave, to feed Crowsnest Lake and River has already been discussed, but should also be noted here.

(14) Although the Precambrian Rockies show less of the parallel structure of the Rockies to the north, the upper Castle drainage behind the front range seems to mildly follow structural lines in a long, sweeping pattern.
(15) The dendritic drainage pattern of streams descending from cirques and hanging valleys into Waterton fjord-lake (which rests on a structurally down-dropped block), may be considered a separate division. A noticeable divide separates it from the upper Castle drainage area.

(16) The remaining area, with the exception of the Milk River drainage may be considered as ordinary dendritic, (but not intricate) and consequent, (but in many places on the plains, perhaps insequent, or accidental, or of unknown cause). A number of parallel streams, (but not to the rock strike heading deep into the heart of the front range (Clarke Range ) far behind its edge, are a special set of streams worthy of being placed in a subgroup. Entrenchment at the edge of the disturbed belt with sluggish meandering streams in wide low valleys beyond, should also be noted. In addition there is an area of water-gaps in the sandstone ridges west of Cardston, especially on Lee Creek. The intricate badland gullying on Mokowan Buttes, on the Blood Indian Reserve, is also somewhat different from the overall pattern. Long, low gullies may be observed along Oldman River also, but this is merely another erosional effect.
Milk River, flowing in a valley on a plateau and draining to the Gulf of Mexico, forms another pattern again, with numerous side gullies and embayments. Alkali lakes without continuous outlets are also found in this area.
IV. CONCLUSION

In conclusion, attention should be drawn to the fact that the drainage pattern of Southwestern Alberta is the only part of the hydrosphere represented there. Two basic aspects to the drainage network are readily apparent. First, the water itself, as streams and lakes, contributes to the landscape picture. Secondly, the erosional phenomena wrought by these waters are important in the geological segment of the landscape. Post-glacial entrenchment is very typical of the stream pattern, both in the mountains and on the plains, and water gaps are uncommonly numerous. Glaciation, which itself might be considered a part of the drainage pattern, and geologic structure have greatly modified the general downslope drainage. Consequently, the drainage is intimately related to the geology, which supplies the raw material, and the atmosphere, which supplies the tools.
SOIL

MANTLE
SOIL MANTLE

I. INTRODUCTION

II. DARK BROWN SOIL ZONE

(a) Hilly Loams and Clay Loams of Milk River Ridge
(b) Glacial Loams Southwest of Fort MacLeod
(c) Alluvial Heavy Loams at Del Bonita
(d) Water Sorted High Lime Clays and Clay Loams at Brocket

III. SHALLOW BLACK SOIL ZONE

(a) Hilly Loams and Clay Loams of the Porcupine Hills
(b) Hilly Loams and Clay Loams South and West of Cardston
(c) Sorted Loams along the Central and West Base of Milk River Ridge
(d) Sorted Loams and Silt Loams of the Foothills
(e) Solonized Silt Loams on the Blood Indian Reserve
(f) Sorted Silt Loams and Silty Clay Loams on St. Mary River
(g) Heavy Textured Water Sorted Soils from Lundbreck to Standoff
IV. BLACK SOIL ZONE
   (a) Hilly Loams of the Foothills
   (b) Valley Soils of the Foothills

V. GREY WOODED SOIL ZONE

VI. ERODED LANDS

VII. RIVER BOTTOM LANDS

VIII. CONCLUSION
SOIL MANTLE

I. INTRODUCTION

The weathered and transported soil cover, which mantles the lithosphere, provides the nourishment and anchoring material for the vegetation which clothes the landscape. The vegetation cover in turn, directly or indirectly supports all animal life, including humanity.

In Alberta the soil belts are classified according to their color, which represents the environment under which the soil formed and its general character. The soil color itself is also a landscape feature, and in Southwestern Alberta the light colored soils of the eastern steppes give a tawny impression to the landscape as compared to the more sombre effect of the black soils in the parklands of the foothills.

Alberta soils tend to vary from brown to grey, as the climate and vegetation vary from dry steppe to damp coniferous forest. In Southwestern Alberta this combined variation is from east to west. The sharp change from plain
Southwestern Alberta
1:1,267,200
SOIL COLOR ZONES

SOURCE: ODYNSKY,
MAP - SOIL ZONES
OF ALBERTA

Legend
- Dark Brown
- Black
- Brown
- Shallow Black
- Not Surveyed
- Largely Grey Wooded
to mountain causes these zones of climate, vegetation and soil to also change rapidly as the mountains are approached. Each soil zone is a transition between the soil zones on the drier and moister sides. Eastward, the dry, Great Plains are generally mantled with brown soil, but nearer the Rockies, increasing moisture and tree growth result in almost the entire provincial soil series being compacted into a narrow belt along the mountain base. The drier and warmer an area is, the closer its soil will be to the brown end of the soil series. On the other hand, the moister and cooler an area is, the closer to the grey wooded end of the soil series its soil will be.

II. DARK BROWN SOIL ZONE

Dark brown soils occur where the annual precipitation is 13 to 15 inches, with fairly high evaporation coupled with hot dry winds. In Southwestern Alberta the precipitation figures for this zone range closer to 15 or 16 inches annually, but here the evaporation is high and greatly assisted by wind. Droughts are noticeable but not quite as frequent and extreme as in the Brown Soil Zone. The vegetational cover is largely short grass prairie, slightly more luxurious than that of the Brown Soil Zone.
Like the Brown soils, the Dark Brown soils have a nitrogen and organic content which is somewhat low. Lack of moisture, however, is the chief crop limiting factor.

(a) Hilly Loams and Clay Loams of Milk River Ridge

The soil of the Milk River Ridge (range 17 to range 23 and to top of township 4, range 20) is largely loam of glacial origin. This soil rests on gently rolling to hilly topography. Along the western side lie heavy loam soils, broken by numerous parent rock outcrops. This parent rock has contributed much to the soil, despite the intrusion of a large number of glacial erratics and debris. The largest area of patchy mixture of residual and transported soils occurs in township 3, ranges 22 and 23. The Milk River Ridge escarpment to the north, which is two to three miles wide and drops 300 to 500 feet, is covered by heavy loam. This general area may be described as a level to sloping "crown" cut by numerous draws draining to the level plain below the escarpment northward. The finer parts of the glacial mantle have probably been removed by erosion, leaving the present soil the result of parent rock weathering.

78 Map -- Soil Zones of Alberta, by W. Odynsky, University of Alberta, Edmonton.

79 The details of soil conditions in the sub-regions of the Dark Brown Soil Zone are largely taken from the following reference:

The draws frequently expose bedrock, but the crowns, if carefully handled so that excessive run-off and soil erosion do not take place, are agriculturally fairly productive. Contour farming would be valuable in this area. Rougher country is only suitable for pasture. At present, grazing dominates the entire economic picture here.

The rest of the ridge is heavy loam, but here also the cover of glacial till is only thin, with a scattering of glacial erratics. Topographically this land is rolling to hilly, but broken by small draws and sloughs. There is some internal drainage to saline lakes, but these cases are the exceptions rather than the rule.

(b) **Glacial Loams Southwest of Fort MacLeod**

Centering in township 7, range 26 lies a glacial crown, ringed by belts of water sorted soils. Both Rocky Mountain and Hudson Bay erratics are present. This somewhat rolling area lies on the border between the Dark Brown and Shallow Black soil zones. The soil becomes heavier and darker toward the south. The northern half is gently rolling but rather stony. The most rolling sections contain low steep-sided hills, and are primarily pasture land. A district of rough, gravel ridges separates the area from the silty, clay loam basin east of the Belly River.
West and northwest of this loam district stretch sorted, glacial silt, loam areas which are transitional between the glacial loams and the sorted clays further west. Topographically this is a sloping, undulating country. Meadows, sloughs and some solonized soil patches are present in this shallow profile area. However, there is good grass growth, and the area is fairly arable.

(c) **Alluvial Heavy Loams at Del Bonita**

A northward reaching arm of Flaxville plains stretches into Alberta from Montana in township 1, ranges 21 and 22. Immediately below the surface lies a thick deposit of interglacial or post-glacial "Saskatchewan" gravels. The surface deposit is largely silt. The topographic configuration is a level to mildly rolling (westward) plateau. Because of the gravelly subsoil, water storage cannot be great and drifting can easily harm the thin, superficial soil mantle. Nevertheless, it is fairly good arable land and is extensively cultivated.

(d) **Water Sorted High Lime Clays and Clay Loams at Brocket**

Heavy textured soils, with a high lime content, occupy an area north of Brocket. The clay and silty, clay loam area north of the Oldman River slopes down from the
Porcupine Hills, exposing parent rock in coulees and on a few of the high, residual, land knobs. The soil is probably weathered from the parent rock. Because of high lime carbonate deposition on the surface, the soil colour is light. It also has a great deal of silt, and most of the area is cultivated. South of the Oldman River at Brocket lies a somewhat level area of light colored, high lime, clay soil which gives a "dead" impression. This soil does not respond too well to cultivation. Similarly, there is also an area of poor, whitish, silt loam, north-eastward. However, to the north in township 8, ranges 29 and 30 lies a gently rolling clay area, with considerably lower lime content, which is fairly good arable land.

III. SHALLOW BLACK SOIL ZONE

Shallow Black soils occur where the annual precipitation is from 14 to 17 inches, with only rare droughts by Alberta standards. In Southwestern Alberta, higher evaporation, because of wind and temperature, balance the higher precipitation (17 inches) here. The vegetation is generally grassland, but more luxuriant than in the Dark Brown Soil Zone. Nitrogen and organic material is also more abundant. More of the Shallow Black Soil Zone is
arable than of the Dark Brown Soil Zone, and this belt is generally a wheat growing area.  

(a) **Hilly Loams and Clay Loams of the Porcupine Hills**

In the southern Porcupine Hills area lie clay loams and loams, riddled with Porcupine sandstone outcrops. Much of the soil is from the parent rock, but the clay portion is transported material. On the slopes and rock ledges, especially toward the west, there is some tree growth. The country is in general fair to good pasture, with arable pockets in some valleys.

East of Pincher Creek, on the north side of the great clay basin, rises a ridge exposing Porcupine sandstone and mantled with clay loam. This is a part of the rolling, "Peigan erosion remnant", referred to in the geological discussion. It is much higher than the nearby land, and therefore vulnerable to wind erosion. The ridge is only good pasture land.

(b) **Hilly Loams and Clay Loams South and West of Cardston**

This group of soils bears a close resemblance to the black hilly loams of the foothills area further west,

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80 Map -- Soil Zones of Alberta.

81 The Shallow Black soil zone's sub-regions are all discussed in some detail in Wyatt, Bowser and Odynsky, Soil Survey, pp. 50-54.
but here the vegetation is grass, unlike the scattered tree growth of the Black Soil Zone. The slopes are largely too dry and steep for cultivation, although level crowns, adjacent to the rock outcrop ridges, are sometimes cultivated. Threaded through the area are good arable valleys, mantled with sorted glacial loam. Otherwise the area is good quality pasture land. Northward stretch slightly rolling, glacial loams which are moderately good, arable lands.

(c) Sorted Loams along the Central and West Base of Milk River Ridge

Around the base of Milk River Ridge escarpment, west of Whiskey Gap and south of Spring Coulee, runs a strip of sorted, glacial, heavy loams. Part of this strip lies in the Dark Brown Soil Zone. Where level, this is good arable land.

(d) Sorted Loams and Silt Loams of the Foothills

In a general area west of the level to undulating Pincher Creek, Cardston heavy-soil basin, and east of the black hilly loams, lies an undulating to gently rolling area of sorted loam and silt loam. Southwest of Cardston these sorted areas usually occupy valleys between hilly ridges. These small pockets of silty, stone-free, deep soils provide very valuable agricultural land in the midst of this range area. From Pincher Creek to Waterton River,
the long gradual slopes are easily cultivated. The northern end is an undulating, silty, clay loam area, sloping to the clay basin. This deep soil area is very good arable land and is cultivated.

(e) Solonized Silt Loams on the Blood Indian Reserve

Between Cardston and township 7, range 24, is a sorted glacial and sorted residual, silt loam area, with a high percentage of solonized soil. Patchy micro-relief has resulted from erosion of the A horizon. In the eastern part, all the soil is solonized with the A horizon (surface) largely eroded away, giving the land a washed appearance. The southern half of the whole area is covered by a glacial deposit. There are few stones, but because of the hard-pan, grass growth is poor. To the west at Layton Creek is a silt loam area with some solonized patches, which is marginal to fairly good arable land. This friable soil has a pinkish tinge, which shows a relation to the underlying, red, Willow Creek bed rock.

Immediately north of Cardston lies a clay area with much of the surface removed. The exposed hard B₁ horizon does not support a good vegetation cover, because the native grasses of the area will not grow here.
(f) Sorted Silt Loams and Silty Clay Loams on St. Mary River

North of Kimball lies an undulating, average to heavy textured, silty soil area. Nitrogen and phosphorous are contained in above average amounts, (for Shallow Black soils) and the soil profile is deep. This is one of the better wheat producing areas.

(g) Heavy Textured Water Sorted Soils from Lundbreck to Standoff

A level to undulating basin of Shallow Black, lacustrian and glacial lacustrian, clay stretches in a long, narrow belt from Lundbreck through Pincher Creek to Standoff. It is a gentle valley, four to five miles wide, which contains silty clay loam east of the Belly River near Glenwoodville and clay between Lundbreck and Ewelme. The texture is generally very heavy. This soil was formed in lake water dammed by the retreating ice sheet, and contains the odd glacial boulder, left here and there. In the main basin, the heavy, waxy, clay may be 10 to 15 feet deep, below which there is a lighter colored clay. The heavy texture is helpful in retaining moisture in this subhumid area, which is largely devoted to dry, strip wheat farming. Clover cultivation would, however, add to the somewhat low nitrogen content and improve the tilth for easier cultivation.
Near Hillspring and vicinity, some areas are partly irrigated with satisfactory results. West of Cardston lies a silt loam, transitional area (with some solonized patches) between the silty, clay loam and the sorted, glacial loams. This is also fairly good arable land.

IV. BLACK SOIL ZONE

The Black Soils occur where the annual precipitation is from 17 to 19 inches, and where droughts are not common. Hot winds are less frequent, and there is less evaporation than in the zones to the east. Grass and poplar parkland generally form the vegetational covering. These are Alberta's most fertile soils. In the first foot below the surface the Black Soils have three to four times as much nitrogen and organic matter as the brown or grey wooded soils. Land use in this general zone is often mixed farming with wheat, but in much of Southwestern Alberta the presence of the towering Rockies, immediately west, poses a frost hazard which hinders really extensive cultivation.

(a) **Hilly Loams of the Foothills**

A ten to twelve mile wide strip of loam occupies the hilly area east of the Crowsnest Forest Reserve. In

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82 Map -- Soil Zones of Alberta.

83 The source of information for the sub-regions of the Black Soil Zone is, Wyatt, Bowser and Odynsky, Soil Survey, pp. 58-59.
this, the disturbed belt, there are numerous outcrop ridges of steeply dipping rock beds bearing some dwarf evergreens. The slopes are mantled by Rocky Mountain glacial material, and are generally wooded, especially close to the mountains. This is fair to very good pasture, where not too densely forested.

(b) Valley Soils of the Foothills

Level valley areas which have been supplied with an alluvial soil carpet from the surrounding uplands, generally have heavy texture loam soils with a high percentage of silt. These valleys generally are arable. An olive to blue tint in B$_1$ horizon indicates restricted drainage in many places, however.

V. GREY WOODED SOIL ZONE

In the Grey Wooded Soil Zone of Southern Alberta, precipitation is greater than in the other zones, being often 20 or more inches, but occasionally less. Northern Alberta's Grey Wooded Soil Zone on the Boreal Forest has slightly different precipitation characteristics. In the high southwest cooler temperatures, lower evaporation, and shorter growing seasons than on the lands eastward, are
significant features associated with this zone. The vegetation cover is made up of moisture holding, mixed, deciduous and evergreen woodlands with much peat and muskeg, (the latter being especially true for Northern Alberta). This is the most water-leached soil, and consequently the most plant-food impoverished. In Southern Alberta almost the entire Grey Wooded belt lies in the mountain zone. Some good alluvial soils might occur in depressions, but these are frequently poorly drained. There is virtually no cultivation here. Hay is probably the safest crop, owing to the frost hazard. 84

VI. ERODED LANDS

Eroded areas are usually good pasture lands, although they are too steep to cultivate. The steepest slopes (such as cut banks) and hillside slip areas, are of little or no pasture value. Some river bottom lands are so rough as to be placed into this classification also. 85

84 Map -- Soil Zones of Alberta.

85 Wyatt, Bowser, and Odynsky, Soil Survey, p. 61.
VII. RIVER BOTTOM SOILS

River bottom soils have a profile of "0". These are alluvial areas, and are usually still subject to flooding. The areas of uniform texture are generally arable. Many such tracts can be, and are, irrigated by dams or tributary coulees. 86

VIII. CONCLUSION

In summarizing the soil chapter, the soil mantle's role, in supporting vegetative life directly and all other life indirectly, should be re-emphasized. In Southwestern Alberta this role is of special significance to man on the plains and in the valleys where crops and domesticated animals are raised. Consequently, proportionately more time is devoted to the details of soil variations on the Great Plains than in the Rocky Mountains. In contrast, the emphasis was reversed in the geologic discussion.

Fundamentally, the soil zones vary with the geographic patterns of the climate and vegetation. This is what is to be expected since, as has been pointed out, the

86 Wyatt, Bowser, and Odynsky, Soil Survey, p. 61.
soil cover is largely the result of these factors. The same east-west zonation from dry and warm (unleached Brown soils) to cool and moist (leached Grey soils) is clearly evident. Within each basic zone are areas of different soil quality. This is primarily caused by different glacial and post-glacial deposits. The clay basins, gravelly moraines and so forth are of special significance to cultivation agriculture, and therefore serve as a key to the understanding of the human landscape pattern which has evolved.
VEGETATION

COVER
VEGETATION COVER

I. VEGETATION'S ROLE IN THE LANDSCAPE

II. FUNDAMENTAL VEGETATION CHARACTERISTICS
   Overall Geographic Pattern
   Vegetation Relations to the Environment

III. VEGETATION ZONES
   Mixed Prairie - Bouteloua - Stipa Association
   Main Parkland Prairie or Submontane Prairie - Festuca Scabrella Association
     Festuca - Danthonia Association
     Agropyron - Stipa - Carex Associates
   Grassland - Woodland Ecotone or Parkland Grove Belt
   Aspen - Poplar Consociation
     Riverside Poplar Vegetation
     Poplar Replacement after Burning
   Boreal - Cordilleran Transition
   Cordilleran Forest - including Subalpine
     White Spruce and Engelmann Spruce Vegetation
     Lodgepole Pine Vegetation
   Montane Forest
     Lumber Pine Vegetation
     Douglas Fir Vegetation
   Alpine Vegetation
     Boulder-Field Vegetation
     Fell-Field Vegetation
     Alpine Meadows
Heath Vegetation
Snow Patch Flora
Alpine Bogs

IV. CONCLUSION
I. VEGETATION'S ROLE IN THE LANDSCAPE

While the geologic foundation gives the general configuration or form to the landscape, vegetation in its role of covering the land gives much of the texture and color to the landscape pattern. (i.e. It clothes the land.) In areas where relief is minimal, or not striking, it is the floral pattern which largely gives the countryside character. Areas too steep or possessing too harsh an environment for any plant growth are relatively rare and may be considered exceptional. Areas of humanly-organized plant growth replacing the wild vegetation are also rather special cases. 87

The wild vegetation pattern is very largely the result of various environmental influences, coupled with the geographic accessibility of the area to plant migrations. The environmental influences of special importance in determining the plant cover are climate, soil, and to a lesser extent, relief. Grazing and fires are two modifying agents of some importance in the parkland, grass poplar

87 See "Economic Mosaic".
Southwestern Alberta

VEGETATION

Legend

Scale: 1:506,880 1 inch to 8 miles

- Non-forested above timber line (Alpine, rock etc.)
- Forest
- Cut or burnt forest
- Broken forest
- Open parkland or broken grassland
- Grassland
- Semi-bare badland

Source: Air Photos, Field
ecotone of Alberta. Both are largely associated with animal activity, and tend to help maintain and extend grassland.

II. FUNDAMENTAL VEGETATION CHARACTERISTICS

Overall Geographic Pattern

Southwestern Alberta is very largely a zone of transition and mixture, from an ecological point of view. Basically the mountain area is forested, and the plains grassy, while the foothills in between tend to be a parkland mixture. Actually, few parts of the area are completely embedded in deep forest. Broken, mixed forest country and parkland tend to be typical of the portion supporting notable tree growth. The open grassland area is also pierced by ribbons of trees along many of the streams, and varies somewhat in internal composition. All in all, Southwestern Alberta is a very diversified area floristically, and ecotones (zones of plant tension) are typical rather than exceptional.

Vegetation Relations to the Environment

As is seen from the foregoing, Southwestern Alberta is a zone of transition, where different vegetation types are struggling with each other for supremacy. In
such a place, the environment balances both sides so delicately that only a minute amount of variation will swing nature's scale in favour of one side or the other. Consequently, the broken, changeable, vegetation pattern reflects environmental differences rather closely.

A brief traverse, from xerophytic badland to misty alpine meadow, follows.

Badland-like topography and its associated, scattered, dry-land vegetation may be found in the far eastern portion of the area studied and continuing eastward in patches. The most notable area is Mokowan Buttes near Standoff, where simi-barren, gully scarred cliffs rise above the grasslands. Although virtually devoid of vegetation, badlands in general may have occasional sage-brushes (Artemisia longifolia, A. cana), creeping juniper (Juniperus horizontalis) and other xerophytic plants such as cacti. Grasses from the adjacent areas grow on less steep, and less quickly drained patches, but the steep, gullied hillsides and banks are virtually naked, because of steep slope, quick drainage and soil.

In much the same class are the vertical river cliffs encountered near the Belly River and elsewhere. The steep plunge to the water and rapid erosion make these cliffs completely bare.

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Another type of country which has little or no vegetation is that covered by a layer of whitish alkali. At best, only scattered plants will make their homes here. However, alkali flats are virtually non-existent in Southwestern Alberta.

In the eastern, much of the central, and parts of the western districts of Southwestern Alberta, grass is the most important vegetation form. Only the areas with a relatively good precipitation effectiveness, and considerable precipitation to begin with, are forested.

Southwestern Alberta's grasslands change from east to west, more or less with the soil zones. A few of the grasses, such as Koeleria gracilis, cover spots all over the area, but most of the species are rather restricted to certain zones. If all the outliers of one color zone in another are considered, the various plants are found to follow the soil color zones very closely. This is what is to be expected, since both the soil profile and the vegetational cover are the result of special precipitation-evaporation conditions during the last few centuries.

Vegetation and soil texture show very good correlation. This is especially true for sandy loam and other light soils. If these occur in Black and Shallow Black soil zones the grassland growing in them characteristically
contain large proportions of Stipa spp. and perhaps Bouteloua gracilis. This reflects the quicker soil drainage, for these grasses are typical of drier areas. The high lime soils located between Pincher Creek and MacLeod however do not seem to have any distinct vegetation.

Vegetation and topography also have a close relationship. Generally speaking, the more steep, south facing slopes, located in the Black soil zone, show large numbers of Bouteloua gracilis, Stipa comata, and other Stipa species. These sites receive the most direct, and consequently stronger, insolation. Therefore these are the warmest, driest sites, and are occupied by preclimax communities. On the other hand, the more steep north facing slopes in the Dark Brown soil zone show considerable coverage by fescue grassland, which is postclimax on the Dark Brown soils. The northern slope is always relatively more moist and cool than the average, level terrain. Microrelief variations may cause considerable floral variations. 89

The lines delimiting grassland from forestland are perhaps the most important vegetation lines in the landscape of Alberta. The character of the countryside changes completely as one goes from grass-carpeted plains to forest-draped hills. Precipitation effectiveness is usually the

key to which area supports forest. Associated with this are of course (a) slope, effecting drainage and incidence of the sun's rays (which effects evaporation) (b) aspect, (c) distance from major topographic features, which influence precipitation, (d) soil and so forth. In addition, fire and grazing are of immense importance in keeping the forest and brush from advancing on the often unstable grassland margins.90

The strips of deciduous trees, which follow some of the major water courses out through the plains, are of course explained by the almost steady water supply. Even so, the drier valley stretches further east are often deficient in tree growth.

To the west, the mountain and high hill areas are usually moist enough to support good tree growth, although here too extensive areas of prairie occur, especially on southward facing slopes. Some of the most striking scenery results from north-south ridges cut by series of east-west valleys on their flanks, with all of the north facing slopes forested and the south facing slopes in grass. It is only far westward, at the foot of the continental divide range, where great, solid forest stands are typical. Here, (as mentioned in the geologic and climatic section) the relief is greatly subdued and the precipitation highest.

90 The section of the Woodland-Grassland Ecotone deals more fully with this.
BANDING OF TREE GROWTH

Forest banding along certain rock beds exposed on mountain sides. Differences in rock hardness, ease of breakdown and soil formation allowing root penetration, as well as drainage and chemical composition influence plant growth and succession patterns.

Tree growth limited to long, rocky, strata outcrops in heaving, soil mantled grassland.
The more prominent foothills and some of the not so rocky mountains have a peculiar banding of vegetation along rock strata and outcrops. In the case of relatively dry grassy foothills, the occasional, rocky strata, outcropping longitudinally over the hill-crests, often bears a few wind tangled trees and associated plants. The mountains, such as Turtle Mountain, which are banded, are usually more or less forested with some rock bands here and there lacking trees, thus giving the mountain flank a stripped, varied appearance. The reasons for this rock preference may be any or all of the following: varying rock hardness resulting in different rates of soil development and plant succession; different drainage characteristics (eg. fissured limestone loses surface water rapidly); different topography (eg. rocky cliff or gentle, featureless, soil-draped slope); varying chemical rock composition and so forth.  

The accompanying cross-section gives a representative cut through the most complex portion of the area studied, including the Porcupine Hills, North Fork area, Livingstone and High Rock Ranges. Its general pattern is applicable in other parts of Southwestern Alberta, when altitude, aspect, etc. are taken into account.

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91 Authority -- Dr. Pillsbury, Department of Botany, University of British Columbia.
Although the diagram largely speaks for itself, a few general comments might be made. Three climatic provinces (Boreal, Cordilleran and Great Plains), each with its associated plant formation, border one another or overlap in Southwestern Alberta. "In any area as the climatic factors become critical and soil and topographic features become more important in determining the development of vegetation". In other words, the plant formations are growing in areas which are toward the edge of their climatic tolerance, and hence, other slightly unfavourable environmental factors may assume unusually great significance in discouraging growth. This is the chief reason for the great variation in vegetation cover on adjacent areas where environmental circumstances are only slightly different.

Trees generally need a good moisture supply. The following factors affect this supply favourably:

(1) high elevations (which tend to have high precipitation and low evapo-transpiration rates);
(2) northerly aspects (which are characterized by low evapo-transpiration rates and perhaps, high orographic precipitation);
(3) orographic position relative to moisture laden winds;
(4) soils with high moisture storing capacity (D and some B and E soils).

These environmental factors especially favour such trees as spruce. Soils which are shallow or have high percolation rates (such as A, C, and many E and B soils) will not support heavy forest growth.\textsuperscript{93}

Three belts of tree growth make up the forests of the northern, Southwestern Alberta. These are the mountains, foothills, and Porcupine Hills.

In the mountain areas, the higher, moister, western valleys support the heaviest forest growth. Typically, these are deeply mantled by valley drift. A combination of heavy precipitation, high cool altitude (one mile above sea level), and short summers reduce evaporation, leaving a water supply for forest development.

Eastward in the mountains, the environment becomes drier as one goes away from the continental divide range. One of the driest portions is the Livingstone River area, a somewhat open, basin-like valley, directly in the lee of the Livingstone Range, as well as distant from the more moist (but also lee) side of the High Rock Range (continental divide). In addition, the soil is fairly shallow with poor water retention, while the low elevation encourages hot temperatures and high evaporation.\textsuperscript{94} These factors do not favour good tree

\textsuperscript{93} Report on Forest Inventory, E.R.F.C.B., Appendix I.
\textsuperscript{94} Ibid., p. 2.
growth, and the net result is grassland broken here and there by a scattered, open stand of lodgepole pine. South and southwest facing slopes of nearby hills also have a grass climax, although north facing slopes are usually forested.

East beyond the front range lies the rolling, uneven foothills. The soils here are often shallow, while the climate is characterized by low, undependable precipitation, not infrequent droughts and high summer temperatures. Lodgepole pine, mixed woods and deciduous groves, broken by grassland, make up the vegetation pattern. The trees are usually small.

The Porcupine Hills rise above the eastern foothills, and being higher receive more orographic precipitation. This is especially true of the more elevated western portions, which also contain the forest growth. The hills' bedrock (sandstone and shale) has weathered to a "deep residual regolith", while the hillsides have been drift plastered, giving soils with good summer storage of winter and spring moisture.\(^\text{95}\) Douglas fir and some spruce are typical for the forests of the Porcupine Hills. In the drier, more exposed southern section (notably Beaver Creek valley) north facing sides of knolls and hills are the favoured sites for trees, while the other aspects tend to be grassy.

The vegetation cover changes most strikingly from east to west, but it also varies from north to south. The most obvious change is the greater forest cover northward in the higher foothills. However, this is largely the result of topography and moisture, rather than a great contrast in solar insolation and heat. The most significant change is probably the dropping out of the montane forest pattern, northward. This is largely the result of cooler, more harsh climatic conditions the further north one goes. Individual plants, present in the montane climax, do grow northward, but a montane climax apparently ends near the Crowsnest area.

Special notice should be given a number of small plants from more southerly lands, which extend just into Southwestern Alberta. In the Waterton Lakes area may be found such exotics as Bear Grass (Xerophyllum tenax) with its "creamy crested plumes" of blossoms, the lovely white Seago Lily and others, usually not found northward. During the summer, Bear Grass typically drapes many of the more open mountain slopes, and is therefore a "trademark" of the Waterton-Glacier landscape.

There is another plant variation which is very much the result of one, clear-cut environmental change,

indirectly affecting virtually all aspects of the whole environment. This is altitudinal zonation of vegetation. While the east-west zones, already discussed, are largely the result of precipitation effectiveness, altitudinal plant zones are primarily caused by temperature effectiveness. However, in both cases all factors are interrelated. There is not a separate set of altitudinal zones, but rather, further zones in the overall pattern, which is primarily the result of precipitation and temperature, which in turn are influenced by altitude. Actually, all the major vegetation belts, east to west, occupy progressively higher altitudes and are consequently somewhat "altitudinal".

Altitudinal zonation is of special importance in the higher ranges, such as in the southern, Precambrian Rockies. Montane forest is replaced by deep, subalpine forest (together referred to as Cordilleran), which gives way to stunted, twisted, subalpine and eventually to alpine meadows. These meadows are herbaceous and grassy, displaying myriads of flowers in early summer. The profusion of dazzling blossoms is partly a reflection of the harsh environment which makes striking, insect-attracting flowers a necessity for pollination during the brief summer. Above the meadows may tower lichen-bedecked, rock cliffs and peaks. Snow, ice and bare rock characterize the highest levels most of the year.97

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97 A more detailed botanical discussion of altitude zones occurs later.
<table>
<thead>
<tr>
<th>INCREASE IN ALTITUDE</th>
<th>VEGETATION LIFE ZONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCTIC-ALPINE</td>
<td>above timberline, blossoms during the short summer with cushion pinks, alpine forget-me-nots, dwarf columbines and so forth.</td>
</tr>
<tr>
<td>Timberline</td>
<td>at approximately 7,000 feet, the timberline zone, including Lyall's Larch, (&quot;soft lacy needles and graceful branches&quot; -- giving the slopes a special character) flaming heathers, avalanche lilies, globe flowers, Saxifrage, and blue carpets of Jacob's Ladder, Phacelias and Gentians;</td>
</tr>
<tr>
<td>7,000 feet</td>
<td>wooded, including lodgepole pine, Englemann Spruce, western balsam, aspen, black cottonwood, mountain maple, elder, honeysuckle, wild currant, blueberry and flowers such as hellebore, Clintonia, Tiarella, yellow columbine, blue clematis, false forget-me-nots, beard-tongue, firewood and golden arnica.</td>
</tr>
<tr>
<td>TRANSITION</td>
<td>prairie grassland, including vetches, diamond willow Saskatoon, silver leaf, prairie rose, Brown-Eyed Susan, aster, shooting-star, Indian paint-brush, larkspur, wild geranium and purple wind flower.</td>
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</tbody>
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98 Adapted from Buchanan Waterton Lakes N.P., Canadian Geographic Journal, February, 1933, pp. 75-79.
III. VEGETATION ZONES

This section is a regional analysis of Southwestern Alberta's plant ecology and geography. It is largely a summary of the more pertinent, geographical, landscape aspects of various botanical papers by Dr. Moss of the University of Alberta. The vegetation zone classification used by Dr. Moss is also used here, instead of the less complete, older, forest classification by Halliday, upon which the Moss system is based.

MIXED PRAIRIE

Bouteloua - Stipa Association

The Bouteloua - Stipa association is the virgin climax grassland for the Brown and Dark Brown soil zones. This is the largest of the North American grasslands, reaching from north Texas to Alberta, and from north Arizona, east Utah to central Nebraska. There are two dominant grasses:

Bouteloua gracilis (H.B.K.) Lag., and
Stipa comata Trin. & Rup.

99 Dr. Moss is one of the foremost authorities on the plant ecology of Southwestern Alberta.

100 W. E. D. Halliday, A Forest Classification for Canada, 1937.
and two commonly associated grasses:

Koeleria gracilis Pers., and
Agropyron Smithii Rydb. 101

The "short grass" phases of this grassland region are edaphic climaxes or disclimaxes. In other words, over-grazing caused the short grass. Hubbard, however, takes another point of view and suggests that a short grass formation should be recognized. 102 Whatever its classification, this dry-looking, short grass steppe has long been a trade-mark of southern Alberta's wide, dusty plains. In the days when only buffalo and antelope grazed the land, early explorers noted the same low type of grassland.

MAIN PARKLAND PRAIRIE

OR

SUBMONTANE PRAIRIE

Festuca Scabrella Association

Festuca scabrella is the dominant of Alberta's submontane or fescure grassland. This grass is frequently associated with the aspen parkland belt, especially northward in the central part of the province. Festuca scabrella itself is really a bunch grass, but in Alberta it frequently


forms short rhizomes, which enlarge the tussock.\textsuperscript{103}

The fescure grassland is usually found on the Black and Shallow Black soil zones. However, the Black and Shallow Black soil zones each have their characteristic plant groups. A Festuca-Danthonia association may be recognized for the Black soils, while a Agropyron-Stipa-Carex Associes occurs in the Shallow Black soil zone. The latter is a zone of mixing between the plants of the Blacks soils to the west and the plants of the Dark Brown soils to the east. The Shallow Black soil itself, is of course transitional.

Festuca-Danthonia Association

The Festuca-Danthonia association is the natural climax prairie for most of the black soils. Under the conditions at present, it is found on large areas of the deeper Black soils. The dominant grasses are:

- Festuca scabrella Torr.
- Festuca idahoensis Elmer
- Danthonia intermedia Vasey
- Danthonia parryi Scribn. \textsuperscript{104}


\textsuperscript{104} E. H. Moss, "Vegetation of Southwestern Alberta", p. 19. Typical associated grasses are Koeleria gracilis, Agropyron griffithsii, Agropyron dasystachyum, Agropyron trachycaulum, Stipa spartea var. curtiseta, Stipa columbiana, Poa cusickii and Avena hookeri. There are also twelve secondary grasses, six sedges, seven shrubs, and more than 65 forbs.
Danthonia species are localized in dominance. At present Danthonia parryi is found in the western portion but may in time extend over the rest of this area.

In sheltered and relatively mesic areas distinct willow thickets are found, with Salix Bebbiana the dominant species. A considerable number of herbaceous forbs is typical. Some are very widespread, others highly localized.\textsuperscript{105}

**Agropyron-Stipa-Carex Associes**

Large parts of Southwestern Alberta, especially in the Shallow Black soil zone, support the Agropyron-Stipa-Carex associes. In this belt some of the secondary species from adjacent associations are very numerous, particularly:

Agropyron Smithii
A. dasystachyium
A. Griffithsii
Stipa spartea v. curtiseta
S. viridula
Carex Eleocharis

The climatic and edaphic conditions in the Shallow Black soil zone appear to be favourable to Agropyron and Stipa species. However, there is good evidence that the

\textsuperscript{105} E. H. Moss, "Vegetation of Southwestern Alberta", C.J.R., p. 19.
true climax of this zone is the Festuca-Danthonia association and that this assoatives is a subclimax. When man arrived in Southwestern Alberta this association on the Shallow Black soils was not fully realized. Because of man's burning, grazing and so forth, the grassland changed back to an earlier phase -- a disclimax rather than subclimax. Selective grazing and particularly overgrazing are mainly responsible for highly palatable fescures being reduced, and replaced by Agropyron, Stipa, Carex Eleocharis and so forth. Soil drifting, from nearby cultivated fields, has also killed many of the virgin species. Agropyron Smithii has then covered the wind-blown areas.\(^{106}\)

Alberta's fescue grasslands, sometimes called submontane prairie, are closely related to the Palouse prairie grasslands of Idaho and eastern Washington. It seems that there is a floristic continuity from this area, via the southern British Columbia valleys as well as through Alberta and Montana mountain passes, to southwestern Alberta's foothills area. Important species which the Palouse prairie and the Alberta foothills have in common are, Festuca idahoensis, Stipa columbiana, Agropyron spicatum, Lithospermum ruderale, Geranium visconsissimum, and Balsamorhiza sagittata. In southern British Columbia,\(^{106}\)

Tisdale has found that Agropyron spicatum, the chief dominant, links three vegetational types into one community. Festuca scabrella is often codominant, thus linking this grassland with the Alberta foothills. Agropyron spicatum and Festuca scabrella dominate the most mesic grassland type in southern British Columbia, but are also found in the other adjacent grasslands. 107

According to Moss and Campbell the Festuca scabrella association is the climax grassland by itself and, in addition, the grassland found between the groves of the parkland belt. They, however, draw attention to the fact that fescue grassland, produced by hay mowing or considerable grazing, is quite different from that of the "virgin prairie" where Festuca scabrella is the sole dominant. The "artificial prairie" has an increase in secondary species, such as Agropyron trachycaulum, Stipa spartea var. curtiseta and so forth. Because the area under consideration is closer to the mountains (through which there has been plant migration) and also further south (which was more quickly reached by colonizing plants after glaciation), it has a much richer and more varied flora than the same grassland further north in central Alberta.

Danthonia parryi and Festuca idahoensis are sub-climaxes in Southwestern Alberta. However, Danthonia parryi

dominates only in special areas, especially on exposed wind-swept slopes north of Waterton Lakes and in the Porcupine Hills. It apparently acts as an edaphic subclimax and disclimax under heavy use. In the rangelands at present, this plant is responsible for more forage than any other individual species. According to Hanson, Danthonia intermedia takes its place in the mountain valleys westward. This plant is smaller and less palatable. 108

Since Festuca scabrella is, and has been, so dominant on the darker soils, it is thought to be responsible for the high quality of the Black soils, and to have also contributed somewhat to the Brown soils. In other words, much of Alberta's agricultural prosperity may stem from this grass.

"In Clementsian language, the fescue community is described as post climax to" (in wetter and cooler areas next to) "the Stipa-Agropyron facination of the mixed prairie, the latter commonly occupying exposed locations within the aspen grove region, such as south-facing slopes and tops of knolls; the fescue community is preclimax to" (in drier and warmer areas next to) "aspen forest". 109

109 Ibid., p. 513.
GRASSLAND-WOODLAND ECOTONE

OR

PARKLAND GROVE BELT

Between pure forest and pure grassland lies a zone of intermingling aspen groves and prairie patches. In Southwestern Alberta the parkland stretches as a belt along the foothills, close to the mountain front. In reality, this belt represents not one zone of tension and transition, but hundreds and thousands, for each clump of trees is ringed by an ecotone, or tension line, of competing prairie and forest (aspen) communities. The trees occupy the more moist locations and the grasses the drier ones.

The grass element has been described under fescue grasslands.

There is continually competition between grass and trees in the parkland belts. Aspen may tend to invade and replace grassland by means of root extension and the formation of suckers, which establish themselves as new trees. Replacement of grassland has especially been noted where humans have prevented wild fires, and the like, from playing havoc with the grass. Otherwise, burning, grazing, rabbit damage, and dessicating winds work against the extension
of forest cover. Originally, the aspen groves were presumably started by aspen seeds, invading a more extensive grassland, toward the close of a recent xerothermic (dry) period, perhaps 4,000 years ago. However, it should be noted that poplar seeds live two to four weeks in natural surroundings, and the surface layer of the soil must be continuously moist for at least the first growth week, since the primary root grows slowly into the soil. Consequently, new aspen groves come into being during exceptional climatic situations by Alberta standards.  

If one accepts the claims of Clements that grasslands have recently expanded, then although the present climate is somewhat mesic, favouring tree expansion, the long range climatic change may have been from a cooler wetter to a warmer drier, thus leaving clumps of trees in the more mesic, protected sites as the grassland expanded.

At present, the windy climate in Southwestern Alberta is less favourable to aspen advance than in central Alberta.  Although climate is recognized as the main controlling factor, the secondary factors favouring grassland (listed above) will help check extensive reforestation at


the return of cooler and wetter conditions. In other words, there are always forces counteracting rapid, excessive advances and keeping things in balance.

In a marginal or transition zone, if the chief control ceases to be important its place is quickly taken over by the second most important control. Very seldom is there only one single control responsible for a border zone. Usually many of the plant's needs are all marginally satisfied near its frontier.

ASPEN POPLAR CONSOCIATION

Some areas support extensive stands of poplar trees. The poplar association generally has five strata:

1. taller trees with nearly continuous canopy;
2. smaller trees and larger shrubs, often poorly developed in aspen forests;
3. lower shrub layer, with varying richness of flora, and often covered up by the next stratum;
4. taller herbs, almost continuous as a stratum and rather prominent toward the end of the growing season;
5. lower herbs (including mosses and lichens), which form something resembling a carpet.

The sites favoured by poplars are as follows. Sheltered positions, resulting from rough topography near the mountains, characteristically have poplar vegetation. "North and east-facing slopes of valleys, slough depressions, ridges, and knolls may bear aspen groves." Stream flats, always well supplied with water, support other aspen species.

The aspen is restricted to the more sheltered places because of many interrelated factors. "Insolation, high soil temperatures, high air temperatures, high evaporation rate, and strong westerly winds characterize the south and southwest slopes..." where the pure prairie without aspen is found. In both growing and resting periods wind is of very great importance. "Chinook winds probably cause killing of plants during the winter and early spring." The alternate warming and freezing result in unseasonal budding and consequent killing.

Southwestern Alberta's aspen poplar forest is considered to be a variant of the central Alberta aspen consociation, although the southwestern area possesses some mountain species (Rubus parviflorus and Spiraea lucida) which are lacking further northeast.

Aspen vegetation, in most of the inner foothills and the outer mountains, grows in small isolated groves, in such positions as to get protection from strong insolation and prevailing winds. Groves are largely confined to depressions and northeast slopes. In the area near southeastern Waterton Lakes National Park there is an extensive aspen consociation. Usually the aspen is not accompanied by other tree species, with the exception of foothill and mountain slopes, where aspen gives way to coniferous growth, notably lodgepole pine, Douglas fir, and white spruce. The great extent of mixed and patchy forest is clearly brought out in the autumn when the evergreen hillsides seem to be embroidered with bands and splashes of golden aspen.

These aspen stands tend to be young and even aged because of recent burning, which took place perhaps 20 to 40 or more years ago. They are low, since the prevailing dry winds retard their growth. In the more exposed positions, the trees show truncated tops and the typically wind-blown habit. Moss has shown that, after a certain height has been reached, further growth is very slow. In this case a number of 38 year old trees had survived a fire 22 years ago, but were no taller than the younger 20 year old, post-fire trees. However, the older trees had a D.B.H. of seven to nine inches, while the younger trees had one of four to five inches. The prevailing winds, rather than poor soil or
topography, are responsible for this height limitation.  

Riverside Poplar Vegetation

River margins and flats, in the Black soil zone, characteristically support stands of balsam or black poplars, especially Populus trichocarpa T. & G., and the variety hastata (Dode) Henry. These are frequently accompanied by willows. To the east, Populus trichocarpa and variety hastata become largely replaced by Populus augustifolia James, and the lanceleaf cottonwood.

Poplar Replacement After Burning

After burning, coniferous and deciduous forests tend to be replaced rather quickly by young poplars, together with some shrubs and grasses. One of the most striking of these plants is the fireweed, Epilobium augustifolium,


117 Ibid., p. 23.

Willows include Salix lutea Nutt., S. caudata (Nutt.) Heller, S. exigua Nutt., S. melanopsis Nutt., and S. monochroma Ball.

"The stoney and gravelly margins of streams are further characterized by the following conspicuous herbs, Epilobium latifolium L., Physaria didymocarpa (Hook.) A. Gray, Astragalus pauciflorus Hook. ..."
whose sudden appearance after a fire is attributed to a great many shoots from old deep-seated roots and rhizomes. "Interlylary cork may relate to the persistence of these organs."118 This, incidentally, is also of some importance in the adaptation of sage brush. Good examples of burned forest and different stages of replacement are to be found along the Coleman Kananaskis road.

BORERAL—CORDILLERAN TRANSITION

In central Alberta lies a fairly wide zone of mixing, where the Boreal forest and the largely subalpine forest of the mountains approach each other. A tongue of this transition forest tends to follow the foothills southward to the North Fork country north of Lundbreck. In Southwestern Alberta the Parkland Prairie, not the Boreal forest, borders this Boreal-Cordilleran transition zone on the east. Lodgepole pine, which is important in the western Boreal, is the main pioneer and dominant subclimax species in this zone as well as in the main Cordilleran area. Where the foothills and mountains meet, Alpine fir comes more into its own. In the subalpine climax association this species and Engelmann spruce dominate.119

119 Ibid., pp. 537-538.
White spruce grades into Engelmann spruce without any sharp or clear boundary. However, these trees grow between quite different, altitudinal limits. According to Clark and Cowan white spruce represents Boreal vegetation, while Engelmann spruce represents the Subalpine. Thus white spruce will tend to extend in tongues up the lower valleys. Typically, the lower and drier sites support white spruce, while higher and moister sites have an Engelmann spruce mixing zone. These trees also hybridize, further confusing their separation. Generally speaking however, Engelmann spruce is typical for the mountains, while white spruce is typical for the foothills.

In Southwestern Alberta specifically, Cormack reports that white spruce is the main tree, although Engelmann spruce is found. White spruce is the climax tree of the east slope area, and extends from near timberline down to around 3,000 feet. This somewhat contradicts the overall, general statement above.
The strata breakdown for virgin spruce forests along the Carbondale River is generally as follows:

(1) a dense spruce stand 100 to 300 feet high and 15 to 30 inches D.B.H. plus associated smaller trees of alpine fir;

(2) a small tree and shrub strata which is very variable;

(3) a herb strata which is rich in species but variable and sparse;

(4) a rich, deep floor-carpet of "feather" mosses, together with scattered lichens.

Another Carbondale area phase of this forest, more or less peculiar to the Montane region, shows a relatively rich fern flora. 120

Lodgepole Pine Vegetation

Lodgepole pine tends to be a "temporary" fire vegetation found in most forest types but is not "diagnostic" of any. If conditions are open, dry or both, species generally found together with this pine include Arctostaphylos uva-ursi, Juniperus spp., Zygadenus elegans plus a luxuriant growth of grass. Scattered loggopole pines, standing above the grasslands of the semi-dry Livingstone River valley are characteristic of this intermontane country. 120

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Generally speaking, lodgepole pine expands to subclimax dominance through frequent burning. Succession to a spruce-fire forest takes place. Cormack claims two general trends, (a) burn, to pine and spruce, to climax, and (b) burn, to pine, to climax. In (a) spruce and fir start out together with some pine. In (b) there is first a stand of pine. On burned mountain slopes at Blairmore, lodgepole pine grows in thick stands. These stands become stagnant after 150 years and are succeeded by spruce, giving stable spruce-fir stands which last a long time. However, spruce regeneration is "conspicuous by its scarcity", suggesting that spruce does not reproduce itself in its own fully developed stands. According to Bloomberg, fire is the controlling factor, and without catastrophic blazes now and then there would be no valuable forests, worthy of fire protection! On the other hand, Cormack feels that the climax spruce-fir forest is stable, and that regeneration takes place under forest-canopy openings caused by windfall of old trees. Alpine fir however is probably the true, theoretical dominant, if given 500 years to dominate over spruce. Fire, however, prevents this from happening.\textsuperscript{121} The net conclusion is that fire can be instrumental in deciding which floras garment the landscape will be clothed in.

MONTANE FOREST

Southwestern Alberta's Montane forest is characterized by Douglas fir, lodgepole pine, Engelmann spruce, white spruce, with limber pine on the foothill ridges and clumps of aspen at the grassland edge. Western white pine, ponderosa pine, and western cedar are also found, but they are quite rare. Ponderosa pine has been reported from the Carbondale River valley. Like Douglas fir, it has probably migrated through mountain passes from the west. Still Alberta's Montane forest zone is best identified by the herb and shrub species, rather than by tree dominants. These smaller plants include Rubus parriflorus, Ribes viscosissimum, Berberis repens, and Clintonia uniflora. This Montane forest is found from 4,500 to 6,500 feet from Waterton Lakes to the Crowsnest Pass.

On rocky ridges, out beyond the mountain front, two main coniferous vegetation types are found, Douglas fir and limber pine. These ridges lie in the Black soil zone which is normally carpeted by Festuca-Danthonia prairie with a scattering of aspen, poplar groves. Some rock exposures and larger foothills also have juniper growth (Juniperus horizontalis Moench, and Juniperus sibrica Burgsd.) White spruce (Picea glauca) and lodgepole pine (Pinus
contorta var. latifolia) are associated together with Douglas fir, limber pine and poplars. In a few local spots these species form almost pure stands. There is considerable variety among the associated plants. "In spring and early summer these areas are veritable rock gardens, displaying a wealth of form and color."

Some of the larger foothills and outer mountains also support prairie vegetation, which merges with the vegetation of talus and rocky ledges. These slopes constitute somewhat small areas, with a variety of edaphic features resulting in highly intermixed vegetation.

Limber Pine Vegetation

Limber pine (Pinus flexilis) typically clings to the tops and drier slopes of the scattered ridges. These portions are exposed to very strong, dessicating winds. Thus the limber pine usually shows a dwarfed and distorted appearance, with many killed branches on the crown's windward side. Limber pine, the dominant species on these sites, grows in an open community containing many exposed patches. It is only here and there that limber pine provides shade and other influence for associated species. The rock is

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generally weathered to a thin, loose, shaly soil, but there are also areas of largely unweathered rock.  

Douglas Fir Vegetation

Douglas fir is found in a number of locations in Southwestern Alberta. These include sandy and gravelly foothill slopes, and the more protected, rocky, pine-ridge slopes. Strong dessicating winds from the west appear to injure or kill Douglas fir. Northern and eastern sheltered spots are therefore the places where Douglas fir will survive. On lower, gentler slopes below the firstands, aspen and some shrubs may be found, which in turn merge with the prairie. In places, Douglas fir forms a close stand, without much ground vegetation. Otherwise an open stand is typical, accompanied by the vegetation found with


The plants may be grouped according to the three basic ridge environments. (a) Species on bare rock exposures and unshaded: Pinus flexilis James, Arctostaphylos Uva-ursi (L.) Spreng., Juniperus horizontalis Moench, Phlox Alyssifolia Greene, etc. (b) Species on shallow soil in partial shade of limber pine: Galium boreale L., Aster conspicuus Lindl., Rosa spp., Pseudotsuga Douglassii Carr., etc. (c) Species on shallow soil and unshaded: Arctostaphylos uva-ursi(L.) Spreng., Juniperus horizontalis Moench, Seliginella densa Rydb., Agropyron spicatum (Pursh) Scribn. & Smith, etc. These are listed in the general order of frequency.
aspen groves, limber pine, or prairie grasses, plus a few extra species.\footnote{125}

ALPINE VEGETATION

The alpine vegetation of the Alberta Rockies is, like much of the alpine vegetation of the northern hemisphere, related to the arctic with an admixture of a few endemic (originally locally native) species. Apparently the alpine vegetation represents remnants left by the ice age, which have retreated to the higher cooler mountain summits.

In Southwestern Alberta the tree line, which is the lower limit of the alpine zone, is approximately 8,000 feet above sea level. Generally speaking, the land of the alpine zone is made up of rock outcrops and, if soil is present, peat or gravel, all lacking in organic matter. The drainage is generally poor. Because of this "edaphic heterogeneity" the plants do not form extensive or homogeneous communities.

Three lines subdivide the alpine zone. These are the timber line, tree line and scrub line. From the timber line of the Subalpine forest to the tree line the change is

\footnote{125 E. H. Moss, "Vegetation of Southwestern Alberta", C.J.R., p. 28.}
gradual, showing groves and scattered individuals. The individual trees are frequently stunted and distorted. These trees in question are alpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmannii), alpine larch (Larix lyallii) and white bark pine (Pinus albicaulis). In the scrub zone the "trees" become more and more stunted. The main stem frequently creeps along the ground, sending up short, vertical shoots, and the plant in general may adapt in a most fantastic manner. "Trees of the 'flag' shape grow here; also matted atoll-like rings of offspring are produced by layering. Here too one finds the alpine meadows, which because of varying aspect, ground slope, and amount of available moisture show "more diversity and greater profusion of flowers than any other region either in the temperate or tropical belts." 126

The forest line in Alberta is largely caused by snow and wind. Other causes are sometimes responsible, especially in other parts of the world.

The following is an outline of the more noteworthy alpine communities in the Alberta Rockies.

BOULDER-FIELD VEGETATION (ROCK CLIDE VEGETATION) is characterized by crustose lichens, and a small assortment of crevice and creeping plants.

FELL-FIELD VEGETATION (GRAVEL AREA VEGETATION) shows a sparse plant cover in which the predominant members are low rosette and mat-forming species.

ALPINE MEADOWS are found in more mesic areas. Typically they show a rich, varied flora. There are two phases:

(a) mat-grassland with a grass predominance and numerous early-flowering, broad-leaved plants;
(b) mat-herbage which is dominated by herbs, but containing a sprinkling of grass. This is less luxuriant.

HEATH VEGETATION commonly lies between coniferous groves in the transition zone.

SNOW-PATCH FLORA results when late melting snow banks retain extra moisture thereby encouraging the growth of certain plants. An example is the snow lily.

ALPINE BOGS have two phases:
(a) sedge bog, dominated by Carex species;
(b) willow bog, dominated by shrubby willows.

Mosses are frequently found here also. 127

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The foregoing account gives a general view of alpine vegetation in western Alberta. In itself it does not vary much. The treeline and other altitudinal lines, however, vary from one part to another, being of course highest in the southern part of the province.

IV. CONCLUSION

The following remarks are offered as a brief summary to the discussion of the vegetation pattern.

The landscape is clothed by the vegetation cover, which gives it much of its color and texture, just as the underlying geology gives it its basic form. In examining the vegetative cover two approaches are required, the purely ecologic and the geographic. The former focuses attention on the relationships of plants to their environment, while the latter emphasizes plant movements, their patterns and the like. Although the vegetation chapter has been divided into an ecological introduction followed by detailed descriptions of the geographic vegetation zones, the plant cover can very conveniently be summarized in one statement. There is a progressive east-west change, with soils, climate and altitude, from bare badland and short grass, through parkland, to subalpine forest and alpine "tundra".
FAUNA

ALTERATION
Although animals in themselves are generally not considered to be a part of the landscape, they do affect the countryside quite markedly at times. Termite and coral construction are well known animal additions in the landscape. Homo sapiens affects the landscape immensely. His alterations are treated in detail in the cultural division.

In Southwestern Alberta the effects of animals below Homo sapiens are largely limited to beaver dams and overgrazing. The latter is quite important, since it may result in erosion, and a change of the vegetative cover. Some wild mountain mammals and stream fish attract tourist sportsmen, but this hardly has a very significant influence on the landscape.
THE

PHYSICAL

LANDSCAPE

SEGMENT
THE PHYSICAL LANDSCAPE SEGMENT

To summarize the physical segment of the landscape an overall, bird's-eye view of Southwestern Alberta will be taken.

On the eastern margin of the area studied, stretch broad grassy plains, cut by sharply incised stream valleys. Widely scattered erosional remnants, in the form of flat-topped blocks or gentle, low-rolling hills, also break the monotony. One of these is Mokowan Buttes which drops away westward in bare, badland scarps, to the contrasting green groves on Belly River flat. In the south rise the elevated Milk River Plateaux, cut through by long deep meltwater gaps. All these areas lack forest growth, except for narrow ribbons of deciduous trees along the river flats. However, the dry climate encourages bright sunshine and dramatic cloud effects, which combined with the lonely expanse of tawny plains, in essence, gives the regional character.

The forest crested, rounded, Porcupine Hills stand high and isolated above the plains in the north. Grass
Southwestern Alberta
1:1,267,200
NATURAL LANDSCAPE REGIONS

Basic Color System
- Grass -- Plain
- Xerophytic-Badland
- Grass -> Parkland
- Forest -- Hill
- Forest-Rugged hill
- Forest -> Alpine
- Rolling
- Mountain
mantled, terrace-like blocks rise up from the level land at the eastern base. The western side of the hills is marked by a sinuous broken cuesta of tilted sedimentary blocks, which are sometimes surmounted by tufts of forest.

To the west, the land rises gently and buckles into long swelling ridges which become progressively higher and more forested as the mountain front is approached. This is the foothills belt. In the northwest, the foothills are high, parallel ranges with ravine-scarred flanks, supporting coniferous forest on the moister northerly sides. Southward, from the Oldman River to the vicinity of Pincher Creek, the higher foothills give way to lower, broken, more rounded ridges, clothed in a varied vegetation-mantle of deciduous and coniferous trees, interspersed with grassy patches. Towards the plains the topography becomes more subdued and grassland gradually replaces tree growth. The foothills in front of the Clarke Range are exceptionally low and undulating, broken only by a zone of low, rock-topped ridges, which, close to the mountains, support "rock gardens" of wild flowers and wind-twisted trees. Glacial moraine, pitted with kettle ponds and occasionally covered by low, savanna-like, parkland, is typical for much of this gentle foothills area. Near the Montana border however, the hills are higher, and have a sandpapere, rolling, character, which is especially enhanced by lack of
tree growth toward the east. As one approaches the mountains the vegetation gradually and evenly changes to parkland and eventually to forest.

The Rocky Mountains tower west of the foothills. The northern front (Livingstone) range rises from the east as a blue-gray, bare, rock wall. It is severed only by the sinuous, glacially deepened gorge known as "The Gap". Behind this front range lies an infold of softer rock, resulting in a trough of subdued, rounded, topography, which is generally forested, but contains several grassy, alluvial pockets and basins. On the west this trough is rimmed in by another bare, rocky range. This is the continental divide range, which is deeply cut at the Crowsnest Pass. Long, bare-looking, limestone ranges and outliers, rising above rounded forested hill land characterize the Rockies in the north.

The southern Precambrian massif of tumbled, glacially sculptured peaks is somewhat different. These mountains are largely forested and alpine in appearance. Only the higher summits, cliffs, and the drier steep, east facing front of the mountains are lacking in good tree growth. Placid tarns, flower carpeted alpine meadows and towering cirque walls are typical in the higher levels. Fjord-like Waterton Lakes tie the mountains and plains by a water passage.
Thus, from the dry, grass covered, eastern plains to the relatively moist, forested western mountains, Southwestern Alberta presents a harmonious gradual change from one extreme to the other.
HISTORICAL EVOLUTION

(WITH SPECIAL REFERENCE TO

THE HUMAN SEQUENT OCCUPANCE)
HISTORICAL EVOLUTION
(WITH SPECIAL REFERENCE TO THE HUMAN SEQUENT OCCUPANCE)

I. PREHISTORIC
   A. Pre-European Indian Period

II. HISTORIC
   A. Fur Trading Period
   B. The Coming of the N.W.M.P.
   C. The Great Ranching Era
   D. Mormon Colonization
   E. The Coming of the Railway
   F. Growth of the Coal Towns
      Blairmore
      Frank
      Lille
      Coleman
   G. Expansion of the Dry Farming Zone
   H. Recent Development and Boom

III. CONCLUSION
HISTORICAL EVOLUTION
(WITH SPECIAL REFERENCE TO THE HUMAN SEQUENT OCCUPANCE)

As has been mentioned in the early chapters, landscapes unaltered by human influence are extremely rare on this planet. Man has almost everywhere, at one time or another, left some marks, ranging from trampled grass to sprawling, smokey cities.

I. PREHISTORIC

The earliest prehistoric evidence indicates Alberta was once a tropical swamp. The remains of plants, dinosaurs and other animal life have now become the great coal and petroleum deposits which play such a vital role in the Alberta economy. This distant past laid the foundation for the present.

The Alberta of today tends to have a youthful aspect. Its landscape is largely the result of recent changes. The Rocky Mountains are young mountains, recently raised. The plains are mantled by relatively new deposits and the entrenched watercourses are even younger. Glaciers
have left the area in modern times (on the mountains). Vegetation patterns are still fluctuating. The Indians are new-comers, having been here for less than 10,000 years, according to some authorities. Europeans first came into the area, in large numbers, toward the close of the last century, and pioneering has been continued on into the present. In fact, Alberta did not become a province until 1905. Its "historic" period is therefore also very brief.

A. Pre-European Indian Period

Before the arrival of the Europeans, only Indians inhabited what is now Southwestern Alberta. The Blackfeet, one of the strongest of Indian nations, claimed Alberta south of the Red Deer River and from the Cypress Hills west to the Rockies. The Blood and the Peigans, who today occupy Reserves in Southwestern Alberta, were members of the Blackfoot confederacy. Actually they were originally one group. However, legend says that while they were encamped near a Kootenai Indian camp, some of the warriors wished to massacre the Kootenai encampment and take spoils. Many of the others were opposed. The result was that only a few went out on the raiding party. These were later called Bloods in memory of their bloodthirsty deed. The remainder, the Peigans

separated from this group.

These people were largely nomadic hunters, living in teepee encampments, and leaving little obvious impression on the country, save that the burning of vegetation may have assisted grassland expansion in the parkland zone. Grass was burned in the fall to "round-up" the buffalo in unburnt patches, to drive other game, during war, and to destroy enemy pasture. Lack of brush was probably a landscape characteristic of this period. The various Indian tribes traded with each other, and regular markets were held in time of peace. Kootenai Indians from the mountains came to the Lower Waterton Lakes area to trade with the Blackfeet and to hunt plains buffalo. Great fairs took place in times of peace. It was here that Fort Kootenai was later established, to take advantage of this meeting place for the fur trade. No remains however, have been left in the landscape from these fairs.

Only in two noticeable ways did the Indians leave "momentos" from the pre-European period. These are the good-luck, stone piles and the buffalo pounds. The Oldman River is named for the evil Oldman of Indian legend, whose "playground" (two obscure stone rectangles) was just inside the mountains at the "Gap" on the Oldman River. Indians entering the mountains here left a rock for good luck. Through the centuries three sizable cairns have been
The largest is eight feet high. Buffalo pounds refer to the places where buffalo were stampeded over cliff-tops, and their carcases collected at the base. The great piles of buffalo bones remaining at the cliff-bases have now largely been removed by Europeans who sold the bone for lime. Buffalo pounds in Southwestern Alberta are found north of Standoff on the Oldman River and in other places, where river cliffs were especially suitable. (Many Alberta place names, such as Jumping Pound Creek commemorate these pounds).

II. HISTORIC

A. Fur Trading Period

The exact date when European explorers and fur traders first came into Southwestern Alberta is not definitely established. It is thought that the earliest Europeans in Alberta may have been Russians trading down from Alaska 400 years ago. Indians told the early British traders that their forefathers had traded at the river fork where Calgary

129 George M. Dawson, Rocky Mountains, 1886, p. 80B.

130 H. A. Dempsey, Historic Sites of the Province of Alberta, Edmonton, Canada, Department of Economic Affairs, Government of the Province of Alberta, Publicity Bureau, A. Shnitka, Queen's Printer for Alberta, 1952, p. 34.
now stands, with small brown men from across the mountains.\footnote{131}{\textit{The Albertan}, Oil and Gas Section, September 6, 1955, p. 5. However, although this seems to have been a regular, European-type trading post, established just beyond the mountains in the dangerous Blackfoot territory, there is some doubt that Russians actually reached this far. Russian history, in fact, denies it.}

The first British people in southern Alberta also discovered that the Indians had armour traded to them by "men who rode". They also grew tobacco and had horses. This indicates earlier contact with the Spaniards, then in process of settling California and extending their exploration and claims to Montana and Southwestern Alberta.\footnote{132}{\textit{Loc. cit.} Again, although some facts and early maps appear favourable, direct contact with Europeans would not be necessary for the Indians to gain these articles. Horses and armour could have filtered through from southern tribes.}

It was in the seventeen and eighteen hundreds that British and French traders came into the Alberta area.\footnote{133}{Henday in 1754 was the first known English trader in this territory.} However, not until the middle of the last century did trading become very important in the southwestern corner of what is now Alberta. As European contact increased, the Indians' old way of life rapidly changed. With the aid of rifles and horses, the native buffalo herds soon dwindled and were eventually exterminated. In 1886 the last wild buffalo was killed near Cardston.\footnote{134}{\textit{Economic Survey of the Town of Cardston}, p. 5.} Tribal warfare also flared up. Canada's last great Indian battle was fought near the present city of Lethbridge in 1870, between Blackfeet and Crees.\footnote{135}{\textit{Historic Sites of the Province of Alberta}, p. 35.}
The forts in Southwestern Alberta were of two kinds, Canadian and illegal, American, whiskey forts. The latter predominated. The most important law which the Americans broke was the failure to pay customs duty. The whiskey smugglers often used the glacial meltwater gaps in the Milk River Ridge area as passageways into Canada, since the main road through Coutts was checked by customs officers. In this period Whiskey Gap received its fame and name.

Structurally the forts varied from simple one room log buildings to stockaded strongholds. Many, if not most, appear to have been closer to the former, rather than to the latter extreme.

The forts in or near Southwestern Alberta were the following:

In the Lethbridge, Fort MacLeod area —

(1) Fort Hamilton or Fort Whoop-Up, near present day Lethbridge, was the most notorious.

(2) Fort Kipp

(3) Fort Slide Out was also important, but was little more than a collection of trading shacks.

(4) Willow Creek Post.

(5) Fort Conrad, was nicknamed Robber's Roost.

All were American whiskey forts.
In Southwestern Alberta proper --

(6) Lee's Post was near present day Pincher Creek.
(7) Fort Standoff was named in honour of "standing off" the U. S. Marshall, who caught the whiskey smugglers in Canadian territory, and could therefore do nothing.
(8) Kootenai Post was opened in 1874 at the "Dardenelles" of Waterton Lakes, by the famed adventurer Kootenai Brown, who later became guardian of Waterton Lakes National Park.\(^{136}\)

In their time, the forts constituted virtually the only permanent human additions in the otherwise wild landscape. Today their locations are only occasionally marked by a small sign.

B. The Coming of the N.W.M.P.

The American traders brought an era of lawlessness to southern Alberta. Besides evading the law, they were a bad influence on the natives. Finally their unscrupulous dealing and smuggling, coupled with fear that the United States might annex this part of what was then the North

\(^{136}\) Historic Sites of the Province of Alberta, p. 38.
West Territories, \(^{137}\) resulted in the hasty formation of
the Royal North West Mounted Police. This semi-military
organization marched to the banks of the Oldman River, where
they established Fort MacLeod in 1874. \(^{138}\)

With the arrival of the law, Alberta District of the
Northwest Territories entered upon a new era. In 1877 the
Blackfoot Indians gathered together, at Blackfoot Crossing
on the Bow River, to negotiate a treaty with the Canadian
Government (represented by Commissioner MacLeod of the
N.W.M.P.) for Alberta south of the Red Deer River. A
treaty was drawn up giving the Indians a reservation around
Blackfoot Crossing (a traditional Indian nucleus). However,
the various tribes were not able to live in perfect harmony,
and the Bloods were retired to the Belly River area, the
Peigans to the southern Porcupine-Oldman area, the Sarcees
to the Elbow River, and the Stoney to Morley, where they
have remained until the present time. \(^{139}\)

C. The Great Ranching Era

Aided by the N.W.M.P.'s tactful diplomacy and
guardianship, the country changed into a vast ranching

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\(^{137}\) Indians escaping from Custer's last battle in Montana,
crossed into Canada. It was feared that if hostilities
between these and the Canadian Indians broke out, and if the
U.S. cavalry followed the Indians on the pretense of keeping
order, Canada might lose the northwest.

\(^{138}\) Historic Sites of the Province of Alberta, pp. 28-29.
Although the need for such a law-enforcing body had been felt
for some time, the above events triggered its formation.

\(^{139}\) Economic Survey of the Town of Cardston, p. 5.
empire. Prospecting also flourished, and it was not long before Southwestern Alberta was criss-crossed by prospectors. The famous story of the "Lost Lemon Gold Lode" is from this period.

In 1881 the Federal Government made regulations that allowed up to 100,000 acres to be leased to ranchers at one per cent (of land value) annual rent.\textsuperscript{140} It was after this that ranching became the great industry of Southwestern Alberta. The Stuart Ranch was one of the earliest and largest in the Pincher Creek area.\textsuperscript{141} The Cochrane Ranch, also one of Alberta's earliest, located near present day Cardston, owned 66,500 acres and leased 100,000 acres. This land however, later was sold to the Mormon Church.\textsuperscript{142}

Another factor which later spurred the livestock raising industry greatly in Alberta was the metallic mining development in the Kootenay area. Southwestern Alberta was the closest ranching land to this new mining district. In the early nineties cattle were driven through the mountains for slaughter. Later, when the railway was built, it took over the shipment of agricultural products.\textsuperscript{143}

\begin{itemize}
\item \textsuperscript{140} Economic Survey of the Town of Pincher Creek, p. 2.
\item \textsuperscript{141} Ibid., p. 4.
\item \textsuperscript{142} Economic Survey of the Town of Cardston, p. 3.
\item \textsuperscript{143} Alberta Facts and Figures, p. 19.
\end{itemize}
When the N.W.M.P. built strategic Fort MacLeod, they found that the best grassland lay on the flats to the west, where the present town of Pincher Creek stands. They therefore took their horses here for pasture, and discovering a pair of pinchers, lost by prospectors in the creek, named the site Pincher Creek.

The Pincher Creek area became an important ranching district. Many police officers took up ranching when their service was completed. In 1878 the first structures, log cabins with sod roofs, were built on Pincher Creek. The next year a combination lumber and grain mill was set up seven miles from the present town. Its purpose was largely to encourage the Indians to settle down and practice sedentary farming.¹⁴⁴ Pioneers came up from Montana, overland from railhead at Medicine Hat, and even by way of Walla Walla, Washington.

D. Mormon Colonization

Meanwhile south of the border, in Utah, the Latter Day Saints or Mormons had been persecuted by their gentile neighbours and by the U. S. federal authorities. Their polygamous practices were especially under attack. Finally

¹⁴⁴ The parts for the mill were transported from the East via the mail route along the Missouri River to Fort Benton in Montana and then overland to Alberta N.W.T. This illustrates the closer relation to the area south of the border, than to eastern Canada. Economic Survey of Pincher Creek, p. 4.
a law had been passed outlawing polygamy. The Mormons had to choose between divorce and tragically broken homes, or jail. Since evasion of the law could not be carried on indefinitely, it was decided that a new settlement should be made in Canada.

In 1886 Charles Ora Gard, a pioneer from northern Utah's Cache valley, led an exploratory group northwestward to found a new colony on British soil. The party passed through Southeastern British Columbia to Calgary, Alberta, from whence they moved south. Here they were much impressed by the tall waving grass, but the land was all grazed and "sodbusters" were not welcome. However, a lease to the south of the newly formed Blood Indian Reserve had just lapsed and this was taken as the site for a new colony.

In June of 1887 the chief Mormon company of nine families arrived at Lee Creek with nine wagons, 23 horses, 40 cattle, and numerous chickens. This group of 41 people first erected a "bowery" church. Later log cabins, a co-operative store and a cheese factory were constructed. To supply lumber, a sawmill in the mountains was built. To take care of agricultural needs they eventually obtained

145 Since only the more energetic, prosperous Mormons could afford several wives, one may assume that the immigrants to Canada were among the leading people of their group.
a threshing machine and a water-power-operated flour mill. The water from the mill race was also used for irrigation. Everything was built and operated on a co-operative church basis. The towns were of the communal, farm-village type. Cardston, named in honour of President Card, was the original settlement on Lee Creek. New Mormon immigrants came from Utah and Britain. The British were already loyal to the Queen and therefore were especially suitable as immigrants to Canada. As more land was acquired, and the population grew, other farm-villages were established.

The Mormons are chiefly responsible for bringing organized, large-scale, crop irrigation to Canada. President Card helped get work started on the Canal head on St. Mary River near Cardston in 1898. In 1904 the Alberta Railway and Irrigation Company's narrow gauge line reached Cardston from the Lethbridge district. It was later widened to standard gauge and in 1926 it was extended to serve the newly developed United Irrigation District, which was the last of the Mormon pioneer lands.146

146 Economic Survey of the Town of Cardston, pp. 5-6.
E. The Coming of the Railway

The coming of the railroad helped open Southwestern Alberta for denser settlement, and a more intensive economy. The miner, farmer, and even the forester now received encouragement in the form of transport links for their products.

Agitation from two directions spurred the building of the east-west rail-link through the Crowsnest Pass. On the east, a railway had already been built to Lethbridge from Medicine Hat. Lethbridge tried to have the railroad extended as a through route to the Pacific, for it feared to be left behind as a "dead end" in the expanding economy of the West. At the same time, the developing, Kootenay metallic mines were anxious to have Canadian rail connections both for transporting ore out, and for food supply transport into the area. There was some concern that U. S. interests might gain economic control of this mining area, by means of spur rail lines.

Toward the end of the last century the railway was finally built by Canadian Pacific. A notably large construction camp, which promised to become a permanent town, sprang up at the eastern end of Crowsnest Lake. Its special function was to serve the blasting operations around the rocky lake shore, which was one of the roughest sections on the route. This early boom town contained a boarding house,
The town mushroomed to prominence in 1897 just after its founding, but by early 1898 it had already degenerated to a ghost town. Apparently, once the rail line had been laid through the Pass, the town could not sustain itself and fell into decline.

After a few years, only crumbling log shacks, and the old graves of construction workers, struck down by scurvy, remained as evidence of the settlement. The townsite was eventually purchased by a man who started a ranch there. It was a long time thereafter, in 1926 that the East Kootenay Power Company built a steam plant here, and Sentinel came into being.

F. Growth of the Coal Towns

The new, direct railway line, through the heart of topographically-subdued and coal-rich Crowsnest Pass, encouraged the establishment of coal mines and towns. The Cretaceous bedrock here not only contained valuable coal seams, but its subdued topographic expression made it an ideal route for the railway and for town construction. As time passed, the railway locomotives themselves proved to be the most important coal market. The lack of dense settlement, and therefore markets, in much of western Canada and northwestern U. S. A. was the chief reason for this slight economic limitation.
Blairmore

Blairmore was one of the earliest settlements in the Crowsnest Pass area. The railway was completed in 1898, and the first dwellings, both log structures, were built in 1899. This site had been the first stopping place for the railroad when it was being built through the Pass. In 1900 the first store commenced operation. It too was a log structure.147

The development of coal mining at Blairmore was spurred by the discoveries and boom at nearby Frank. West Canadian Collieries, the same company which initiated mining operations on Grassy Mountain, started the coal mining industry in Blairmore.

As Blairmore became a mining center, its population skyrocketed in a typical coal-development boom. Then after the initial expansion, population became more stationary.

Incorporated as village 1901 ... population 231
Incorporated as town 1911 ... population 1,137
1921 ... population 1,552
1931 ... population 1,629
1941 ... population 1,731
1951 ... population 1,933148

147 Economic Survey, Town of Blairmore, p. 2.
148 Loc. cit.
As the building boom continued, the high fire insurance rates coupled with expensive fireproof building materials, helped encourage the establishment of a cement plant, known as "The Rocky Mountain Cement Company Ltd." Suitable rock was locally plentiful, and a promising industry took root. However, it has now closed operation.  

Frank

When the railway came through the Crowsnest Pass, one of the largest and most prosperous towns to grow up was Frank, with a population of over 1,000. Frank lay at the foot of steep, rocky Turtle Mountain and made its livelihood from a rich coal mine in this mountain. The railway itself also gave a certain amount of importance to the town. Among the numerous and varied business establishments were stores, a bank, hotel, newspaper office (for "The Frank Sentinel") and so forth. A half million dollar zinc ore smelter for Slocan, B. C. ore was built at Frank, but it did not have a chance to operate. Coking ovens for Lille coal were also planned.  

At 4:10 A.M., on April 29, 1903, a great block at the top of Turtle Mountain broke loose and roared down on the sleeping village. The eastern part of the town was

149 Economic Survey, Town of Blairmore, p. 2.

150 Just east of Turtle Mountain Playgrounds lie the ruins of the old smelter. Ken, E. LiddeLL, This is Alberta, Toronto, The Ryerson Press, 1952.
crushed and buried, but since the edge of the slide was fairly sharp, much of the western part, including some of the commercial core (such as the hotel) escaped destruction. About 70 to 100 people lost their lives. Among the establishments wiped out were the tipple and plant at the mouth of the Canadian American Coal and Coke Co. mine, several of the poorer people's cottages (which were largely in east Frank), and two ranches. This great slide gave Frank its "death blow". Although the town recovered slightly, it never regained its former prominence. In 1912, what remained of Frank, was moved slightly westward, out of danger from future slides.

Lille

In 1901 J. J. Fleutot, a gold prospector, prospected Grassy Mountain and was successful in finding large coal deposits. Therefore he returned to his homeland, France, to get financial support for a West Canadian Collieries company. In 1903, on Grassy Mountain north of Frank, the coal operation was about to begin and a railway from the Crowsnest valley was in the process of construction. However, the Frank Slide buried the construction camp and one mile of the railroad. Thus the railway was built from west of the slide at Frank instead of Bellevue, by way of Gold

151 Liddell, This is Alberta, p. 52.
Creek, to the company town of Lille\textsuperscript{152} on Grassy Mountain. The Frank and Grassy Mountain Railway (as it was called) made use of 32 trestles to cross and recross Gold Creek and three switchbacks to get up the seven miles of steep grade from Frank up to Lille. A locomotive was able to take only three empty cars at a time. Cars which broke away, merely ran into the banks at the switchbacks.

This railway and a narrow, twisting road (or trail) were the only means of reaching Lille. However, the high cost of transport and the relatively small coal deposit resulted in Lille being abandoned in 1912. The people and some of the buildings were moved down to Bellevue. The mining equipment is still in use by West Canadian Collieries, which is now a major company in "The Pass". In its time of prosperity Lille was a large town with boarding house, butcher shop, general store, school, hotel and liquor store and also boasted a 50-oven coking plant as well as a mine tipple with a capacity of 1,200 tons in two shifts. Now only rotting water mains remain in this ghost town,\textsuperscript{153} but strip coal mining is still in operation nearby.

\textsuperscript{152} Lille was named in honour of the chief shareholder's home in France.

\textsuperscript{153} Liddell, \textit{This is Alberta}, pp. 51-53.
Around 1902 a number of businessmen in Spokane, Washington, formed the International Coal & Coke Co. Ltd. to acquire Crowsnest Pass coal for the production of coke, which was to be used in the western smelters. Denison Coal Properties, at what is now Coleman, Alberta, were purchased. Mr. A. C. Flumerfelt, a Victoria, B. C. financier, became head of this company. In 1903 Coleman was founded (on McGillivary Hill), when a large colliery plant and 75 beehive coke ovens were built. Sale of lots started in October, 1903 and by December the Coleman Hotel was finished. The lots were sold on condition that certain liquor restrictions were observed for 15 years, for Coleman was planned to be a model mining town, devoid of undesirables.

G. Expansion of the Dry Farming Zone

After the railway came, near the turn of the century, Southern Alberta had good transport links with the rest of the world. This was also the great period of immigration, when thousands poured into Western Canada. Population pressure became greater, and much of the old range area yielded to cultivated crops, which gave a greater financial return per acre.
The lack of markets however often proved to be a problem. The expanding mineral industry in the Kootenays, provided one of the most important markets, not only for range livestock, but also for general farm products. Nevertheless, some early settlers found it advantageous to take part time work on the railroad construction-projects, to supplement their homestead income.

The early farm emphasis was clearly on livestock. Alberta in 1906 showed approximately one half of its cropland acreage devoted to oats. By the early 1900's summer fallowing had been adopted, especially as a protection against drought effects. In 1910 Marquis wheat was introduced, with the result that the wheat acreage expanded greatly.¹⁵⁴ As time went on, there developed techniques of dry land farming in Alberta's environment, with grains especially adapted to Albertan conditions. For southwestern Alberta particularly, one of the most important developments was the introduction of strip farming, as a protection against wind and drought. Eventually a fairly stable, but continually fluctuating pattern of cultivation carpeted Southwestern Alberta's agricultural districts.

¹⁵⁴ Facts and Figures, Alberta, p. 20.
H. Recent Development and Boom

The more recent developments which have affected Southwestern Alberta have been largely of two kinds, oil and natural gas, and irrigation and mixed farming. Generally, the recent development-trends and some of the future possibilities are given detailed discussions in the economic chapter. The preceding historical outline brings the basic landscape pattern to the present era.

Exploration and drilling for oil and natural gas have uncovered great wealth in Southwestern Alberta. This petroleum resource may bring considerable industrial development to the area. A chemical plant is at present underway here. Great quantities of cheap fuel should attract more industry to this corner of the province, which at present lacks extensive manufacturing.

Irrigation has expanded in Southern Alberta in recent years. The greatest and most significant development is St. Mary Dam. This dam and lake lie on the eastern border of the area studied. Level lands to the east with long frost-free periods, are now being extensively irrigated by waters from this development, the St. Mary - Milk River Project.
III. CONCLUSION

In weaving together the threads of history two things are evident. As man moulds the landscape for his own use, this same landscape moulds man himself. In this study it is the former which is of special concern. Southwestern Alberta's history has seen the land change from wild hunting country, through grazing, to planned, intensive, irrigation farming. At present, all the old landscape patterns are found in the area. Great, past civilizations, with long periods of human exploitation and time lapse, have not been on the scene. Alberta started fresh from virtual wilderness, less than 100 years ago. Consequently, Southwestern Alberta can present a historic cross-section of cultural landscape types as well as the rainbow of physical types, already referred to. Semi-nomadic Indians, grazing land, Mormon farm villages, strip wheat country and mining towns all add to the landscape picture. A short history coupled with a varied physical environment are largely responsible for this conglomeration.
POPULATION PATTERN

Population is of significance in the landscape, only insofar as it affects the landscape pattern. By definition, humanity itself is not a part of the landscape. The specific effects are discussed in the economic and settlement chapters. However, the population density is of some importance in connection with the economy. The two help explain each other's geographic pattern.

In Southwestern Alberta, the population density pattern tends to form a number of zones, closely related to the economic pursuits of the inhabitants. Briefly these zones are as follows:

(1) a relatively densely inhabited intensively irrigated area, characterized by relatively smaller farms, around Glenwoodville, with a less dense population in less intensively irrigated tracts;

(2) the dry land farming zone, with a population of average density, but varying from fairly dense on the heavy soil flats at Pincher Creek to sparse in the outer fringes near the range area where farms are larger.
Legend
Scale 1:506,880 1 inch to 8 miles
Each dot represents 5 people (1951 Census)

3,000
2,500
2,000
1,500
1,000
500
100

Incorporated Towns Pincher Creek 1,456
Cardslon 2,487 Incorporated Villages
Coleman 1,961 Frank 239
Blairmore 1,933 Cowley 119
Source: Census of Canada 1951 data adapted to field observation
(3) the grazing lands with a very sparse population, since greater tracts are needed to support one person than in the cultivated districts;

(4) the Crowsnest Pass country marked by a string of prominent, urban, mining centers;

(5) the virtually empty Crowsnest Forest Reserve.

The two chief trading towns in the agricultural areas, Pincher Creek (1,456) and Cardston, (2,487) are not very different in size. Their hinterlands just maintain them on a fairly stable balance. Local manufacturing has, as yet, not caused one center to become industrialized and independent of its local hinterland.

The accompanying map indicates the general population pattern based on census figures for 36-square-mile, township blocks.

An example of a densely populated irrigation area is T 5 R 27 W 4th Meridian which has 589 people. This is a density of 16.3 people per square mile. Included however is the farm village of Glenwoodville. Some of its residents are farmers who cultivate the surrounding land but there are many who aren't. It is difficult to find an irrigated township with only scattered farmsteads, since the Mormon farm village system of settlement has been used to colonize all the irrigated districts in Southwestern Alberta.
In the dry land farming zone T 5 R 29 W 4th Meridian near Pincher Creek has 189 people, or a density of 5.25. This is considerably less than that on irrigated land. The Del Bonita area shows a density of approximately 4.4 per square mile. Population densities of this order are what one might call average for Southwestern Alberta, although this "average" merely represents a mid-point between extremes and is far from typical for the entire area.

The ranching areas have a less dense population, which is shown by T 5 R 1 W 5th Meridian where only 45 people reside. This is a density of 1.25 people per square mile. Further from the main transport lines and towns the density is even less. For example, T 10 R 2 W 5th Meridian in the North Fork country has 0.5 people per square mile.

The emptiest country in Southwestern Alberta is the Crowsnest Forest Reserve, where densities run from 2.5 and 0.5 people per square mile in the Castle drainage to zero in much of the remaining area. Only forestry, trapping and coal mining support the few people present.

In sharp contrast to this lonely mountain land are the congested mining centers in the Crowsnest valley. The

155 Statistics for the more densely populated flats, immediately around Pincher Creek town, are not sufficiently accurate to be quoted. The part of the nucleation beyond the town line is apparently grouped with the rural population.
two largest towns, Coleman and Blairmore, have 1,961 and 1,933 people respectively. However, the populations of the greater town areas are probably closer to 3,000 people in both cases. The rural population of the Crowsnest district is relatively small, but if only the valley floor is considered it must be in the order of several people per square mile.

The Indian Reserves and Waterton Lakes National Park should also be mentioned. (Waterton's population of 237 is concentrated in the townsite and a few isolated park warden cabins.) All three areas have restrictions with respect to population. The Peigan Indian Reserve with 773 people and the Blood Indian Reserve with 1,782 both reflect the fact that there is still much land available to the Indians, even if their population should increase enormously. Both reserves are sizable and the Blood Reserve is, in fact, Canada's largest.

In conclusion, it should be pointed out that room for expansion and further development characterize the population aspect of the landscape picture in Southwestern Alberta as a whole. The area is far from overpopulated, although being historically older and southerly it is more densely populated than many parts of the province.
ECONOMIC

MOSAIC
I. THE ECONOMY'S ROLE IN THE LANDSCAPE

II. AGRICULTURE -- CULTIVATION AND GRAZING

IRRIGATED DISTRICTS

(a) United Irrigation District
(b) Mountain View Irrigation District
(c) Leavitt Irrigation District
(d) Aetna Irrigation District

MILK RIVER PLATEAUX
DRY CULTIVATION AND RANCHING

OLDMAN BELLY DRY-LAND FARMING ZONE (LARGELY STRIP-WHEAT CULTIVATION)

RANCHING IN THE FOOTHILLS AND ADJACENT AREA

(a) Southern Foothills Ranching Area
(b) North Fork Ranching Area
(c) Forest Reserve Grazing
(d) Crowsnest Grazing Area
(e) Porcupine Hills Ranching Area

INDIAN RESERVES

III. FORESTRY

PRESENT FOREST UTILIZATION

SAWLOG FOREST MANAGEMENT AND FORESTRY PROSPECTS IN SOUTHWESTERN ALBERTA

IV. TRAPPING, HUNTING AND FISHING
V. MINING

COAL

Types of Mining
  (a) Underground Mining
  (b) Surface Strip Mining

OIL AND GAS

LIMESTONE

PHOSPHATES

IRON ORE

VI. POWER

VII. MANUFACTURING

VIII. TRANSPORT

  RAIL
  ROAD
  WATER
  AIR

IX. TOURISM

X. CONCLUSION
ECONOMIC MOSAIC

I. THE ECONOMY'S ROLE IN THE LANDSCAPE

Man's economic mosaic, which patterns so much of the earth's surface, is both the result and moulder of human culture. Each environment presents a number of livelihood possibilities to mankind. Within the environmental limits what use a certain group makes of an area depends upon the group's cultural heritage. However, the cultural heritage itself owes much to the economy of past generations, from which it has taken its roots. The economic mosaic gives a picture of the varying ways of life, environmental dependence, and products of the countryside.

Not only is the specific livelihood important, but man's way of making that livelihood, so well reflected in the landscape pattern, is a key to the human geography of the area. In other words, not only is it significant that rice is grown at Banaue Philippines, but the fact that it is cultivated in flooded paddies, on mountainside terraces, is at least equally important. Man's whole settlement pattern is intimately tied to, and partly the result of, the economic mosaic in the landscape. Together economy and settlement, never distinctly separated, are the chief ingredients in the cultural segment of the landscape.
The various possible economic pursuits may be subdivided into a number of categories according to their manner of utilizing different parts of the landscape and their catering to human needs.

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<th>ECONOMY</th>
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<td>(1) Agriculture</td>
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<td>(6) Manufacturing</td>
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<tr>
<td>(7) Transport</td>
</tr>
<tr>
<td>(8) Service</td>
</tr>
<tr>
<td>(9) Tourism</td>
</tr>
</tbody>
</table>

- **BASIC RAW PRODUCTION**
  - **ORGANIC**
    - Irrigation
    - Mixed Farming
    - Cultivation
      - Dry
      - Grazing
  - Forestry
    - Tree Crops (eg. rubber latex)
    - Lumbering
    - Trapping
  - Hunting
  - Fishing
  - Mining
    - Underground
    - Drilling
  - Power
    - Primary (eg. smelting ore, processing food)
    - Secondary (eg. constructing machines)
  - Manufacturing
    - Primary (eg. smelting ore, processing food)
    - Secondary (eg. constructing machines)
  - Transport
  - Service (eg. commercial, medical, etc.)
  - Tourism
Primary, secondary and service economies are the first, obvious divisions. Primary economic pursuits deal directly with the natural environment and are usually the most important in a landscape, since they are chiefly responsible for man's rearranging of "nature". The secondary economic pursuits, utilizing raw materials from the primary pursuits, may largely be grouped under "manufacturing" and affect the landscape mostly by factories and plants, which are often located in the settlements. Service pursuits, such as transport, commerce, tourism and so forth, give service to people. Except for the transportation network, this category has little effect upon the land outside the settlements. Thus except for the primary economic patterns the bulk of the remainder can be dealt with under nucleated settlements and their function.

The primary pursuits may further be subdivided into those directly concerned with the organic (biosphere) and the inorganic (lithosphere, hydrosphere, and atmosphere) segments of the landscape. The organic subdivision includes agriculture -- "the controlled raising of plants or animals", as well as the random utilization of the biosphere such as forestry, trapping, hunting and fishing. Forestry, however under modern planting and cutting methods, tends to be very close to tree farming. (Note examples in U.S.S.R, Canada, Sweden, and New Zealand.) The organic, primary economies rearrange and/or utilize things which grow back into the
landscape. The inorganic, primary economies are concerned with extracting from the lithosphere (mining), without rapid replacement. However, hydro-electric power makes use of the hydrosphere and windmills make use of the atmosphere without directly removing anything from nature. In conclusion it may be said that cultivation and surface mining (strip and dredging) directly affect the wild landscape more than any other economic patterns. Indirect effects may, however, be far greater from major manufacturing or power developments, when the entire face of the land undergoes the equivalent of plastic surgery in order to suit it to the new land use.

II. AGRICULTURE -- CULTIVATION AND GRAZING

Agriculture, the cornerstone of advanced human settlement, is one of Southwestern Alberta's major economic pursuits. The sprawling agricultural quiltwork of fields and rangeland blankets most of the non-forested area.

Like all primary economic industries, agriculture is closely tied to the natural environment. Since agriculture's natural foundations vary in Southwestern Alberta, agriculture itself takes on diverse forms in the changing environments of the area. In addition, the cultural background
and outlook of the people occupying the land must be considered to fully explain the present pattern of agriculture. Topographically, Alberta's southwestern corner unfolds the full range, from vertical mountain wall to seemingly endless plain. As a consequence of this, climate and soil must also vary considerably. Climate, which determines warmth and moisture for growth, and soil, which provides the nourishment, are the truly fundamental determiners of agricultural possibilities. Humanity then comes upon the scene and cultivates or grazes somewhere within the limits of these possibilities, depending on the group's cultural level, social outlook and heritage.

In subdividing the raising economies in the biosphere of Southwestern Alberta, the first and fundamental division must be between grazing and cultivation. This division is best in theory, for many landholders practice both in a rather mixed pattern. Internally, cultivation may be subdivided into dry-land and irrigation farming. Grazing is usually either for the animal's meat or for some by-product, such as milk. The conventional division is between dairying and ranching,(the latter being usually for beef or wool).

Two other divisions of the agricultural pattern are also possible. One regards the type of crop or animal production which is engaged in, while the second separates the different methods of production.
## METHODS OF AGRICULTURAL PRODUCTION

<table>
<thead>
<tr>
<th>FIELD PATTERN</th>
<th>Water Supply Pattern</th>
<th>Flood Irrigation</th>
<th>Canal Irrigation</th>
<th>Dry</th>
<th>Drained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Grazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Irregular Shifting</td>
<td></td>
<td></td>
<td>Amazon Selva</td>
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<tr>
<td>(milpa)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circular</td>
<td></td>
<td></td>
<td>Pre-Roman Britain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angular</td>
<td></td>
<td>Central Wash., U.S.A.</td>
<td>Holland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strip</td>
<td></td>
<td></td>
<td>French Canada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strip Rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Contoured</td>
<td></td>
<td></td>
<td>Palouse Wash., U.S.A.</td>
<td></td>
<td></td>
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<tr>
<td>Terracing</td>
<td></td>
<td>Orient Paddy Rice on Hills</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- in Southwestern Alberta

- (a) Dry grazing
- (b) Flood irrigated river flats
- (c) Rectangular irrigated fields
- (d) Rectangular (and angular) unirrigated fields (eg. forage crops in the foothills)
- (e) Unirrigated strip wheat farming
AGRICULTURAL PRODUCTION

PLANT
- Tree
  - Orchard ..................... (eg. apples, peaches, etc.)
- Vine
  - Plantation .................. (eg. grapes, hops)
- "Bush"
  - Orchard ..................... (eg. raspberries, tea)

Vegetables, roots, etc. — For extraction (eg. sugar beets)
  - Direct consumption (vegetables)
    - Grazing  ..................... (eg. alfalfa)
    - Grass
      - Fodder  
      - Grain  
        - Cane, etc.

Grain
  - Cane, etc.

ANIMAL
- Insect
  - For food production (eg. honey bee)
  - For nonfood production (eg. silk worms)
- Fish
  - For direct consumption (eg. eating fish)
  - For by-product (eg. caviar)
- Bird
  - For direct consumption (eg. chickens)
  - For by-product (eg. egg)
- Mammal
  - For direct consumption (eg. beef cattle)
  - For by-product (eg. milk, leather, wool)

= significant in Southwestern Alberta
In addition, the relative compactness of the field pattern (i.e. percentage of effectively occupied land) and the size of fields and range tracts are of some importance in the landscape picture.

Purely for convenience, about five regions of agriculture may be recognized in Southwestern Alberta. None are homogeneous and all have zones of mixing around their rather vague borders. These are: (1) the Milk River Plateaux because of altitude and isolation; (2) the Mormon irrigated zone centering on Cardston; (3) the dry-land strip-wheat country sprawling around Pincher Creek; (4) a. the foothills and nearby ranching belt with a possible sub-region in the b. Crowsnest Pass area, where dairy farming has relatively greater prominence; (5) the Indian Reserves, which are largely range areas with some dry-land farming around the settlement cores.

The agricultural zonation is largely an east-west variation resting upon the natural environment's change from the moist, cool, continental divide range to the progressively drier, warmer, rain-shadow plains, eastward. Warm, dessicating, chinook winds further parch the semi-arid land. However, the periodically moisture-drenched mountain ranges in turn supply water to numerous streams descending to the parched plains. This more or less ensures irrigation possibilities for most of the area (except isolated and topographically-unsuited tracts). Near the mountains and in the mountains themselves,
there is a sufficiency of precipitation, so irrigation is not needed. Consequently it is only the eastern zone of Southwestern Alberta which is irrigated. Not only does the precipitation pattern show a progressive variation west to east, it is also true of the temperature pattern, which is especially significant to the frost-free period. As one approaches the mountains from the east, the frost-free period becomes shorter and more hazardous. Therefore, the more demanding forms of agriculture drop out, one by one westward, until only ranching remains. East of the thesis area lies the zone having the longest frost-free season in Alberta. It is also the driest portion. Many parts of that zone, which are accessible to irrigation water, are irrigated and produce luxuriant crops of sugar beets, vegetables, small fruits and the like. Even cotton can be grown there. As one moves into the area under study, day-time summer temperatures are still hot, but proximity to the mountains has cancelled out extensive sugar beet and vegetable production. Westward, although the land is better supplied with moisture, cold air, periodically sweeping down from the mountain ranges, more and more discourages cultivation. However, unirrigated grain fields, stripped to conserve moisture and prevent wind erosion, spread over the rolling countryside, eventually breaking up into isolated bits and pieces among the great rangelands.
IRRIGATED DISTRICTS

Southwestern Alberta's irrigation districts owe their particular locations to a number of environmental factors. The basic reasons for their general location, along the eastern edge of the area studied, (drought and a longer growing season for valuable crops) have already been discussed. The reasons for their specific positions are: relatively low, level topography accessible to irrigation water, (this includes most of the western Great Plains below the foothills border, and north of the Milk River Ridge); nearby streams with an ample, steady water supply, (this same part of the western Great Plains possesses these characteristics also); settlement by people interested in growing crops requiring irrigation, and preferably possessing a heritage of irrigation technology, (the Mormons who settled on the Great Plains and foothills had these characteristics, but the native Indians did not.)

All these irrigation areas in Southwestern Alberta owe their existence directly to Mormon enterprise. In fact all irrigation in Alberta is the direct or indirect result of Mormon inspiration. The first Mormon (Latter Day Saint) colonists came from Utah in the 1880's, where they had already adapted to an arid environment by resorting to artificial watering. When they arrived in the Cardston
area of Alberta, one of their first projects was to build irrigation canals. They thus set an example which was to be followed by other Canadians at a later date.

The following are the irrigated areas:

<table>
<thead>
<tr>
<th>Irrigation Districts</th>
<th>Irrigable Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Irrigation District</td>
<td>34,000 acres</td>
</tr>
<tr>
<td>Mountain View Irrigation District</td>
<td>3,600 acres</td>
</tr>
<tr>
<td>Leavitt Irrigation District</td>
<td>4,631 acres</td>
</tr>
<tr>
<td>Aetna Irrigation District</td>
<td>8,303 acres</td>
</tr>
</tbody>
</table>

Belly River is the source of supply in all cases. The total irrigable area is not always irrigated. Two of the newer projects, Mountain View (1923) and United (1919) Irrigation Districts, irrigate about one half of the possible irrigable area.  

All the irrigated tracts of Southwestern Alberta tend to be similar, because all are located in the same zone adjacent to the foothills margin; and are all settled by Mormons. None of the irrigated areas are completely 100% under irrigation. Land, located in such a position that it is difficult to bring water to it, is devoted to dry-land farming or range grazing. Since such high value, small area crops as vegetables and sugar beets are not satisfac-

torily grown so near the mountains, the irrigation emphasis is on forage crops. Grain fields are seldom irrigated.

"...The high capital cost of irrigated lands, plus the cost of applying water, makes such land too costly to grow wheat in competition with the dry-land farm; that is to grow wheat to the complete exclusion of all other crops. Alfalfa and the intertilled crops are generally ... irrigation crops.... They are more specialized and usually pay a higher return per acre than do the cereal crops."157 The alfalfa and other fodder is used to feed the farm animals and range livestock, which are sometimes moved onto the irrigated areas for winter fattening. Therefore, the irrigationist tends to rely somewhat on the ranchers to use his surplus feed and pasture grounds, while the rancher in turn relies on the irrigationist for some of his fodder supply. Thus there is a tendency toward the establishment of an economic land-use balance.

The role of soil in irrigation farming is also of considerable significance, especially in determining how well dry-farming can compete.

Soils with heavier textures, such as clay loams and clays, have greater capacities for retaining water than light textured sand loam soils. Therefore, in heavy-texture soil districts, where the precipitation is light

157 Wyatt, Bowser, and Odynsky, Soil Survey, p. 74.
to moderate, dry-land farming can economically compete with irrigation farming. Where the precipitation is so light that artificial watering is necessary for cultivation, the light textured soils are best. Root and other crops, which need intensive cultivation and care, are especially favoured by light soils when irrigated. The soils of the irrigation districts in Southwestern Alberta are generally medium to heavy, and the precipitation is not excessively low. Therefore, sizeable unirrigated grain areas are not uncommon even in the irrigation districts.

(a) **United Irrigation District**

The largest irrigated area is the United Irrigation District between Belly and Waterton Rivers, centering on the settlements of Glenwoodville and Hillspring. The soil here is nearly all of glacio-lacustrian origin. Unfortunately, proximity to the mountains limits cultivation to hardier and often less valuable plants than in the Raymond-Magrath district. As mentioned, cold air slipping down from the mountains cuts the frost-free season sharply. Fodder is therefore the main irrigated crop. Dry-land grain and grazing form a matrix between the irrigated blocks.

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The United Irrigation District changes in character somewhat from southwest to northeast. The southwestern (headwaters) portion lies in the rolling foothills. This is the source area for the great irrigation canals. Northward in this foothills part, spread broad, circular, storage reservoirs, which ensure a steady water supply. The land use here gives the impression of being rangeland interspersed with irrigated hay fields, and very occasionally, grain fields. The rolling character of the terrain results in much unirrigated land in this upper or foothills portion of the district. Northeastward the pattern changes gradually, cultivation becoming denser and more intense. Wheat, barley, oats, hay and some other fodder are the main crops at Hillspring. Wheat is probably the most important grain, while barley predominates over oats. The irrigated land is almost exclusively used to grow hay and other fodder. On the plains, in the vicinity of Glenwoodville, feed crops such as alfalfa are more in evidence than further south. Northeast toward Stand-Off, irrigation is less in evidence, and strip-wheat land, similar to the adjacent Pincher Creek Fort Macleod areas, dominates the scene. Some Hutterite farm-colonies are located in this general area.

As would be expected, such a partially irrigated belt as the United Irrigation District is a general mixed farming area. Cattle for beef and milk are very extensively
raised. The great numbers of milk cows support a cheese factory in Glenwoodville. Pig and poultry production, as well as sheep ranching, also flourish. Much of the cultivation supports animal husbandry directly (as hay for example) but fields of other special crops (such as wheat) may also be used for feeding, after the crops have been harvested. Bee culture also flourishes here and there in the United Irrigation District. Adjacent clover fields often encourages the establishment of apiaries. Agriculture in this area may be summarized as relatively intensive and varied, with some portions irrigated. South and west of Hillspring, which is actually in the disturbed belt, open rangeland and hay predominate on the undulating plains found here. Much of this area is upstream from the irrigation canal intakes and storage reservoirs. In addition it is even closer to the ragged blue wall of the Rockies and their climatically cooling effect. Consequently, ranching comes more into its own here.

(b) Mountain View Irrigation District

The Mountain View Irrigation District lies in the foothills south of the United Irrigation District. Its general character is very similar to that of the southwestern or "foothills portion" of the United District. Considerable tracts of grassland and fields of hay or other fodder are typical. However, some grain, without the aid of irrigation
water, is also cultivated.

Proximity to the mountains is a very important, limiting factor in the agricultural picture. In addition, the rolling terrain hinders irrigation in much of the district. Nevertheless, relatively to other portions of the foothills zone, the Mountain View Irrigation District is one of the more level sections. The broad valley which cradles Mountain View village is the most intensively cultivated core of this district. Another reason for the lack of intense cropping, is the absence of a railway link. Had Mountain View been on a main railway line, there would have been greater incentive for cultivation. The surrounding country is a prosperous, old, ranching area, and Mountain View's irrigation is largely associated with this ranching industry.

(c) Leavitt Irrigation District

A tract of land around the settlement of Leavitt is also irrigated. In most aspects, it very closely resembles the Mountain View area to the west. The village itself, like Mountain View, lies in a broad foothills valley which seems ideal for agricultural pursuits. The Leavitt Irrigation District supports some cereal crops and a large number of livestock. As in the other cases, the grain fields are un-irrigated, while hay and fodder are often irrigated. Ridges and rough topography are usually in grass.
(d) Aetna Irrigation District

The Aetna Irrigation District lies southeast of Cardston, and centers on the village of Aetna. It is also similar to the Mountain View and Leavitt areas in many respects. However, it differs topographically, in that it occupies the western fringe of the Great Plains, just below the foothills edge. It is also further from the mountains and therefore slightly drier. Economically the Aetna Irrigation District shows a greater emphasis on grain cultivation than do the irrigated districts in the foothills. Heavy soils and rather level topography partly account for this relative emphasis on non-irrigated crops.

On the great level plains to the east of the area studied, irrigation farming becomes more extensive and much more intensive. The Mormon-settled, irrigated Magrath-Raymond plains are among the more important sugar beet and vegetable producing districts in southern Alberta.

MILK RIVER PLATEAUX DRY CULTIVATION AND RANCHING

Southeast of the irrigated areas, rise the Milk River Plateaux. These plateaux lie 3,900 to 4,500 feet above sea level. The irrigated Magrath-Raymond plains lie approximately 1,000 feet lower at 3,200 feet elevation.
High elevation, making temperature averages lower and precipitation more effective, combines with the topography to encourage non-irrigated agriculture. Rough terrain, isolation, and the difficulty of bringing irrigation water from the entrenched, internationally controlled Milk River system, also cause most of the plateau area to be dry cultivation and grazing.

Cultivation is largely limited to the heavy, alluvial loams of the level Del Bonita Plateau. The cultivation however, is not intensive. Large strip-wheat fields and extensive tracts of livestock forage make up the field pattern in this area. Strip-wheat cultivation helps to guard the thin soil mantle from drifting, for wind erosion can be a major menace, especially during dry periods. In addition, these fields lying at 4,300 to 4,400 feet above sea level are some of the highest cultivated tracts in all Canada. Snow tends to arrive earlier in the fall, and linger later in the spring. Nevertheless, the cultivated Del Bonita area presents a prosperous, agricultural picture.

The Milk River Ridge proper and the adjacent high or rough plateaux and hills are virtually completely devoted to grazing. A few hay fields break the otherwise endless expanse of gullied and rolling grassland. Roads and even ranchsteads are very limited in number, since many ranchers live in adjacent areas, either at the foot of the ridge or near Del Bonita.
OLDMAN BELLY DRY-LAND FARMING ZONE (LARGELY STRIP-WHEAT CULTIVATION)

Northwest beyond the irrigated districts, stretches a broad zone of dry farming, which is characterized by strip-wheat cultivation. The core of this zone is the heavy, glacio-lacustrian soil area below the foothills edge, especially in the vicinity of Pincher Creek.

A number of internal subdivisions of this dry-farming belt may be made: (1) the North Fork valley and the southern Porcupine Hills flank; (2) the glacio-lacustrian "core area" below the foothills margin; (3) the upland above the foothills "escarpment" edge. However, the overall field pattern is very similar, although the width of the strips does vary somewhat.

The North Fork valley, between the Porcupine Hills and the Livingstone Range, supports extensive strip-wheat cultivation in the southeast near the Oldman River. This cultivated area coincides with the level lacustrian plain left by blocked glacial meltwater during the melting of the ice sheet. The resulting combination of level land and heavy, water-retaining soil, located near a railway line has set the stage for a flourishing cultivated tract here. The high altitude (3,900 to 4,000 feet above sea level), limited growing season, frost hazard near the mountains,
and dessicating wind however, combine to limit the type of cultivation. Only wheat, grown in narrow strips, and fodder (often hay or oats) in large sprawling fields, are cultivated.

The sloping, rolling land, rising toward the southern Porcupine Hills, north of the Oldman River, is also partially devoted to strip-wheat. Again, the cultivated area bears a close relation to a tongue of glacio-lacustrian soil. Exceptionally narrow strips of wheat also help conserve moisture and protect the soil from wind erosion, in this high exposed area.

The partially sheltered Beaver Creek valley extends deep into the Porcupine Hills. In its broader, windier southern portion, strip-wheat cultivation occupies the valley, but northward oats and hay predominate. Eventually, all cultivation gives way to grass and forest.

The hills bordering the valley are grazing lands surmounted by forested summits. This valley shows good irrigation possibilities, because of accessible, arable land and adjacent moister hills mantled by water-retaining forests.

South of the Oldman and Crowsnest Rivers lies a continuation of the glacio-lacustrian soils. In the North Fork country the lacustrian soil covers the plains-foothills

159 10,000 acres are potentially irrigable in Beaver Creek Valley. Wyatt, Bowser and Odynsky, Soil Survey, p. 73.
contact, but in the vicinity of Pincher Creek a gentle 200-foot escarpment marks the border of the disturbed, foothills belt. The heavy lacustrian soils here are limited to a zone on the plains just below the escarpment. This zone of water-retaining, heavy soils is very largely given over to strip-wheat cultivation. In addition to the area's good soil, its location on a major rail link, and early settlement have helped establish this district as a prosperous, well populated, agricultural belt. The Pincher Creek district lies just beyond the mouth of the Crowsnest Pass area and adjacent subdued country, from which dessicating winds sweep out with great force and continuity. Consequently, strip-farming completely dominates the scene, broken only by the odd field of livestock forage. These seemingly endless, sweeping plains, practically devoid of native trees and cut into long alternating golden and black strips, with the wall of the blue Rockies as a distant backdrop, give a strikingly lonely, three-dimensional effect.

Above the eastern rim of the foothills, stretch similar tracts of strip-wheat cultivation. The "escarpment" itself however, is utilized for livestock grazing because of its slope and soil. This long, narrow, grassland belt, separating a low and high level of strip-cultivation, is a characteristic feature of the Pincher Creek area. The

160 Halifax Flat at Pincher Creek was one of the first parts of Southwestern Alberta settled by sedentary, European stock (1870).
upper level of dry farming is virtually a continuation of the lower lacustrian basin, although the soil is not nearly so heavy. Slightly higher and more effective, precipitation values however, should theoretically help to offset this. Nevertheless, the strip-wheat cultivation occupies only the level, plain-like, eastern side of the disturbed, foothills belt. Southeastward the wheatland soon becomes mixed with broad rectangular fields of oats, barley, hay and other forage, which in turn quickly give way to open grazingland. Precipitation in this area is generally sufficient for good, non-irrigated farming, but the proximity to the high, Precambrian Rockies from which unseasonably cold air may slip down, coupled with poorer soil and rougher topography, tend to discourage cultivation. It might be noted that strip-wheat farming, together with some oats, hay etc. advances closest to the mountains near the Crowsnest and Castle Rivers where the Rockies are lower and less blocklike and where reasonably level, arable, glacio-lacustrian soils are found.

The dry-farming of the Oldman, Belly Rivers area can conveniently be described as a unit, despite the internal variations just mentioned. The general land-use and field pattern is of special interest from a landscape point of view.
Many areas in otherwise cultivated tracts of land are given over to grazing. Sometimes this is merely due to a mixing of the wheat and livestock industries. Frequently, a farmer may own vast livestock herds while he indulges in extensive cultivation. Likewise many ranches have considerable cultivated acreages. In other words, it is very difficult, if not impossible, to draw an economic boundary between grazing and cultivation. Only land used for grazing versus cultivated land can be separated conveniently.  

In the zone where cultivation is dominant, grazing lands lie in pockets of poor soil and rough or hummocky topography, and stretch along the banks of rivers and streams. Since cultivation tends to be in regular blocks, block-like sections are left over for grazing rather than natural pockets and strips. (See photos.) Thus, land along rivers, where tributary coulees are entrenched back into the high plain, is nearly all devoted to grazing. Only if a full, field-size of land lies between the coulees might that tract be cultivated, and then often for hay, to compliment the grazing pursuits along the banks. Grazing land along stream courses is quite ideal, for not only can the livestock utilize grassland areas which would otherwise lie idle and give no economic return, but the animals are also supplied with a fresh, naturally replenishing, band of water, within close

161 However, this division is not quite perfect either for cattle are sometimes grazed on the stubble of grain fields.
AGRICULTURAL PATTERNS

Grazing land along stream

Strip-wheat cultivation in blocks avoiding entrenched watercourses

Strip-wheat on heavy-soil, level to rolling land

Grazing on hilly land with poor stony soil
reach from the "pasture". In addition, shade is provided by the trees along the water-courses in an otherwise treeless, shadeless area.

Since strip-farming is practiced throughout the cultivated sections of Southwestern Alberta, and since its pattern is the most dominant feature of the cultivated landscape segment there, it is worthy of especially detailed comment. As mentioned, there is a dual purpose to the planting of alternate strips of wheat, separated by strips of summer fallow, the two of which exchange position annually. Besides hampering wind erosion by close spacing of growing plant-strips, between the exposed soil-strips, the fact that these alternate bands only bear one crop every two years conserves moisture for each crop. According to experiments at Swift Current, wheat following fallow needs only two-thirds as much precipitation to produce one bushel as does wheat following wheat. 162

However, there are some problems associated with strip farming. First, the soil's organic matter and nitrogen is reduced, because the fallowed land's increased air and moisture contact favours quicker decomposition. There is a greater accumulation of available plant foods on fallow land than on cropped land, at the season's end. Secondly, if only one crop is involved in the rotation, the soil fibre

will be destroyed in 10 to 15 years, unless replaced. This will further aggravate soil drifting. A cure for these problems is the inclusion of a hay crop from time to time. This helps replace organic matter, which in turn increases the soil's capacity to hold moisture. For example, average soil when saturated has 15% to 40% water, while saturated organic matter has 50% to 200% water. Many tracts of land in Southwestern Alberta lie "at rest" now and then, but the old strip pattern visible from the air gives away the fact that this is former strip-wheat land, which is now resting or abandoned.

However, strip farming as just described is only one of the better methods of controlling soil drifting. The use of plowless fallow, with stubble and trash on the ground, is a very good way of hindering wind erosion also. In addition this method helps to hold winter snow, thus adding to the moisture reserve. Obviously plowless fallow is more economical than plowed fallow. Swift Current experiments show that ten to twenty rod wide strips with good trash cover make soil drifting very remote. Rows of cover plants, planted in the fall, are also used to keep the fallow from drifting during the winter and spring. Thus, there are a number of variations possible of the fallow-wheat rotation. Some such rotation of fallow and crop, or fallow, crop and hay or legumenous plant is a fairly standard practice

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164 Ibid., pp. 69-70.
southern Alberta dry-land farming. Consequently the field
land use of one year is hardly ever the land use of the
following year. The cultivated landscape segment is in a
constant state of fluctuation and change.

In addition to internal fluctuation and change, the periphery tends to swell and contract with moisture
and economic conditions. If natural conditions are favourable
and market prices high, dry-land wheat cultivation tends to
spread outward into adjacent, less favourable environments.
The dusty, drought-ridden plains and outlying, foothill
pockets then yield to the plow. However, the only stable
year-in-year-out cultivation in the drier areas requires
irrigation. Besides correcting for lack of moisture in dry
periods, irrigation makes possible two other allied advantages.
The fallow system of cultivation leaves one-half or one-third
of the land idle in summer fallow. Under irrigation all the
land may be cultivated. Some of the highest paying crops,
such as strawberries, sugar beets, peas and so forth need
more moisture than the natural precipitation gives them.
Thus irrigation adds immensely to the value of a farmer's
production, both quantitatively and qualitatively. However,
these high value crops can not of course all be grown
in the area being studied because of the proximity of the
Rockies. Nevertheless, the overall pattern still holds.
On the foothill periphery of the dry-land farming belt,
moisture is generally sufficient and fairly stable, but
the frost-free period is even shorter and more unstable. Here
there is really no substitute, such as irrigation eastward,
which can take over and protect the crops. Consequently livestock ranching becomes the only agricultural pursuit.

At present the grain cultivation in the foothills zone is dominantly spring wheat. This is partly a cultural overflow from the plains eastward. The farmers know spring wheat cultivation, and hence they cultivate it anywhere it will grow satisfactorily, with little thought about what new agricultural pattern might give even greater returns in the area. In addition to the frost danger near the mountains the drying effect of the chinook winds is often greatest in July (for example 28 inches of evaporation at Claresholm), a month when the growing crop is very vulnerable. Winter precipitation largely runs off, leaving previous fall and growing season to supply the moisture for the crop. Therefore grass crops, for hay or seed, and winter wheat would utilize the annual moisture pattern better. In many parts, this would thus favour mixed farming and ranching rather than complete reliance on spring wheat. It is possible that the future may show a slight shift in the economic landscape mosaic, toward such a land use pattern.

Diseases also have a limiting influence on grain growing. A hazard affecting cereal cultivation in Southwestern Alberta is the Take-All root rot. Ophibolus graminis Sacc.,

a parasitic fungus is responsible for this disease. This parasite lives on certain sod grasses and attacks wheat on newly broken land. The second or third wheat crops are especially vulnerable. Semi-wooded areas rather than open plains seem to be especially affected. Wet years, rather than dry years, stimulate the fungus. Much damage to wheat and some damage to barley and rye may result. Oats on the other hand are unaffected. 166

A number of other diseases and pests also hazard grains in southern Alberta, but these tend to be more general and less closely related to any specific geographic environment. Usually, they can also be fairly well controlled.

RANCHING IN THE Foothills AND ADJACENT AREA

Of all agricultural pursuits, rangeland grazing, shows the least direct effect on a wild landscape. Except for the ranchsteads, corrals, fences, and a few plots of hay or oats, the countryside appears to be in a natural state. Grazing, however, can alter the physical landscape

166 R. C. Russell, Take-All — A Root-Rot of Cereal Crops, Ottawa, Canada, Division of Botany, Dominion Experimental Farms, Department of Agriculture, Publication 485, Circular 93, March, 1936.
segment considerably. Heavy grazing alters the vegetational pattern, usually encouraging grassland and discouraging forest. Overgrazing may initiate or accelerate gully erosion and the formation of badland topography. Since typical ranching does not greatly affect the original, wild, landscape, the regional variations in the ranching areas tend to be largely physical.

Ranching is the traditional economic activity of Southwestern Alberta. Only the Indian, nomadic hunting and fur trading are older. Around 1870 ranching became firmly established under the protection of the newly formed N.W.M.P. During the following decades livestock flourished on the luxuriant grasslands and the ranching industry grew prosperous, helped by exports to the newly booming Kootenay mines across the continental divide. However, as immigrants poured into the west around the turn of the century, population pressure pushed back the rangeland from the more arable (notably heavy soil) areas. With the help of irrigation and strip-farming, the cultivated mosaic advanced further into the grazinglands. Government policy generally favoured farming settlement, although the ranchers resisted the land use change. Nevertheless vast tracts of Southwestern Alberta and adjacent territory have remained in grassland, largely for environmental reasons, and the ranchers are intensely proud of their tradition and way of life.
Beyond the dry-land farming zone, and its scattered outliers, ranching becomes more dominant north, south, and especially westward. Associated with the range grazing area are usually one or more of the following environmental conditions: (1) broken, rough or hilly topography; (2) poor stoney or somewhat leached soils, especially in mountainous areas; (3) an unreliable, short, frost-free season; (4) too dry for cultivation and no irrigation available; (5) luxuriant grassland; (6) early settlement by ranchers who have resisted encroachment by cultivators; (7) isolated location with poorly developed transport links; (8) under protection as a forest reserve.

Southwestern Alberta's major grazing areas may be divided into the following sub-districts: (1) the foothills zone from the mouth of the Crowsnest Pass to the Montana border; (2) the North Fork country; (3) the eastern Porcupine Hills and vicinity; (4) the Livingstone basin in the Rocky Mountains; (5) the Crowsnest basin, also in the Rockies; (6) the Milk River Ridge area; (7) outlying portions of the Indian Reserves. Of these the Milk River Ridge has already been mentioned and the Indian Reserves, in their entirety, will receive separate mention later. Consequently the emphasis here will be on the foothills and adjacent territory. The North Fork country is a continuation of the foothills belt from south of the Crowsnest River, and the
Porcupine Hills are also associated with the North Fork area. Thus there is basically one ranching zone along the mountain front, with two grassy mountain basins behind the front range.

Broadly speaking, the foothills belt presents a series of fertile, arable, valleys, separated by steep ridges, useful only for grazing. Consequently this area is ideal for mixed farming or ranching, which will utilize ridges for grazing and valleys for the cultivation of forage crops to tide the livestock over periods of poor, natural range (notably winter). In the eastern foothills, where the valleys are wider and the frost-free season longer, level areas are extensively cultivated. An excellent example is the Mountain View district, which grows forage crops with the aid of irrigation in the broad valleys, while the hills lie in rangeland grass. Westward, the valleys in the rougher, cooler foothills are less cultivated. Unbroken range here dominates the agricultural picture. At some distant future time, greater population pressure may force a more intensive use of this grazing area, with greater emphasis on a combination of mixed farming and ranching.

(a) Southern Foothills Ranching Area

The subdued, rolling southern foothills change from mixed, forage cultivation in the broad valleys and
sweeping plains of the eastern part to total rangeland in the west. The sandpapered hill-land south of highway five is especially characterized by occasional patches of forage in the low pockets and valleys of the otherwise wide, grassy rangeland. The middle section, west of the United Irrigation District, shows a typical change from forage cultivation in the east to mixed parkland grazing near the mountain footh. The unusually smooth, subdued, almost plain-like, topography is largely responsible for this typical, gradual and even change, east to west. West of Pincher Creek the character of the foothills is somewhat different. The rolling land here gives way to high foothill ridges westward. The more subdued eastern edge id predominantly in strip-wheat, although there are some fields of forage crops on the western edge of the cultivated belt where ranching takes over as the main economic pursuit. To the west, the alluvial valleys among the parallel foothill ridges have more forage cultivation than the same area southward. Both large and small ranchsteads nestle in the valleys, which form the nucleii of the ranching industry. The hills are also grazed, but as the mountains are approached sheltered forest patches in moist locations become more numerous, thereby limiting the grazingland.
(b) North Fork Ranching Area

Between the Porcupine Hills and the Livingstone Range lies the North Fork country. Except for the extensive strip-wheat lands on the southeastern lacustrian plain, this northern part of the foothills is rangeland. The ranching area coincides with the country possessing the roughest terrain, shortest frost-free season and least heavy soil. Near the southeastern, cultivated area the hills are lower and grassier, but north of the Oldman (North Fork) River rise great, semi-forested hill-ranges. In this northerly district, and other areas like it, ranches must be bigger, because rough topography and forest land eliminate part of the territory from grazing. Some very large, prosperous ranches are located here.

(c) Forest Reserve Grazing

Closely associated with the North Fork ranching country, is the adjacent Corwsnest Forest Reserve. During the late summer, when the plain and foothill rangelands are parched and perhaps exhausted, thousands of head of cattle find pasture in the mountain, forest reserves. The grassy basin and valley along the Livingstone and Oldman Rivers behind the front range, is the most important mountain range area in the Crowsnest Forest Reserve. Access to this isolated pocket is obtained through the "Gap". Each year,
cowboys herd cattle to the highlands through this narrow, twisting, passageway in the Livingstone Range, and each fall at roundup, the cattle are returned to the North Fork country. This annual migration enables the ranchers to utilize the fresh, luxuriant, mountain grasslands, which would otherwise only be partially eaten by the wild game.

(d) **Crowsnest Grazing Area**

The Crowsnest Pass area itself is not included in the forest reserve. This grassy valley basin, between the divide and front ranges, is extensively grazed by farmers and ranchers. The area's location on a trans-Western-Canada transportation line, and the presence of numerous non-agricultural mining towns, has encouraged dairying. A modern dairy is located at Bellevue. In addition to the ranches, these dairy farms are notable features in the landscape. Generally, they are old establishments located near the town edges. Away from the urban nucleations, most of the Crowsnest valley is open grassland, broken only by scattered tree clumps and the occasional fence. There is virtually no cultivation in this 4,300 foot high valley-basin, except a few hay flats.

(e) **Porcupine Hills Ranching Area**

To the east of the North Fork foothills area rises the Porcupine Hills, highland outlier. Since much of this
hill-land is grass carpeted, rather than forested, it is an important grazing area. The western flank, which in a sense forms a part of the North Fork country, is dotted with fields of forage tucked away among the hillsides and between broken escarpment remnants. The broad, plateau and hill-like, eastern area is open grazingland, only occasionally marred by patches of cultivated forage or a lone, outlier field of strip-wheat. The adjacent part of the plains at the eastern base of the hills is also devoted to the same kind of open rangeland. The eastern side of the Porcupines is in a rainshadow position, and in addition, is menaced by an unreliable, short, frost-free season. Hence, cultivation has not encroached much from the Claresholm district. The forested hill-crests and generally poor soils, combined with higher altitude in the heart of the Porcupines discourage all but pastoral pursuits. Fresh, summer grasslands on the upper levels are used for summer pasture by ranchers who move their herds up into the hills, when the hot, lower grasslands need relief from grazing. In this respect the Porcupine Hills with their forest reserve outlier, play a similar role to the Rocky Mountains and the main part of the Crowsnest reserve.

The ranching industry as a whole and its problems in Southwestern Alberta deserve some additional comment.
The greatest overall problem of the ranching industry is overgrazing. This however, seldom concerns the ranchers in Southwestern Alberta, where foothills grazingland is usually supplied with sufficient moisture to sustain a large, healthy, livestock industry. However, the uncertain wet and dry cycles do present a hazard. Stockmen are tempted to increase herds during moist, grassy periods. When dry, dusty years come, these extra animals will not only eat themselves out of their own range, but will also consume so much of the scarce valuable grass that the regular herd will starve as well. To prevent this deterioration of the entire herd, the extra animals must be destroyed, or sold if the rancher is lucky. Stockmen who work in cooperation with irrigation farmers are, however, assured of a feed supply. In contrast, the stockman who is alone in his struggle for survival either has to store surplus feed to tide over meagre periods or else keep a moderate herd.  

The effect of overgrazing on the landscape is chiefly to change natural fescue grassland into a more mixed, "artificial", fescue grassland. This has already been discussed in the chapter on vegetation cover. In addition severe overgrazing may denude the landscape and encourage blow-outs, soil drifting, severe gullying and

invasion by sage brush. The end results are abandoned farm and ranch buildings leaning into the dust-laden wind. Although common in Southeastern Alberta, especially in the 1930's, this is rare in moister, Southwestern Alberta.

The very vegetation upon which the ranching industry relies poses another hazard. Some species of the Alberta prairie are harmful or poisonous to animals. For example, the two-grooved vetch as well as some other plants pick up selenium from certain soils. Two types of poisoning, alkali disease and the blind staggers, result when these plants are eaten by cattle in areas with selenium in the soil. Astragalus pectinatus (narrow leafed vetch) has produced poisoning in bees in Alberta. In addition the following are poisonous to livestock:

- low larkspur (Delphinium bicolor)
- lupines (Lupinus spp.)
- death camas (Zygadenus gramineus)
- loco weeds (oxytropis spp.)

However, the economic impact of this danger does not seem very grave in Southwestern Alberta.

Stock watering places usually present problems in dry areas. Southwestern Alberta, however, is fortunate in

this respect. The mountains and inner foothills plus the higher Porcupine Hills are not water deficient and offer numerous small streams and ponds cradled in the rough topography. Areas of continental moraine in the outer, foothills zone, which partly because of topography are devoted to grazing, are literally dotted with little ponds. In the drier areas coulee draws offer numerous locations for stock-watering dams. Some farms provide artificial ponds for stock and other use at the farmstead. This is especially noticeable in the irrigation districts, where a water supply is continually available and farming is diversified.

The animals grazed in Southwestern Alberta are generally cattle, sheep, and horses. In recent years with the spread of farm mechanization, horse breeding has become much less important. Cattle have tended to take over much of the old horse range. Between cattle and sheep, there is of course constant competition. Sheep can generally survive on more sparse, rougher grassland. They are especially noticeable in the ridge country west of Cardston and in irrigated areas, such as the United Irrigation District, where intensive production and fattening are possible. Many other areas also support sizeable, sheep populations.

All cattle in Southwestern Alberta are not raised for beef. There is a fairly prominent dairy industry established in this corner of the province as well. Creameries,
distributing milk, are located in Bellevue, Pincher Creek, and Cardston. In addition, Glenwoodville has a cheese factory. Farms near the towns and especially farms in irrigated sections, as well as in the Crowsnest country, supply the milk and cream.

INDIAN RESERVES

Two large Indian Reserves are located in Southwestern Alberta. In many respects these reserves show similar agricultural patterns. Both are largely grazing land surrounding a cultivated core, where the bulk of the population lives. The farming tracts however are not extensive. Cultivation is of the same type as in the adjacent strip-wheat and forage growing areas. The Indians in this portion of Alberta have no tradition of cultivated farming. The excellent farming which they practice today has been learned from their new neighbours of European descent.

As in the area outside the reserves, the cultivated land has a tendency to be located in heavy soil areas. Actually, heavy soils are not as common on the Indian lands as in the adjacent district. In fact, some of the poorest soils on the western plains of Southwestern Alberta lie in
or near the Peigan Reserve. This partly accounts for the extensive grasslands on these Indian territories. However, the most significant reasons are lack of population relative to the area occupied, and Indian love for a free life similar to the traditional nomadism. Hence ranching is very important in the Indian areas.

Some Reserve land is also leased to outside farmers and ranchers. An example is the British Commonwealth's largest wheat field contained within a single fence, which lies in the northern part of the Blood Indian Reserve. It is 36,000 acres in area.
<table>
<thead>
<tr>
<th></th>
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<td>Mine 199</td>
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<td>Mine 396</td>
<td>Mine 1584</td>
<td>Mine 1695</td>
<td>Mine 1731</td>
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<td>Coleman</td>
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<td>Coleman</td>
<td>Pincher Creek</td>
</tr>
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<td>Drift and Strip Mine</td>
<td>Drift</td>
<td>Drift</td>
<td>Drift and Strip Mine</td>
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<td>Drift</td>
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<td>L.S. 10 Sec. 3 S.E. 1/4 L.S. 2 Sec. S. 17, 19 &amp; 32 of Twp. 8 Rge. 4 W5 Meridian</td>
<td>L.S. 10 Sec. 2 Twp. 8 Rge. 4 W5 Meridian</td>
<td>L.S. 15 Sec. 31 Twp. 6 Rge. 3 W5 Meridian</td>
<td>Sec. 11 Twp. 7 Rge. 2 W5 Meridian</td>
<td>Sec. 9 Twp. 6 R5 Meridian</td>
<td></td>
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<td>C. P. R. &amp; Truck</td>
<td>C. P. R. &amp; Truck</td>
<td>C. P. R. &amp; Truck</td>
<td>C. P. R. &amp; Truck</td>
<td>C. P. R. &amp; Truck</td>
<td>C. P. R. Truck</td>
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<td>Bituminous</td>
<td>Bituminous</td>
<td>Bituminous</td>
<td>Bituminous Bituminous</td>
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<td>1909</td>
<td>1909</td>
<td>1913</td>
<td>1942</td>
<td>1949</td>
<td>1953</td>
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III. FORESTRY

Forestry resembles agriculture in that it relies on the biosphere for its raw materials, but differs in that organization and nurturing are usually not involved. In recent years, however, planting of forests and reforestation, together with carefully planned forestry management, have given the industry almost the appearance of "tree farming".

The chief trademarks of forestry in the landscape are cut-over hillsides, log choked streams, smokey sawmills, and isolated, often twisting, forestry access-roads from the cutting sites to the mills. In Southwestern Alberta all these are present, with the exception of floating logs in the rivers. Streams in this part of Alberta tend to be small with very irregular flow. Transportation is therefore exclusively by truck from the cutting areas to the mills and railways. The areas of tree cutting are rather limited and well controlled by the Eastern Rockies Forest Conservation Board. Only small pockets of mature trees are allowed to be cut, and wastage is hindered as much as possible. The areas which have been deforested present a rather bare aspect, often partially covered by new brush in the plant succession and cut by a network of forestry trails. When viewed from the air, the latter strikingly resemble gigantic fingerprints pressed into the green hillsides. Three small sawmills are located in Southwestern Alberta, two in
Southwestern Alberta

FORESTRY

Legend
Scale 1:506,880 1 inch to 8 miles
Woodland edge (including some groves)
Crow's Nest Forest Reserve of Eastern Rockies Forest Conservation Area
Forest reserve headquarters
Uncut mature stands
Present cutting operations
Indian reserve timber limits
Waterton Lakes National Park (No cutting)
Sawmills

Source: 1955 Flemming report for Eastern Rockies Forest Conservation Board, Calgary, Field & Topo. Maps
Crowsnest valley settlements and one in the heart of the Porcupines, forest area.

Southwestern Alberta's tree growth is rather restricted to certain favourable areas. The mountains, inner foothills and higher Porcupines show forest growth. Usually this forest is not continuous over a very large area, but rather forms a band, clump or a sparse, mixed woodland. Only in the more moist, well drained, usually alluvial valleys and on richly, soil-mantled hills and hillsides do flourishing, dense stands of timber occur. The total area of forest land is, in itself, not too meaningful to the forestry industry. Much scattered and mixed, mountain, forest growth is highly inaccessible because of topography. In the foothills lies the broad grassland-woodland zone of mixing, with its small scattered groves of low poplars. Beyond the parkland zone, trees are found only on the alluvial, well-watered, stream flats. Tree growth in the stream valleys is at best only a very limited strip which is frequently broken and scattered. In addition, it is hard to get at, since it is bounded by steep and sometimes high banks. Also, as in the scattered foothills groves, some of the growth may be puney. Thus the grove section, the stream flats and large tracts of the mountainous area are unsatisfactory for exploitation by commercial, forestry interests.

Throughout the area, the trees present are vital in water and soil conservation. As an agent deterring
erosion and overly rapid run-off of precipitation trees are irrereplaceable. The entire agricultural economy would be jeopardized if trees were indiscriminately cut down. Consequently most of the valuable east slope forest has been placed under forest reserve, and forms a portion of a great conservation area aimed at protecting the eastern Rockies and the Great Plains. The Crowsnest Forest Reserve, administrated from Blairmore, includes all the major forest stands in Southwestern Alberta, the area under study. This Reserve forms a section of the Eastern Rockies Forest Conservation Area, which is administrated from Calgary. Its boundaries were purposely drawn to include all substantial forest lands adjacent to the stream sources in the high, moister Rocky Mountains. Only the densely settled Crowsnest area and national parks (which are conservation areas themselves) are not included. This excellent arrangement guarantees a steady forest supply, an even irrigation water supply, a continuing wildlife population, and preserved scenic beauty, in addition to erosion and flood control.

When considering forestry in Southwestern Alberta it is just as well to limit the discussion to the Crowsnest Forest Reserve. Waterton Lakes National Park excludes forestry pursuits by law, while the remainder of the area generally possesses only uncommercial tree stands or no trees at all. The Crowsnest Forest Reserve area and, in fact, the entire E.R.F.C.A. may be subdivided into two broad sections, the foothills and the mountains.
NATURAL DIVISIONS OF THE
EASTERN ROCKIES FOREST RESERVES

CONTINENTAL DIVIDE

FRONT RANGE

ROUGHIER MORE HUMID AREA

MORE SUBDUED DRIER AREA

EAST BORDER OF RESERVE
In the high western valleys and basins of the area north from the Crowsnest district grows some of the best saw timber south of the Bow River valley. A combination of very suitable natural features is responsible for this. A deep mantle of drift covers the valley bottoms, and orographic precipitation is heavy in this rough, western district. Short, cool summers, resulting from the mile-high altitude, cause reduced evaporation and ensure a good water supply for tree growth.169

Although the trees are usually not of saw timber size in the greater part of the foothills belt, the local ranchers and farmers make some use of what there is, for such things as fence posts, poles and firewood. The occasional log cabins scattered throughout this area are also built of local or mountain trees.

The Porcupine Hills at present support a little forestry activity. There is one sawmill in the heart of the southern Porcupines, just north of Beaver Creek valley's cultivated patches. This valley offers a convenient approach deep into the higher, forested parts of the hills.

At one time the Porcupine Hills supported relatively heavy stands of Douglas Fir as well as a little spruce saw timber. Unfortunately, most of this has now been removed, partly by Indians and partly by overly enthusiastic, European settlers. It will take some time before this country will again be in a sustained yield condition. Consequently forestry in these hills, so conveniently close to the treeless plains, is rather limited, although the demand is high.

The forest pattern of Southwestern Alberta may be summarized as good but characterized by relatively slow growing coniferous forest in the high mountain valleys, becoming more broken and mixed with deciduous eastwards and yielding to grassland pockets in the wider intermontane basins, while the foothills range from good, often mixed, forest stands to luxuriant parkland and eventually to low shrubby, in places savanna-like, parkland. Long, narrow, broken tongues of deciduous forest snakingly follow the stream flood-plains out into the open grasslands. The elevated Porcupine Hills form an unusual coniferous-topped outlier in the otherwise largely open grasslands. Forestry pressure on these hills might denude them rapidly were it not for the forest reserve restrictions.
Present Forest Utilization

The general pattern of forest utilization of the east slope, forest reserves deserves comment. The 1948 to 1953 period showed an average yearly production of 35.8 million feet board measure of saw timber. However, this does not include 10 to 30 percent of the annual production which is lost by logging in bush. At present, the accessible immature saw timber has a 3.2 million cubic feet, net annual increment while the annual cut in overmature and mature timber is 10.0 million cubic feet. It is estimated that the reserves have 480 million cubic feet of accessible saw timber. Disregarding ingrowth, mortality and waste, the present forestry industry could be supported for 50 years at best. However, since some of this forest is in patches and stringers, 50 years is a very optimistic figure. If 30 years is taken as the most realistic figure, the average total, immature, saw-timber stands of 3,200 cubic feet per acre, with a mean annual increment of 20 cubic feet per acre, will give 3,800 cubic feet per acre at the end of 30 years. This is fairly close to the merchantable volume of 4,000 cubic feet per acre for the present mature and overmature timber.

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172 This represents 8.5 million cubic feet of round timber annually.
Future sawlog production will be economic because of new fire protection roads. After the present, mature stands near the roads are cut there will, however, be a leveling off of financial returns. At the current rate of demand, the rate of production for the next 30 to 50 years must decline.\textsuperscript{173}

## Table I

**LAND CLASSIFICATION (1954)**

<table>
<thead>
<tr>
<th>Accessible Areas (2)</th>
<th>Area Sq. Miles</th>
<th>% of Total Accessible</th>
<th>% of Total Crowsnest Forest</th>
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<tr>
<td><strong>Productive</strong></td>
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<tr>
<td>Softwood Merchantable</td>
<td>208.2</td>
<td>25.1</td>
<td>16.1</td>
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<td>Young Growth</td>
<td>275.0</td>
<td>33.2</td>
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<td>Mixed Merchantable</td>
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<td>0.4</td>
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<td>26.6</td>
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<td>2.1</td>
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<td>0.1</td>
<td>0.0</td>
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<td>80.2</td>
<td>9.7</td>
<td>6.2</td>
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<tr>
<td>All Types Merchantable</td>
<td>213.0</td>
<td>25.7</td>
<td>16.5</td>
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<tr>
<td>Young Growth</td>
<td>381.8</td>
<td>46.1</td>
<td>29.4</td>
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<tr>
<td><strong>Total Productive</strong></td>
<td>594.8</td>
<td>71.8</td>
<td>45.9</td>
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<tr>
<td><strong>Total Non Productive (4)</strong></td>
<td>233.2</td>
<td>28.2</td>
<td>18.0</td>
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<td><strong>Total Accessible Areas</strong></td>
<td>828.0</td>
<td>100.0</td>
<td>63.9</td>
</tr>
</tbody>
</table>


(1) Reserve Boundaries as of April 1st, 1954, Forest Type Boundaries as of the year 1950-51.

(2) Accessible Areas — All areas under 6,000 ft. elevation.

(3) Merchantable Stands — All stands with an average D.B.H. of 4" or better and an average height of 30 ft. or more.

(4) Non Productive Forest — Forest incapable of yielding products other than fuel because of adverse site including slow growing, dwarf, or stunted forests, as well as rock areas, rivers, marshes, townsites, roads, etc.
Table II

MERCHANTABLE TIMBER B SPECIES

(In Millions of Cubic Feet in the Accessible Area Only) (1)

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Volume(2)</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Spruce</td>
<td>238.6</td>
<td>50.4</td>
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<tr>
<td>Lodgepole Pine</td>
<td>168.9</td>
<td>35.7</td>
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<tr>
<td>Alpine Fir</td>
<td>28.1</td>
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<tr>
<td>Douglas Fir</td>
<td>30.7</td>
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<tr>
<td>Other Softwoods</td>
<td>3.3</td>
<td>0.7</td>
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<tr>
<td>Hardwoods(3)</td>
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<td>0.8</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>473.3</strong></td>
<td><strong>100.0</strong></td>
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</tbody>
</table>

All Diameters over 4" D.B.H.


(2) Volume figures are based on field survey during the summers 1949-1953, by the E.R.F.C.B. All volume figures are in gross cubic feet.

(3) Hardwoods composed of poplar species.
Sawlog Forest Management and Forestry
Prospects in Southwestern Alberta

The East Slope as a whole, under present economic conditions, is not a sustained-yield, saw timber area, and the rate of growth is slow as compared to northern Alberta and interior British Columbia. However, Dutch Creek, north of the Crowsnest Pass, is an exception. A pulp industry would be the best way of utilizing this timber stand.

At the present time only spruce is considered a major, commercial species in this area. The spruce trees are however not clear, straight and fast growing.\(^{174}\) Good spruce regeneration is another major problem. Spruce seed years show periodic fluctuations. In addition, there are periodic droughts. Solutions to the problem would be provision of adequate seed sources, some kind of soil scarification, and partial or complete replanting of the cut over areas. But on the other hand, over stocking and stagnation should be avoided. The long rotation age of 140 years also poses some economic disadvantage.

The great fires of the dry 1930's have resulted in large stands of young pine and almost no young spruce

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\(^{174}\) The average spruce sawlog tree is approximately 11 inches D.B.H. and about 60 to 70 feet high. The form tends to be poor and limby. As much as 20 percent of the gross volume in the overmature stands may be lost by heat rot. From -- W. J. Flemming, Forest Inventory, E.R.F.C.B., p. 4.
approaching maturity. Large, homogeneous, pine stands present a problem of protection from insects, especially after maturity. This problem probably already exists in the Dutch Creek basin, where the best, mature and overmature, spruce stands are located.175

In addition to these problems, the establishment of a pulp mill in Southwestern Alberta is impractical. A large water supply and a large stream, for dumping waste chemicals (without serious pollution), are needed. No such large streams (for a 200 ton kraft mill) are found in the area studied.

Comparison (All measurements in cubic feet)

<table>
<thead>
<tr>
<th></th>
<th>All time Max. Flow</th>
<th>All time Min. Flow</th>
<th>Mean Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellowstone at Livingston</td>
<td>30,600.0</td>
<td>590.0</td>
<td>3,602.0</td>
</tr>
<tr>
<td>Oldman at Fort MacLeod</td>
<td>78,500.0</td>
<td>6.5</td>
<td>1,413.0</td>
</tr>
</tbody>
</table>

The Yellowstone River at Livingston, Montana is considered to have too low a minimum. The Oldman River at Fort MacLeod is much lower. Consequently the pulp plant, if built, must be built on the moister, British Columbia side of the watershed.176

176 Ibid., p. 6.
There is also the possibility of establishing an integrated, solid wood operation, based on the present mature and overmature Dutch Creek timber.

IV. TRAPPING, HUNTING AND FISHING

In exploiting the wild-animal world, trapping, hunting and fishing are the counterparts of forestry, which exploits the wild-vegetation cover. However, animals are not considered to be part of the landscape. Therefore, their removal is significant only in as far as it provides a livelihood for people, or alters the countryside.

Hunting was the earliest economic pursuit in Southwestern Alberta. The plains Indians, especially, were great buffalo hunters. With the coming of the Europeans the emphasis shifted from hunting for food and clothing, to hunting and trapping for pelts, to be traded in large quantities for manufactured commodities. As the countryside was settled, cultivated, and grazed by domesticated livestock, the wild animals retreated to uninhabited tracts or were exterminated. When this era came to an end, only sport hunting and a little trapping continued. The buffalo traps are now gone, but remnants of the buffalo pounds may be found. Otherwise the landscape appears to be unaltered.
Some trapping is carried on in the forest reserves, but isolated log cabins are the only landscape evidence of this. These cabins are destroyed periodically according to forest conservation board regulation.

Fishing has never been important in the small streams and rivers of the eastern Rockies and western plains. Coal pollution threatens to become a problem in Crowsnest River, but the other streams in general support fairly good sport fishing. Trout is especially an attraction in the clearer waters.

In summary, the trapping, hunting and fishing economies may be said to have changed during the last century from basic and all important to largely recreational and relatively insignificant.

V. MINING

Mining is an extractive activity in the landscape picture. While agriculture organizes, nurtures, reaps and then repeats this cycle, mining like typical forestry, only "reaps" (extracts). However, forests replenish themselves in a relatively short time. Minerals are replaced so slowly in nature, that considering the human life span, one
might say that the material extracted by mining is gone "forever", without replacement.

Agriculture, forestry, hunting, fishing and trapping take their products only from the biosphere, but mining relies on the basic lithosphere.

Fundamentally there are three ways in which mining extracts from the lithosphere. The simplest is surface excavation by quarrying or strip mining. However, if the minerals are far underground tunneling or drilling are used. All three, quarrying (including strip mining), drilling, and regular underground, tunnel mining are to be found in Southwestern Alberta.

Except for some small volcanic pockets, Southwestern Alberta rests almost entirely on a sedimentary rock foundation. The volcanics, which are largely found in the Crowsnest area of the Rocky Mountains, have as yet yielded no economically significant minerals. If valuable minerals are found, these volcanic pockets would probably only give a small supply. Consequently, mining in Southwestern Alberta relies almost exclusively on the sedimentary beds. Because of their nature sedimentary rocks usually yield fuels rather than metallics. Mining in the area studied is extensive and important, but largely limited to coal, petroleum and natural gas.

177 Many volcanics, notably lavas, are notorious for their lack of mineable minerals.
Coal mines in operation 1955-56
Koolenay coal bearing beds in Crowsnest area
Crowsnest mining belt

Oil fields
Natural gas
Limestone
Iron ore (undeveloped)
Phosphate may be found in economic quantities but is not developed.

COAL

At present, coal mining is by far the most important mining activity in Southwestern Alberta. In fact, in no portion of western Canada is coal mining more significant. One area especially is almost entirely dominated by this activity. This is the Crowsnest area, from the continental divide to the front of the mountains, and formerly onto the plains beyond. There is also some mining southward in the foothills at Beaver Mines. In the remainder of the area, coal mining is at present largely inactive because of economic conditions. Lack of markets has caused the shut-down of all but the larger, richer mines.

At one time or another, coal has been mined, a little here and there, throughout most of Southwestern Alberta. There are, however, some parts which have supported little or no such mining activity. Among these are the level plains around Glenwoodville and the Porcupine Hills together with some of the adjacent country, all of which rests on the Paleocene and Upper Cretaceous beds of the Alberta syncline. Immediately eastward however, lie beds upon which the prominent, Lethbridge, coal industry relies. Southward, in the Milk River Ridge country, coal has also been mined, but only in small quantities.
It is primarily westward, in the disturbed belts of the foothills and mountains, that the most important coal mining has been and still remains. Coal bearing beds are found especially among the Cretaceous sediments which comprise the foothills zone and the infolds between the higher, Palaeozoic, mountain ranges. The intense folding and faulting of the strata results in a greater variety of beds being exposed at, or near, the surface. This in turn facilitates discovery and mining of coal. In addition, the mountain building pressures have turned soft beds of coal into hard coal, which commands higher prices on the market and is therefore more financially rewarding to mine.

In the foothills zone coal has chiefly been mined in the areas west of Cardston and west of Pincher Creek. In the former, the mines were small and are now no longer in operation. The mines west of Pincher Creek are located at Beaver Mines and at the entrance to the Crowsnest area, notably at Lundbreck. This coal district might be considered a continuation of the Crowsnest area. Some coal is still mined at Beaver Mines although the community appears partially deserted. The Alberta and Kootenay Railroad to the settlement is no longer in operation. About two years ago the mine at Lundbreck was closed down. Ranching and transport, however, still support this centre.
The great coal area of Southwestern Alberta lies in the Cretaceous infold of the Crowsnest basin, district of the Rocky Mountains. Coal mining dominates over every other activity here and most of the settlements rely almost exclusively on coal for their basic support. Coleman, Blairmore, Frank, the extinct Lille, Hillcrest Mines, and Bellevue are all coal mining centers. These towns are also all located near the bands of coal-bearing, Kootenay strata which occur in the Cretaceous rocks (see map). Were it not for this Cretaceous infold, the mountain area here would probably not have any coal mining activity at all. Coal is not mined in the high, mountain block of the Precambrian Rockies or in the Palaeozoic peaks and ranges. Coal mining only exists in the basins and embayments of Cretaceous rock in the mountain zone. The subdued, Cretaceous topography, with its gentler valleys, is also an asset in building railways to move the coal, which of course exists there because of this same Cretaceous bedrock. Without the east to west C.P.R. railway, crossing western Canada through the Crowsnest area, coal mining would not have flourished as it has. The railway sparked the coal mining ventures.

Southwestern Alberta's coal is largely of bituminous type. The coal zones of the province lie in broadly northwest southeast belts, paralleling the grain of the Rocky Mountains
and foothills. Hard anthricite coal is found in the high mountains, where this type has been formed by intense pressure, often associated with mountain building. As one progresses eastward pressure on the rocks has been less. Consequently the coal beds become less hard, going from bituminous, in parts of the mountains and the foothills, to sub-bituminous on the western plains to lignite further eastward on the interior plains, especially in Saskatchewan Province.

In addition to mountain-building, pressure-caused maturity in coal, actual age is a determining factor. The coals of the Crowsnest area are among the oldest (but still not very old) in Alberta. This is yet another reason for the high quality coal and the resulting, extensive mining in this area.¹⁷⁸

Types of Mining

Coal is mined in two ways in Alberta, by underground mines and by surface strip mines. Both are important in the mining picture, although the former is the most common.

(a) **Underground Mining**

In the Crowsnest valley proper, coal mining is largely limited to the underground type. The larger mines are located adjacent to the railway lines, which provide the cheapest, bulk transportation for coal. Major mines are located at Bellevue, Blairmore, and Coleman. All the typical structures associated with underground mines are present. Preparation plant, tipples, main mine building and plant for circulating fresh air into the mine are characteristic landscape features of the Crowsnest Pass country. For obvious reasons black is the dominant color of the mines and adjacent countryside. Many of the mine roads are even surfaced with "coal gravel", which does not tend to become muddy during periods of rain. The buildings themselves are generally black, with the occasional bright and economical tin roof. Snow tends to slip off these light, durable, metal roofs, thus giving them an additional advantage in the relatively snowy, Cordilleran area.
The underground mine itself may be of two types. One is the room and pillar system. The other is the long-wall system. In the former narrow "pillars" separate the rooms in which the coal is mined. The rooms, which may be extended, lie parallel to one another. Fifty percent of the coal may be taken in the initial working. Later working recovers coal from the pillars by progressive roof caving. The long-wall system of mining removes the entire coal seam and leaves few pillars. The coal may be mined outward from the entrance leaving roadways leading to the working face, or it may be worked backwards from the far end of the seam.

All of the coal mined is not of the same quality. Pieces of partings, or of the roof and floor, may be included. Coal, however, should be uniform when marketed. Otherwise the result will be varying heat when it is burned. Therefore the big collieries have preparation plants associated with them. There the coal is cleaned, so that it will have a uniform ash content and is also dried to a specific moisture content, if it has been wet-washed. In addition screening is used to separate the coal into various sizes.


180 Ibid., p. 89.
Besides the mine and preparation plant, the highly mechanized, Crowsnest mines also have tipples. These are fairly standard and therefore require no further elaboration.

(b) **Surface Strip Mining**

The strip mines in Southwestern Alberta are largely located in hill country on either side of the Crowsnest valley. Here the coal beds are relatively close to the surface, which enables the miners to strip off the shallow over-burden and excavate the coal in an open pit by means of a steam shovel. The coal is shoveled into trucks, which carry it down to the railway in the Crowsnest valley, over tortuous, twisting, mountain roads.¹⁸¹

Strip mining leaves very prominent scars in the landscape. A large, quarry-like, coal-black, pocket nestling among the hill tops is the typical appearance of these mines.

Strip mining has increased very greatly during the last few years, because stripping is a cheaper operation than underground tunneling. Since the coal mining industry has recently experienced difficulties, the more economical operations have a distinct advantage.

At present, coal mining is a declining rather than expanding industry. The reason for this is not lack of coal. Alberta has 46,562,000,000 tons of coal "reserves" (i.e. coal minable with the present technology). Of this, the Crowsnest area has about 5,100,000,000 tons while Southwestern Alberta as a whole including outlying border areas has 8,500,000,000 to 9,000,000,000 tons of coal reserves. Only about one percent of Alberta's coal reserve has as yet been used up.\(^{182}\) It should also be added that the Province of Alberta has 48 percent of Canada's entire coal reserves.\(^{183}\) Competition with oil and natural gas has caused coal to lose much of its former market. Both space heating and power generation have been affected by a switch toward petroleum and gas products. The railway's dieselization was the most severe blow to the coal industry. With a greatly lessened demand for coal its importance as a fuel has decreased, and the amount of coal mined has consequently decreased. This accounts for so many mines being abandoned, shut down or put on a part time shift. As a result, towns based on coal mining must also decline somewhat. The numerous abandoned buildings (especially commercial) in the Crowsnest area attest to this. Population has also dwindled somewhat.

\(^{182}\) Facts and Figures, Alberta, p. 108.

\(^{183}\) Alberta's Economic Prospects, p. 88.
The decline of the coal industry is however apparently only temporary. Coal is still the cornerstone of industry in the world's most heavily industrialized areas. A good market for Alberta coal has always been the industry's main problem. Until recently the railways provided the chief market. As long as the bulk of Canada's population is in the east, far from Alberta, the marketing problem will exist. However, the following possibilities, as mentioned in the Gordon Royal Commission, should eventually assist the industry.

(1) The government may offer assistance. (This is unlikely.)

(2) If Alberta becomes the seat of an iron and steel industry great amounts of coal would be needed.

(3) Advances in combustion engineering might help coal become even more suitable for heat and power generation.

(4) Coal may recapture a good part of the railway-fuel market. Work is now underway on coal-fired, gas turbines.

(5) A chemical industry based on coal, and complementary to the petrochemical industry is a distinct possibility. 184

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184 Alberta's Economic Prospects, pp. 93-94.
The last possibility seems ideal for the Crowsnest area, which lies directly on major east-west railway and highway connections, and which already has a large labour force settled in well established towns. At present, something along this line appears to be the most significant alteration in the human, landscape segment's pattern, which could take place in Southwestern Alberta during the next few decades. Again however, marketing of the products may present a problem.

OIL AND GAS

Next to coal, oil and natural gas are Southwestern Alberta's most important mining products. Four parts of Alberta's southwestern corner have been significant to the petroleum industry. These districts are near Del Bonita, Waterton Lakes, Pincher Creek (Twin Butte) and in the forest reserve north of Coleman.

Alberta's first oil well was drilled around 1902, near Cameron Creek, high in Waterton Lakes National Park. It reached a depth of 1,020 feet and struck oil. This was, however, not the first report of oil having been found there. The Indians used oil for dressing wounds, and one of the pioneers sold oil to the nearby farmers for machinery lubrication and for the protection of fence posts. A little
village was built called Oil City near the discovery site. However, the boom declined and the town was completely abandoned. Today only decaying, crumbling remnants bear evidence of Oil City. As late as the 1930's an old well filled with crude oil was used by Waterton residents for a source of lubrication and road oiling. (The cribbing is now no longer intact.) Apparently, no really, economically great, oil pocket has been located here, despite the very promising surface showings, which even include oil in the river sands.  

In the same Rocky Mountain region far to the north of Waterton, lies one of Southern Alberta's newer discoveries. This is the Savanna Creek No. 1 gas-well, located in the forest reserve, immediately behind the Livingstone Range, along the new Coleman Kananaskis forestry road. It appears that this area holds some promise, as it has been taken into account by the authorities in considering Alberta's gas export possibilities.

The greatest oil and natural gas area in Southwestern Alberta is probably located in the foothills belt, south of Pincher Creek. Wells have been drilled near Twin Butte, which have given very good results. An oil company is at present developing this area quite extensively.

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185 "First Well in Alberta Drilled Near Waterton", The Albertan, Tuesday, September 6, 1955, Oil and Gas Section, pp. 1-2.
Already one petro-chemical plant is planned in Southwestern Alberta. The Pincher Creek field is both a natural gas and oil field. However, it is the gas which is especially significant here. It has even been rumoured that this field is being protected from export, for use in booming Southern Alberta, while gas in less accessible areas is sent out of the Province.

On the high plains around Del Bonita lies a prominent but small oil and gas field supporting 12 wells (in 1955). This has brought added prosperity and fame to a somewhat outlying area. The odd tall, slender derrick standing above the wide horizontal plains is an especially striking contrast here.

With respect to the appearance of the oil wells in the landscape three features should be mentioned, the derrick, the capped well and the burning of waste. At present, active, drilling wells have a derrick of the portable type. From a distance this looks much like the standard, permanent derrick. The portable type is a good economy measure, since the derrick can be moved to where it is needed for drilling, instead of left at the original well as an expensive steel structure to rust away. A well may be capped and put on steady flow via pipeline to a collecting center or refinery. This, however, appears to be especially common

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186 Through personal correspondence in 1956 with Mr. J.G. MacGregor, Chairman of the Alberta Power Commission.
in north-central Alberta. The burning of wastes has been curtailed by the Alberta Government. In the not so distant past, the great columns of black smoke rising from burning wastes and the pillars of flame associated with uncapped gas wells broke the distant horizons by day and lit up the countryside by night. Some of the flares are still seen, but they are now occasional, not "permanent" as before.

The present economic outlook for the petroleum industry in both Alberta generally and the southwestern corner of the province specifically, is overwhelmingly optimistic. The industry is in a state of booming expansion and has contributed materially to Alberta's postwar prosperity. Together with Alberta's generally healthy economy it has in turn spurred new construction and highway development. These effects are in evidence in the new bungalows and businesses at Cardston, Pincher Creek and other centers, plus the recently paved, main arterial highways. An all around healthy economy is at the roots of this, although petroleum exploration and discovery has particularly helped.

LIMESTONE

Much of the Rocky Mountains is composed of limestone. Therefore, quarrying of this rock is an important economic pursuit. There is one quarry, the Summit Lime
Works Limited, located in the Crowsnest Pass, between Island and Crowsnest Lakes. The semi-bare, limestone cliffs rise on one side, while the railway runs through part of the operation on the other side. This is a truly ideal location. The stone is used for lime and limestone products. (Spreadwell Hydrated Lime and Red Flash Pulverized Lime are the trade-marks used in marketing.)

PHOSPHATES

Phosphate deposits, in the same formations which are much mined in Montana, Wyoming and Idaho, extend into the Alberta Rocky Mountains. As yet, truly economic deposits have not been located in Alberta. However, the possibility exists and Southwestern Alberta, being closest to the mined areas, would be one of the most likely parts in which it would be found. Potash and phosphates would be very valuable as fertilizers for the cultivated districts of Alberta. In other words, if discovered, phosphate could become very significant to the local economic picture. This is however only a future possibility. 187

IRON ORE

Despite what has been said about metallics being untypical for sedimentary areas, metallics do occasionally occur in these regions. A notable example is found near Burmis in Southwestern Alberta.

In the Burmis area lie three iron bearing beds of black magnetic sands with intervening bands of sandstone. Outcrops indicate a 40% average iron content. Unfortunately, titanium oxide is also present. This must be removed, and therefore the costs of iron production will be great. Core drilling has been done in the area but no actual mining has yet taken place.

In the future, this eight mile long belt may be the site of a sizeable iron mining scheme, perhaps of the surface excavation type. Since fuels, both coal and natural gas are cheaply available nearby, an iron steal industry may even arise here. But that is in the future.
VI. POWER

Power developments, whether hydro-electric dams or steam generating plants, tend to be very prominent features in the landscape picture. Modern economy, especially manufacturing, relies heavily on these large scale power developments.

At present Southwestern Alberta is not significant as a source of power. Hydro-electric power dams and installations are totally lacking. The only local source of power is the large steam plant at Sentinel. However, this plant has been closed for more than two years, and there is even a possibility that it will not reopen.

It is rather unlikely that hydro-electric power will be developed in Southwestern Alberta. Perhaps some forty years ago, the power potentials of the rivers in this area were computed by the Dominion Water Power. By today's standards and needs, these rivers are generally not worth developing. The reasons for this are as follows:

(a) The streams are small.

(b) The difference between minimum and maximum flow, and the flow from year to year, is enormous.

(c) The entire drainage area is on the dry, rain shadow side of the mountains.

(d) There are few lake basins for natural water storage, with the exception of Waterton Lakes.
(e) Although the rivers flow from mountains to plain, the drop is not striking, although there are a number of river gaps where huge dams could be constructed, if the water supply warranted it.

(f) The use of most of the streams for irrigation precludes their use for power.

The hanging valleys in Southwestern Alberta's highest, most moist area, Waterton Lakes National Park, are somewhat of an exception to the above. However, this area is a national park and dam construction, stream ponding and so forth are prohibited, or at least very strictly controlled.

Nevertheless the power potential of the coal rich Crowsnest Pass area is quite considerable. Great steam power plants could make use of the high quality coal here. According to the Alberta Power Commission, a local Alberta power company might develop a plant of 50,000 to 100,000 K.W., while the power hungry U.S. Northwest might be interested in constructing a 500,000 K.W. plant in the Pass. The Pincher Creek natural gas reserves are also a potential power source. This would encourage future industrial location in the area.

At present, Calgary Power supplies Southwestern Alberta's power needs. Blocks of land in the more densely settled, farming areas have rural electrification.

188 Through personal correspondence with Mr. J. G. MacGregor, Chairman of the Alberta Power Commission, in July, 1956.
Except for powerlines along some of the roads, the landscape effect of this power supply is very negligible. Many outlying farms and ranches have their own characteristic, power windmill.

VII. MANUFACTURING

Manufacturing may be defined here, as the industry of producing artificially made goods from natural, raw materials. Manufacturing is an integral part of modern life, since the bulk of tools, machines, artifacts and even foods are manufactured. Manufacturing industries, however, usually need large numbers of people for labour, and therefore tend to be located in urban centers.

Southwestern Alberta has very little manufacturing. The distance to markets, lack of cities and large local population, plus recent settlement largely account for this.

The industries in Southwestern Alberta are directly concerned with primary processing of the raw materials produced locally. There is no manufacture of specialized articles such as clothing, books, machinery, and so forth. The manufacturing is associated with agriculture, mining, and forestry products.
The agricultural manufacturing plants are limited to creameries and cheese factories. There are three prominent creameries in Southwestern Alberta, one in the Crowsnest Pass country at Bellevue, one at Cardston and one at Pincher Creek. The cheese factory is located at Glenwoodville in the United Irrigation District, where dairying and mixed farming are important.

Sawmills are the only "manufacturing" establishments associated with the forestry industry (with the exception of local contractors and carpenter's shops.) Sawmills are located at Blairmore in the mountains, Burmis in the foothills, and in the central Porcupine Hills. Each forested, topographic section, thus has one mill. At one time sawmills were also located at Oil City in Waterton Lakes National Park, just after fire badly damaged an extensive forest tract there. 189

Manufacturing from mining products is at present limited to lime at Crowsnest Lake but will soon include chemicals at the projected, petro-chemical plant in the Pincher Creek, natural gas area. Formerly, in the Crowsnest Pass area, a cement plant operated from 1909 to about 1916 at Blairmore, while coking ovens were in operation at Coleman, and a smelter for Kootenay ore was constructed at Frank, but

189 The Albertan, Oil and Gas Section, Tuesday, September 6, 1955, p. 2.
did not have a chance to operate.

As indicated in the section on power, large, cheap supplies of coal and natural gas should spur industrial location in Southwestern Alberta in the future.

VIII. TRANSPORT

Intimately associated with the economic geography of an area is the transport network, which not only serves the economy but is actually a part of the economic geography pattern.

Since Southwestern Alberta, from an economic point of view, is generally speaking highly commercialized and not a self-sufficient, subsistence area, transport is a vital link moving goods in and out of the district. The great coal mines, extensive tracts of wheatland, thousands of head of range cattle and sheep, as well as lumber all depend on outside markets. It is almost an understatement to say that Southwestern Alberta engages in the large scale production of highly specialized products. However, there is considerable internal diversity also.

Southwestern Alberta's specialization, by its very nature, has left many gaps to fill. Large scale manufacturing is virtually nonexistant. Consequently manufactured products,
ranging from breakfast food to books and jewelry must be brought in, largely from Lethbridge and Calgary. Commercialized specialization usually means that a community or district is well advanced economically and consequently has good purchasing power. Therefore, more high quality and luxury goods may be in demand. This factor further stimulates trade.

It should also be pointed out that there is considerable movement of goods within the area, plus movement of people to and from the trading and social centers. There is sufficient diversity in Southwestern Alberta that in time of war and broken outside contacts, the area could survive as long as internal links were not too badly shattered.

A number of main, first-class transportation arteries, with a moderately good network of secondary connectors, serve Southwestern Alberta. Generally speaking, the main transportation links give fairly good access to most of the area, and although not dense, are more closely spaced than in some nearby areas. The secondary transport network however, is less complete, especially in the higher more rugged districts to the west.
Rail

Southwestern Alberta has only two rail lines connecting it with the rest of the world. The most important of these is the C. P. R. Crowsnest Line from Medicine Hat, Alberta, to Hope, British Columbia. At Fort MacLeod, Alberta a connection is made northward to the heart of the Province. At Lethbridge, Alberta connections also run north and south to Montana, U. S. A., while at Yahk, B. C. a connection runs to Spokane, Washington in the "Inland Empire" U. S. A. Southwestern Alberta's second railway connects the relatively densely populated, irrigated districts around Glenwoodville, Cardston, Magrath and Raymond with Lethbridge. A spur line from Raley, near Cardston, reaches down to Whiskey Gap, which serves as an outlet for the Milk River Plateaux.

The railway, in Southwestern Alberta, is probably the most important transport link from an economic point of view. In the Crowsnest Pass the coal mines were made possible by the coming of the C. P. R., which provided transport to markets and in addition used most of the coal mined for its own engines. Cattle, horses and wheat as well as specialty irrigation crops all rely on the railway for movement to market. However, all are first moved to the railway loading points by road. Livestock loading corrals, grain elevators and coal tipples are very characteristic features along the railway lines. Although rail is
important, no major rail junction or large railway yards are located in Southwestern Alberta.

Road

Main roads serve the area rather well, but not completely. Highway 3 follows the C. P. R. Crowsnest Line and, like it, is a cross-country transportation link. It is the only all-season, Canadian road crossing the Rockies between Pacific and Atlantic. It is also the best road (with few high, rough, twisting sections) and most heavily trafficked cross-country artery. Highway 2 extends southward from Fort MacLeod through Cardston to Carway on the Montana border. It has recently been paved, shortened and now serves as the shortest, fastest link between Montana, Cardston and Calgary. Highway 5 is the link between Cardston, the Magrath irrigation country, Lethbridge, and Waterton Park. It is probably the most vital, local road for Cardston economically. Highway 6 connects Pincher Creek with Waterton Lakes National Park and Glacier Park by a scenic foothills route. It is thus the most westerly highway serving the range country near the mountain base. It also has been paved, primarily for tourist travel. Other seasonally good, but gravelled roads lead to Kananaskis from Coleman, from Cardston to Kimball and Del Bonita, and from Lundbreck to Maycroft. The Kananaskis road is a forestry,
fire prevention and access road, but is also used by tourists as a scenic short cut from the Crowsnest Pass to Banff. (It is open only in summer.) The Del Bonita and Maycroft roads serve outlying districts. Both are through roads, the former continuing to Coutts, the latter to Nanton.

With respect to secondary roads these reflect the land use pattern, being more dense in the more intensely utilized, densely settled agricultural areas, and less dense and poorer in the less intensively used districts. As one comes into complete ranching country and rough terrain, (the two are frequently associated), the roads lose their rectangular, interfield pattern and criss-cross in a seemingly random manner, but actually run naturally from place to place, following the lay of the land. In the wilder parts of the Milk River Ridge and the Rocky Mountains there are no roads and only occasional trails. Lack of significant economic and population activity in these remote places are the reasons for this.

Water

The only water transport in the area is the summer boat service from Waterton Town across the border to Goathauot Landing in Glacier National Park. This is what one would expect. Streams are generally rushing torrents or are shallow and gravelly, frequently not good enough even for canoes, especially in low water. St. Mary's Reservoir, on the eastern border of the area considered, is now the largest
body of water in Southwestern Alberta. It can be used for recreational boating. Its location in the area furthest from the mountains in Southwestern Alberta is fortunate, for here is the greatest need for a recreation spot.

Air

The chief transcontinental air line through Calgary does not cross Southwestern Alberta, but main line service is in operation through nearby Lethbridge. These planes fly over the Crowsnest Pass, but do not land in the area.

There is an emergency field at Cowley, and small planes can land in the Crowsnest Pass and at Pincher Creek Air Field, which even has a flying instructor and several local pilots. Planes have landed at Waterton also. Ranchers and farmers sometimes maintain private planes for checking their vast tracts of land and livestock. Open grassland and fields are used for landing strips.

IX. TOURISM

The effects of the tourist industry upon the landscape are often rather limited. Areas of unusual scenic interest and beauty are frequently reserved and protected from other human exploitation, such as forestry,
cultivation and mining. Southwestern Alberta has one national and two provincial parks plus one historic-scenic area (the Frank Slide), which is protected by restrictions against defacing. Human additions to such restricted areas are purposely kept to a minimum in order to preserve the natural state which, in itself, is often the main attraction. A few access roads may be constructed and a number of picturesque hotels and cabins built in a style harmonious with the surroundings. This is well shown in Waterton Lakes National Park. Except for these features the restricted areas are generally as close to the virgin state as possible.

Waterton Lakes National Park is primarily a scenic area, but it also serves the recreation needs of southern Alberta. Golf course, beach, boating, trail riding, and fishing are most important recreation facilities.

Provincial Parks are located at Lundbreck Falls and Bovey Lake, both in the foothills west of Pincher Creek. (Waterton amply serves the needs further south). These are largely campsite, and cabin locations, although both are picturesquely scenic. Lundbreck Falls is in fact more important as a scenic spot than as a recreation or camp area.
In addition to these parks, recreation is provided by a number of scenic, dude ranches in the inner foothills and mountains, notably the JO near Beaver Mines.

Rather special attractions are offered by the scenic and historic Frank Slide on Highway 3 and by the newly completed forestry road from Coleman to Kananaskis. The latter road traverses almost 200 miles of wilderness broken only by a few campsites and ranger stations. No commercial establishments, such as gas stations, are located in the forest reserves.

In conclusion, one might say that scenically, Southwestern Alberta is magnificently diversified, and historically, one of Alberta's most romantic, almost legendary parts.

X. CONCLUSION

A few concluding comments to the preceding economic discussion should help re-emphasize some of the fundamental ideas.
The economic mosaic in the landscape represents man's different utilizations of his environment. Man's settlement pattern and his whole culture rests upon this base. Southwestern Alberta's economy is as varied as its scenery. Very roughly, agriculture dominates the scene on the plains and in the valleys, while forestry dominates the timbered slopes. Mining extracts below both of these surface activities, while manufacturing, service and so forth tend to be located in the nucleated settlements. Tourism is a rather passive economic pursuit in Southwestern Alberta. Majestic mountain summits, to be viewed and climbed by the vacationer, are its chief resource. The life-blood of this entire economic system pulsates in the transport arteries, without which large scale commercial production -- so characteristic of western Canada -- could not exist. This summary, however, is merely another way of considering the economic mosaic.
SETTLEMENT

ADDITIONS

AND

ADJUSTMENTS
SETTLEMENT ADDITIONS AND ADJUSTMENTS

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IV. CONCLUSION
I. INTRODUCTION

The human settlement pattern of an area is chiefly based on three things, the cultural heritage of the inhabitants, their economic pursuits, and the physical environmental factors. Therefore, a people's historical background, together with the economic possibilities of the land they inhabit, largely account for the settlement additions and adjustments in the landscape.

Settlement may be divided into two broad types, nucleated and dispersed, (non-nucleated). As in most broad divisions, there are numerous examples of borderline cases. Nucleated settlements are ideally urban or town centers, but include also farm villages. Dispersed (rural) settlement is at best a pattern of one family "headquarters" (home and associated structures) scattered over the countryside in such a manner that no two are adjacent. However, it happens that several families inhabit one farmstead (which may in extreme cases be designated village farms). Perfect dispersal is likewise not always encountered, for farms may tend to congregate at crossroads.

190 Southwestern Alberta's farm villages generally fit in best with the rural discussion. In latter years home building on the farms has also increased, making some areas a mixture of two settlement traditions. Accounts of specific centers today, are given in the part dealing with nucleated (urbanized) settlement.
A pattern of dispersed settlements producing raw materials, with a sprinkling of trade, supply and manufacturing nucleations, might be considered typical for much of Alberta. In Southwestern Alberta, the Pincher Creek area, with its dry-land farming and ranching, most closely approaches this ideal. Mormon, Hutterite and mining settlements all have nucleated aspects.

I. DISPERSED (RURAL) SETTLEMENT

Much of Southwestern Alberta's population lives in a widely scattered rural settlement pattern, rather than in nucleated settlements, such as towns and villages. The nucleations, in fact, frequently owe their existence to this far-flung population, producing raw materials for the area's economy.

Scattered settlement in Southwestern Alberta generally falls into a number of patterns related to the economic background of the inhabitants. Agricultural settlement falls roughly into three patterns, irrigation farming, dryland grain growing and mixed farming, and ranching. Mining is largely a nucleated settlement industry. An exception is the widely scattered oil and gas wells of Southwestern Alberta. Forestry likewise tends to concentrate in the towns, but the gathering of the raw materials is exclusively a non-nucleated or temporarily
nucleated pattern. Trapping, hunting and sometimes fishing are non-nucleated. Other economic pursuits leave marks both in the nucleated centers and in the far-flung hinterlands. Tourism, power and transport come into this class.

The rural or non-nucleated, dispersed settlement pattern has somewhat of a nucleated aspect to it. When farmsteads and ranches are large, with many people occupying the "headquarters", this becomes a minor nucleus surrounded by "empty" land. In addition, religious communal colonies are nucleated.

Generally the nucleation aspect of rural settlement decreases as one goes westward across Southwestern Alberta. In the east are the Hutterite and Mormon religious communal farms and farm villages. Then there is the dry farming zone and next the ranching zone, with their large "headquarters" inhabited by many people. However, some of these are very small, isolated farm and ranchsteads. Westward lies the realm of the lonely trapper or forester's cabin. Coal mining towns and forestry camps in this area are nucleated settlements, and stand out in sharp contrast to their surroundings.

In southeastern, Southwestern Alberta the Milk River Plateau country shows a dry-farming, ranching pattern of settlement in the lower, more level, southern zone. The higher Milk River Ridge zone north of the Milk River,
with its gentle escarpment above the irrigated Magrath plain is largely open, virtually uninhabited, with very few roads. Livestock are grazed here by people living adjacent to this area.

A. HUTTERITE COLONIES

Somewhat beyond the area being considered in this study, lie a number of religious, Hutterite colonies. These are more or less communal ranches and farms following similar agricultural pursuits as their neighbours, but being re-organized into colonies. The Hutterite people are frugal and take good care of their land. The East Cardston Colony is one of 98 in the greater west (including U.S.A.). It is a ranch of some 2,700 acres inhabited by 85 people. The main products are wheat, poultry and vegetables. Hutterite colonies may be loosely described as village-farms rather than farm villages, since each communal settlement is responsible for only one large "farm".

To fully appreciate the Hutterites, their historic and religious background must be mentioned. These people are descended from German refugees of the last century. Their cardinal principles are pacifism, adult baptism and simple living. Dress and customs are 19th century. Modern attitudes and artifacts are largely scorned. However, the farming is highly mechanized and trade with the outside world averages $100,000 per year, per colony. Trucks and
telephones are widely used also. Yet outside marriage is considered sinful.\footnote{191}

B. MORMON FARM VILLAGE AREA (IRRIGATED)

The area of Mormon settlement in Alberta generally, and Southwestern Alberta in particular, focuses on Cardston, the spiritual nucleus for Canadian Mormonism. The heartland core of settlement extends from Cardston through Magrath to Raymond on the irrigated plains between the Blood Indian Reserve and the high, grassy, Milk River Ridge. Much of this area is devoted to intensive sugar beet growing together with some vegetable cultivation. This lush oasis strip is largely beyond the area here being considered. The grain, fodder and livestock district of the disturbed foothills belt and adjacent western plains is that section of the Mormon empire discussed in this study. It stretches from Cardston, around the southern end of the Blood Indian Reserve and northward between the Waterton and Belly Rivers in a second, minor, irrigated tongue lapping out onto the semi-arid plains. Proximity to the Alberta Rockies, however, prevents it from developing into a lush vegetable, fruit and sugar beet zone, because of the frost hazard.

The early Mormon pioneers from Utah brought with them the farm village system of settlement. Instead of building idolated farmsteads on the land they cultivated and grazed, the people settled together in spacious "farm villages". In so doing all members of the community, being in close proximity, could help organize and partake of defense, economic, social, cultural and religious advantages. These advantages could only be made available by nucleated settlement. A widely scattered population could hardly have organized and maintained these services and organizations, to say nothing of the atmosphere of cooperation, which could only be developed in a single, close community, under the guidance of one, all-powerful, patriarchal church.

The farm village was laid out in large, square blocks with wide streets. The lots were large, providing ample room for a barn, outhouses (sheds), vegetable gardens, oat fields, pasture and so forth, behind each dwelling. One street became the main commercial artery, with shops and stores. In temple towns, one block near the core of the settlement was set aside for the temple and grounds.

192 Defense against Indian attack was an important reason for establishing and maintaining the farm-village system, especially in early Utah.

193 The Salt Lake City master plan which served as model for the other Mormon towns consisted of square ten-acre blocks with 132-foot wide streets. Each lot was 1¼ acres in size. As a fire control measure, lots and houses ran north-south and east-west in alternate blocks. In this way, the streets had houses on only one side.
In lesser centers only a church was built.

The farm villages were arranged in a hierarchy, culminating with Salt Lake City in Utah as the supreme center of Mormondom. Below this were the regional temple cities, among them Cardston, Alberta's "Mormon Mecca". There were also other local centers, and finally the humblest and simplest of farm villages.

However, towns, large or small, served above all else as religious centers. Under church leadership nearly all activities received assistance and encouragement. The church served as the social center, and the town meeting center for discussing economic or political problems. In addition, educationa and even industry were organized under church leadership. The temporal and spiritual were not clearly distinguished. Hence the great strength of the L.D.S. church and settlements.

In addition to the communal aspect, Mormon settlement was characterized by orderliness and lush greenness. The regular, square blocks of the towns befitted cities of Zion, while the intensely utilized, agricultural tracts, cut through by regular irrigation lines and laced with access

194 Brigham Young said that no one should lay under himself more land than he could use. Ten acres of good land well cultivated was better than 20 or 30 skimmed over and producing weeds, according to early Mormons. In addition, only small pockets could be utilized for irrigation cultivation and therefore had to be intensely, carefully cultivated.
roads, where also most conveniently regimented into regular and orderly, rectangular, mosaic blocks. Rows of poplar windbreaks protected some houses and roads. Thus the town nuclei, or nerve centers, were surrounded by a green quilt-work, fed by life giving, irrigation water which kept the luxuriant, cultural landscape cover from wilting under the naturally harsh environment. This was the communal, theocratic settlement pattern the Mormon colonists brought to Alberta.

There were a number of reasons why the Cardston area of Alberta was selected to become a new Mormon "empire". Impressively long, luxuriant grass and vacant range lease in the Cardston area were the chief reasons for the original settlement. Good soils (in many cases glacio-lacustrian), available streams for irrigation, and safe distance from the mountains and their great frost hazard, combined with the endurance, energy, and foresight of the Mormon pioneers, made the present Latter Day Saints "oasis" a reality.

The original Mormon policies of communal ownership and farm village settlements have now been greatly replaced by private ownership and home construction on the farm land (i.e. einzelhof settlement), in both Utah and Alberta. The communal ownership of land received an early set-back in Utah from the U.S.A. Federal Government while the location of homes on the land -- especially

extensive farm tracts as in Alberta or even North Utah, which were not subject to Indian depredations — have proved quite satisfactory in the more modern era of rapid communications and farm conveniences. Nevertheless the Mormon mark has been so firmly developed and imprinted that its stamp can readily be seen in Mormon settled districts.

Today the Mormon irrigated zone is characterized by spaced, sprawling, farm village nuclei set on a green carpet interlaced with a broad pattern of irrigation canals. A scattering of farmsteads now dot segments of this lush tract. Each nestles beside stately rows of poplar (or other) windbreaks. Occasionally, a farm pond lies beside the yard, and frequently orderly plant rows mark an adjacent garden plot. All around a well-watered, well-weeded, relatively intensively-utilized quiltwork of fields produce alfalfa, allied fodder plants, barley, wheat, some oats and pasture. The grains however, are seldom artificially watered in the western sections. Associated with this growth is a great variety of domesticated animals, ranging from bees, which thrive on the clover nectar, to poultry (chickens, turkeys, etc.) pigs, cattle and large numbers of sheep. Some of the latter two may be range animals brought onto irrigated pastures for fattening.

196 Lombardy poplar, used extensively in Utah, has difficulty surviving Southwestern Alberta's alternating winter chinooks and cold spells. Hence, hardier poplar varieties are grown for shade and windbreaks here.
Architecturally, many of the older Mormon homes have similar styles to those of early Utah. Semi-Victorian and early U. S. styles have often been incorporated. Some dwellings are spacious, two storey, manor-like, brick structures. Others are wooden buildings, but most tend to have an air of permanence and stability, which is enhanced by the extensive plantings of windbreaks and gardens. In latter years the low, modern, Alberta bungalow or ranch-style home has become most popular. This is especially true since homes have been constructed on the farms, and where new irrigation areas have been organized. True to Mormon emphasis on family life many of these structures are very up to date and comfortable, comparable with middle class homes in neighbouring cities. Fresh, modern color combinations are the rule, with white predominating, but even magenta and purple may be observed.

The farm houses associated with the irrigated, Mormon farmstead include a barn, sheds -- some for the storage of machinery on the better farms, sometimes a garage plus special structures for pigs, poultry, bees and hay or grain if these constitute part of the farm's economic life. These "special structures" sometimes show distinct architectural adaptations.

Associated with the irrigated farms are irrigation canals, distribution systems, and small canal dams. Spillways, reservoirs, stream dams, and aqueducts are also
prominent in the landscape, but these are associated with the community, irrigation-water supply, rather than individual farms.

Since the church is the dominant influence, spiritually and temporally, its organization deserves a few concluding comments. The territory is divided into a number of stakes (three in Alberta, one of which, The Alberta Stake, lies in the area being studied). These have the duty of collecting tithes. Since both Utah and Alberta were hazardous pioneering areas, possessing harsh, moisture-deficient environments, it was only natural that the church should become a protective and economic power.

The surplus funds of the church have been invested in various schemes ranging from beet sugar corporations and refineries to irrigation and land settlement projects. The chief property-owning section of Canada's Mormon Church is, "The President and High Council of the Alberta Stake of Zion, Inc." In 1906 it purchased 65,000 acres between Waterton and Belly Rivers, not very far from the mountain front. This area plus some other land tracts were quickly settled and irrigated by Mormon families. Colonizers who failed were either given new land or found other occupations by the church. Always the church guarded and helped its members. Genuine failure and poverty in Mormon settlements is unknown.197

The area between the Belly and the Waterton Rivers has flourished into the United Irrigation District, under the guidance of the Mormon church, without any government help. About 36,000 acres are irrigated while the remainder of the area is still owned by the church itself and is operated as a "church" ranch. Vast numbers of sheep and cattle are grazed here. In the early 1930's, 500 cattle were annually shipped out from this tract alone. An additional church help to the community is the "farming-out" of hundreds of cattle to local Mormons for feeding and choice, baby-beef raising. 198

However, all the irrigated farms are not Mormon, nor are all Mormon farms irrigated. Non-Mormon irrigated farms, however, share some of the stable atmosphere typical of Mormon settlement.

In a general zone westward from the irrigated districts lies the dry farming area, which merges with the former in the east and the ranching country in the west. As mentioned, many grain fields within the western irrigation districts are not irrigated. Likewise, hay tracts in the farming and ranching areas may be locally irrigated. 199


199 Alberta's first irrigation was constructed by Foothill ranchers in this area. The Mormon's later brought the technique of large scale irrigation, to Canada from Utah.
Ranching and dry farming mingle so that lands advantageously cultivated in the range area are cultivated, and areas unsuited to cultivation in the wheat belt are grazed. Many people indulge in both grazing and cultivating pursuits.

C. EINZELHOFF DRY-LAND FARMING (STRIP-WHEAT ZONE)

Most of the dry farming area is devoted to strip-wheat cultivation. This is especially true in the exceedingly windy areas, such as the country beyond the mouth of the Crowsnest Pass. It is also this zone, from the North Fork country to the United Irrigation District, which is the main dry-land farming area. In addition, the higher Milk River Plateau area also has much land devoted to non-irrigated, grain fields. After this zone lying between the frost-ridden, questionable soil belt at the mountain foot and the drought-menaced, open plains eastward, had been found suitable to grain cultivation, much of the level to sweeping flats (especially Halifax Flats at Pincher Creek became wheat land. The introduction of stripping in this windy area helped stabilize the wheat cultivation there.

The land in this dry farming area shows strips of black and gold stretching away toward the distant horizon, broken only here and there by tracts of grazing land where
cultivation is undesirable or awkward. (See Economic Section.) Individual farm holdings are fairly large — considerably larger than irrigated farms — for wheat is an extensive rather than intensive crop, especially when grown in a dry area with half the land in summer fallow. The fields tend to be huge, each containing many alternate strips of wheat and fallow. Except for the farmsteads and watercourses, only occasional, dusty roads, and rows of power and telephone poles, break the empty vastness.

As would be expected, the farmsteads tend to be widely spaced (except on the rich Halifax Flats just east of Pincher Creek.) Since this area is very windy and the topography somewhat rolling in places, with entrenched stream valleys, the farmsteads are located in protected situations, if at all possible and not too inconvenient. Locations in the lee of hills or knolls, and on stream flats are not uncommon. If nothing else is available, the home may be constructed in the lee of a few trees or even another building. (See photos.)

The einzelhof farmsteads, although rather varied and individualistic in character, do possess many trademarks

200 According to the 1951 Canadian Census, more farms in the irrigated districts fall into the 70 to 239 acre category than any other, while the 240 to 399 and 760 to 1,119 acre categories are the most important in the Pincher Creek, dry, strip-wheat area.
in common. Airy openness and lavish use of space are the most striking features. However, this is to be expected in a wide, windswept country, where neighbours are few and far between. The farmstead often lacks shade trees and may also lack a garden, although many -- especially the older and more prosperous ones -- have a few trees and shrubs as well as gardens. The number of buildings varies considerably, depending largely upon whether the farmer concentrates on wheat or whether he pursues a varied livelihood of grain, cattle, etc. In the former, a place of residence, a few granaries, and some machinery, standing in the open beside the house, constitute the farm nucleus. A protective building for the machines is sometimes included. In the latter case, where grain growing and grazing mix, numerous outhouses, corrals, barns, sheds and so forth are characteristic. Often a larger number of people operate such a farm with its more varied economic tasks. Some farms have such variety (including turkeys, milk cows, and egg production) that they may best be called mixed farming establishments. These, however, are more typical of the irrigated areas, and central Alberta. All, nevertheless, tend to have a sprawling farmyard, usually lined with a variety of conveyances, machinery, wagons and even oil drums. In addition, haystacks and piles of threshing debris are genuine trademarks of the wheat belt farmsteads, especially where the farmer has some livestock.
Architecturally, the farmsteads have a variety of styles. The residence house may be a humble, wooden cottage, devoid of paint and shade trees, or it may be a sleek, modern, stucco bungalow set beside bright flower beds. Some of the older, well established, prosperous farmsteads have large, two-storey, family-type homes, complete with veranda and windbreaks. Many of the farmers and ranchers, although often "well-to-do", prefer bright and modern, but modest dwellings. The architecture of the other farm buildings varies from rustically picturesque, unpainted structures to modern, bright-hued, barns and sheds. From the air, rather interesting patterns of granaries and corrals are in evidence at the larger farmsteads and ranch headquarters. If a farm has poultry, pigs, sheep or other animals, special structures and pens, similar to those in the irrigation districts, will also be present. Windmills for supplying electricity are sometimes also present, especially in windy areas, far from rural electrification lines. If the farm is old and located near forestland, some of the original log cabins, sheds and barns may still be in evidence.

A few concluding remarks, to give deeper meaning to the foregoing descriptions, should be made regarding the dry-land farmers' origin and outlook. Pincher Creek and vicinity were largely settled by hardy pioneers who
BARN TYPES

MOUNTAIN VIEW
New barn, with a durable light all-metal roof in an area of relatively high snowfall.

PINCHER CREEK & WEST OF CARDSTON
Typical of many of the foothills ranches.

CLARESHOLM
New barn with metal roof. This is a farming and ranching area.

TWIN BUTTE AND INNER FOOTHILLS
Log barn.
ACCESSORY STRUCTURES

Pig Barn
West of
Glenwoodville
United I. D.

Types of Bee Hives
in the
United I. D.

Hay Storage Barn with
metal roof
and partly
open sides.
The hay is
mechanically
baled.
United I. D.

Granary,
a small
wooden
structure
for grain
storage.
These buildings
may be on the fields.
trekked overland from railhead at Medicine Hat. They tried hard to make a living on the windswept plains, near the Rocky Mountain front. Although the environment was not always in their favour, the farmers managed quite well until the coming of extensive, strip-wheat cultivation. Then farming, on a stable base, expanded and flourished, especially where the soil was good and rail transport close by.

D. RANGELAND GRAZING

Westward, northward, southward and in the rougher areas ranching dominates the economic and settlement scene. Here the land is very sparsely settled, with vast grazing tracts and isolated ranch nucleii (headquarters). The countryside is characterized by grassiness and lack of obvious human alteration. Occasional fields of hay or even oats are tucked away here and there in the rolling or hilly countryside. The presence of human beings is chiefly seen in the scattered ranch nucleii and the occasional range fences with their "Texas Gates".

The ranch headquarters are often situated in stream valleys or in the lee of hills, as are the wheat farmsteads. The stream bottom sites are especially favourable since there is a combination of wind protection, a water supply and lush river-flat pasture for the stock, plus some natural shade trees.
In many respects the ranchsteads resemble the larger, mixed, dry-land farmsteads. The same sprawling character marks the scattered ranch buildings, and the structures themselves are frequently similar. One or more large barns and the adjacent corrals are the most striking ranch trademarks. In addition bunkhouses and sheds, often constructed of local logs are also in evidence. The main residence house is usually a rather prominent structure, similar to a large farm home. Since cultivation on a ranch is limited to such winter fodder as hay or oats, less machinery is present than on a farmstead, and there are no granaries. However, a power saw is not uncommon. Bush and forestland are usually nearby, and fence posts, fuel and so forth are much in demand.

The architecture of the ranch buildings varies with the age and location of the ranch. Older ranches, located in outlying areas near the forest, often have picturesquely rustic, log structures. Large, prosperous ranches, in rich grassland areas, are usually modern and frequently brightly painted. Well established, old ranches may have substantial two-storey family residences, but in some cases the living quarters are not very striking features of the ranchstead.

In the early days of southern Alberta ranching all the rangeland was leased from the Federal Government. Today, much of the old ranching domain has been carved up into
cultivated patches, and southern Alberta ranchers usually own their rangeland now except for a few districts, which are still leased, and the forest reserves, which are also periodically grazed.

In conclusion, it should be remembered that the ranchers were the first, stable, European settlers in Southwestern Alberta. At one time all the non-forested land was grazing country.

E. INDIAN SEMI-NOMADIC ENCAMPMENTS AND EINZELHOFs

A settlement pattern which traditionally affects the natural landscape even less than ranching is that of the nomad Indians, pitching their wigwams by a watercourse or wherever fortune dictates. Some of the Indians on the Southwestern Alberta Reserves still make use of tents but the small, usually painted, frame house standing on the windswept plain is now a landscape characteristic here also. (This pattern is very similar to the einzelhof settlement previously described). Many Indians make their livelihood from ranching, and some from dry-land farming. Since the area where the Reserves are located is sufficiently far from the mountains, the chinook winds have enough effect to leave the ground bare of snow for sufficiently long periods in winter to permit all-year grazing. Hence barns are dispensable. (Many non-Indian farmers and ranchers
also allow their cattle to graze out all winter). In addition, income is derived by leasing out some Reserve land to adjacent, non-Indian farmers and ranchers.

Many of the Indians, however, make their residence in the village nucleations. This seems natural since even the old teepees were pitched in communal camps. Here Indian schools, health services, stores, churches, and administration are maintained. Cardston's townline coincides with the southern border of the Blood Indian Reserve. On the Reserve side, across the road from the Cardston Hospital, lies a large Indian hospital, and a temporary camp of small, uniformly orange-painted, Indian dwellings. These are, of course, without trees and other frills since the earlier wigwams were temporarily set up on the open plain. Shade trees are largely European introductions. They are not a part of Alberta Indian culture.

F. FOREST CABINS

Forestry Camps (Lumbering) - Ranger Stations -

In the forested, hilly to mountainous tracts of the thesis area's western portion, human scars and additions in the landscape are not very noticeable. Most of this area is either National Park or Forest Reserve territory. Hence
little alteration is to be expected. Besides the odd trapper's log shack (which are periodically destroyed by law) and a number of ranger stations, which are usually well-kept, red-trimmed, rustic log structures, the logging industry supports the only significant settlement there. Temporary lumbering camps, in those accessible timber areas which may be cut, constitute the settlement pattern. Nearby hillsides are scarred by access lines and cut-over, timber giving the impression of a trail-interlaced, denuded, countryside. However, these tracts are only small pockets in the vast forest.

Aside from these minor alterations in the wild landscape, the protected, forested, mountain areas only show human scars in the form of strip, coal mines. These black, bare pockets and their tortuous zig-zagging access roads are all located in the low mountains immediately north and south of the Crowsnest Valley.
III. NUCLEATED (URBAN) SETTLEMENTS

A. NUCLEATED SETTLEMENTS IN RELATION TO DISPERSED SETTLEMENT

Settlement nucleations tend to be nuclei for the adjacent areas of dispersed settlement. In other words, they supply services which cannot be maintained by each, dispersed settler or distributed throughout vast, thinly populated areas. These services such as stores, marketing facilities, banks, medical and legal services, administration, transport core, entertainment, culture and so forth are provided in the towns, where large numbers of people have settled together. In addition, such economic pursuits as mining and manufacturing usually necessitate a large, adjacent, labour supply. These factors encourage town settlement. Human gregariousness should not be overlooked, either, as an added stimulous in town growth. Recently there has even been a tendency in western Canada for rural people to live in a nearby village and commute to their farmland.

B. GENERAL SITUATION AND SITE PATTERN OF NUCLEATIONS

From the accompanying map, a basic pattern emerges with respect to the location of nucleated settlements. The
NUCLEATIONS
SITE AND SITUATION

SITE - inner circle
SITUATION - outer ring

Legend
Scale 1:506,880 1 inch to 8 miles
SITE - inner circle  SITUATION - outer ring
- Level
- Undulating or Uneven
- Sweeping valley
- Sloping (gentle)
- Terrace-like (may be sloping)
- Above a steep slope
- Below a steep slope
- (on a flat)
- Piedmont
- (usually foot of a mountain)
- Mountain (or foothill) valley or basin
- Passage
- (Gap or Fjord)
- Delta
- Double level
- Multi level

Source: Field, Air Photos & Topo Maps
Classification from Dr. B. Zaborski,
Geographical Branch, D.M.T.S., Ottawa
more prominent centres tend to lie either in the Crowsnest Pass, cretaceous belt, where seams of coal were actually the basic, original reasons for town building, or near the disturbed belt, Great Plains margin, where streams descending onto the plains have gentler banks, and the distance from the mountains sufficiently great that frost danger is not a serious menace. Any town of large population is located on a stream. Stream valleys in Alberta usually have striking relief, with the result that even the more level stream sides provide varied topography for town sites. The Crowsnest towns are built on flats, slopes or terraces situated in a valley-basin. The Alberta syncline towns cater to both ranching and wheat cultivation, because of their convenient half-way location between the irrigated, south-central part of the province with its own centres, and the wild Rocky Mountains. There are also a number of gap settlements, which take advantage of the transport passageways eroded by past meltwater channeling. Waterton's location on a delta is unique, as is the town itself.

C. GENERAL STRUCTURE PATTERN OF NUCLEATIONS

Two structure zones seem to stand out in the overall picture. To the south is the Mormon, planned, large grid settlements with a number of small, one-street or cross-roads
Legend

Scale 1:506,880 1 inch to 8 miles

Inner circle is the most dominant

- One street
- Cross roads
- Ladder (usually offset)
- Large square
- Mormon grid
- Ordinary rectangular grid
- Multi grid
- Irregular straight pattern
- Curved pattern

Source: Field, Air Photos, Topo. Maps, Classification from Dr. B. Zaborski, Geographical Branch, D. M. & T. S., Ottawa
centers. Along the main transcontinental highway and railway through the Pincher Creek and Crowsnest areas, towns have a tighter more compact grid. If a town lies on two sides of a stream, or follows a meandering stream for some distance, a multi-grid pattern has developed. Centers on the open plains are single grid and often show considerable, open scattering of houses, sprawling over the grid. Two side-ladder towns lie parallel to the highway. These are Burmis with its white company homes and store, by the Burmis sawmill, and Brocket, the Peigan Indian Reserve headquarters, with its hospital and administration buildings. Both towns are small and special, and are set off the highway's main artery.

D. GENERAL FUNCTION PATTERN OF NUCLEATIONS

The functions of the nucleations are so closely related to their regional economy that little comment is required. Coal mining towns lie in the Crowsnest area, while centres catering to ranching and wheat cultivation districts lie in the outer foothills and western plains, as previously mentioned. There are a few exceptions, however, Burmis, on the main transportation arteries, is a sawmilling centre in the forested, high foothills. Waterton is an

201 Street patterns tend to be oriented parallel to the stream. A meandering creek or river almost invariably results in more than one street grid.
NUCLEATIONS FUNCTION

Legend

Scale 1:506,880 1 inch to 8 miles

Relative dominance decreases from center outward on town discs

- Administration or Religious Center (e.g. Mecca)
- Resort or a center for local tourist attractions
- Trade (Major Commercial Center)
- Ranching
- Dry Cultiv (Wheat etc)
- Irrigation Cultiv.
- Forestry (Sawmill)
- Mine (Coal)
- Power
- Transport (Chiefly Rail)

Source: Field Economic Statistics, Classification method adapted from others by Dr. B. Zaborski, Geo. Bra., D.M. & T.S., Ottawa

p. 336-8
internationally famous resort tucked away in the rugged Rockies. Brocket is an Indian Reserve administrative capital, as is Ninastoko.

E. NUCLEATION EXAMPLES

SENTINEL

Situation and Site

Sentinel is situated on the eastern shore of Crowsnest Lake, just after the railway line has entered the pass, and immediately before it becomes hemmed in by the lake on one side and cliffs on the other. The railway lies at the mountain foot north of the settlement. The lake spreads out on the other side of Sentinel, bordered by huge limestone mountain walls, partially devoid of vegetation. Eastward from the pass lies the grassy basin dominated by Crowsnest Mountain, and beyond it lies Coleman.

The site upon which Sentinel has been built is a low hill, the homes occupying the broad top and gentle southeastern slopes, while the steam plant lies on the hillside to the west, just above the lake.
SETTLEMENT LAND USE KEY

COMMERCIAL .................................................. ▒
TRANSPORT .................................................. ▒
INDUSTRIAL ................................................... ▒
INSTITUTIONAL ............................................... ▒
RESIDENTIAL ............................................... ▒
STORAGE ........................................................ ▒
(GRAIN, COAL ETC.) ........................................ ▒
PARK & RECREATION ......................................... ▒
MINE ............................................................... ▒
STREAMS & LAKES ............................................ ▒
RAILWAYS ...................................................... ▒
ROADS ............................................................. ▒
Structure

Sentinel is made up of the East Kootenay Power Company, steam plant and the associated company housing. The plant itself is a large, red, brick building surrounded by coal heaps and transformers. Towering high above it, and dominating the whole settlement, is the tall gray, soot-stained smoke stack. The company housing is comprised of seven, spacious, substantially built houses for married workers and their families, and one large staff house for single workers. The homes are neat but lack extensive gardens. There is no real street pattern. A winding road goes up the hillside past the houses and then swings downward, in a loop, to the plant on the other side of the hill.

Function

Sentinel functions only as a power center for the East Kootenay Power Company. It supports no other enterprises. This site for the steam power plant was selected for three major reasons. It was close to the coal mines, which supplied the fuel, while a good steady water supply was available from the lake. The plant was also located at Sentinel in order to balance the distribution of the system load. This was the first plant in the far west to
use pulverized coal. Water was taken in at 10,000 gallons per minute. Originally an auxilliary, the plant has now been modernized to a major generating plant for the system. At present however, the steam plant is closed, and may not reopen. East Kootenay Power and Calgary Power have a mutual hook-up with a major power line coming down to the Crowsnest area from Kananaskis, Alberta via the British Columbia side of the continental divide.

COLEMAN

Situation and Site

Coleman and its associated suburbs lie in the narrowest part of the Crowsnest River valley-basin, between the Crowsnest Pass and the Blairmore-Frank "Gap". Immediately to the south rise low mountains carpeted with sombre coniferous forest. Northward, a number of low partially grassy ridges descend toward the Crowsnest River. The downtown core of Coleman together with the railway and mine are located on the river flats, with a high bench, or terrace immediately to the north hemming in the commercial

203 Alberta Power Commission - correspondence.
204 Interview - East Kootenay Power Co., Fernie, B. C.
core and adjacent residential area on the flats. The grass covered bench, or upper level, slopes gently eastward to more, open, grassy country. North of this upper level rise low, forested hills. To the west the valley is still somewhat constricted but soon opens up into the wide grass bottomed basin which lies at the foot of Crowsnest Mountain. Coleman's varied buildings, cascading over the different levels and set against the wild grandeur of towering peaks, rivals an Alpine town in picturesqueness.

**Structure**

Coleman might best be classified as a multi-grid, street-pattern town with three congested valley bottom cores and a widely dispersed, upper-level, residential suburb. The commercial, administrative and transport core of Coleman, as well as Carbondale suburb to the west, lie in embayments of lowland below the bench along the Crowsnest River. There has been high pressure to make good use of all the land in these convenient pockets. As a consequence these two centers have become rather congested. When viewed from the bench above, the downtown area presents a tight agglomeration of business structures, while the areas to the west and the Carbondale pocket display a mass of small, sometimes unpainted miner's cottages. The huge, coal mine, across the railroad yards, forms a dark smokey backdrop for these clusters of sombre buildings, which are highlighted here
and there by bright splashes of paint. Some streets present monotonous rows of sardine-like packed homes. Trees are not numerous. The odd green garden patch lies tucked away here and there. Across the railway tracks, on the only sizable level pocket there, lies Bush Town. This is a collection of small, dark (brownish) miner's cottages plus some more prominent houses. These three lower settlement pockets are all quite isolated from each other, and are connected only by one paved road in each case.

North of the downtown area the slope to the bench is relatively gentle and therefore possesses the main, street-connections between the two levels. This slope and the nearby upper level boasts some of the better homes in Coleman. These are relatively spacious, well painted and set amid gardens with the occasional tree. A ravine in this area has been converted into a recreation park, with tennis courts and a large, attractive, new arena. Immediately above it, beyond the settled area, lies the rodeo grounds. Ridges cut the upper level and northward the slope steepens, with the result that settlement toward the edges becomes very scattered and far flung. The ridges are generally avoided, because they are higher, steeper and more wind exposed. Just east from the downtown pocket, the upper level advances south toward the tracks, to which it descends by cliffs and hillsides. Here a scattering of houses lie on the hillside along the old highway, which still serves as a secondary outlet from Coleman.
All the different sections and pockets of the greater Coleman area have their own grids, with curving roads at the cliff bases or railway sides. The lower, older central sections have tight grids while the outlying hillsides of the upper bench have huge grids apparently optimistically planned for a growing little metropolis. The new highway detours the congested core and follows the upper level, cutting through the area of scattered settlement.

**Function**

Coleman's function as a nucleated settlement is that of a mining town. Miner's residences, and service establishments catering to their needs and to the needs of the mines themselves, make up the bulk of the town. A few ranches operate on the grassy areas of Crowsnest River valley-basin near Coleman. In addition, a forestry ranger station is located on the outskirts of Coleman, at the beginning of the Coleman-Kananaskis road. Customers from Sentinel and passing tourists help the business activity slightly. Tourism is increasing because of the newly opened Coleman-Kananaskis road, which provides a short cut to Banff National Park. Last but not least, the railway provides some employment, but this is largely associated with shipping of coal and formerly coke. Coal is the economic cornerstone of Coleman's activity.
Because of Coleman's dependence on coal mining, its prosperity fluctuates directly with the economic variations of this industry. Coleman was a well established community early in the present century. During the last few years the markets for coal have steadily decreased, thus causing less improvement and building activity in Coleman. Consequently much of Coleman presents a picturesque, slightly old appearance. Several stores and shops have been boarded up and left, giving abandoned patches in the older parts of town. Nevertheless, the recent period has shown ten new houses built annually. Today there are 690 to 700 houses in Coleman. Greater Coleman has a trading population of approximately 4,000.  

BLAIRMORE

Situation and Site

Blairmore practically fills the level valley bottom of the Crowsnest River, just before this river flows between the sombre vertical rock walls of the Crowsnest River Gap through the Rocky Mountain front range. Coal mine

205 Coleman Journal, June 30, 1953.
structures, industry and cemeteries climb the forested valley sides, but the bulk of the town spreads out on level terrain, the town shape clearly following the edges of the evergreen valley sides. The gravelly bed of the Crowsnest River, shaded by tall leafy trees, crosses Blairmore in the northern part of town, thus separating the coal mine and sawmill industrial zone from the bulk of the residential area. Westward, the valley broadens out into a more basin-like, grassy piece of country.

**Structure**

Blairmore's street pattern is multi-grid, but not strikingly so. Most of the town has a square grid, although westward, as the valley swings, the main highway swings also, and is paralleled by a new grid of elongated blocks adjacent to the road. A small pocket of residential streets follows a different grid immediately north of the river.

Unlike Coleman's compact core, the business core of Blairmore is a long one-sided street, faced by a green park band, on the other side of which lie the railway tracks. The various business establishments line this broad main thoroughfare, which is part of highway number 3. The residential areas lie on both sides of this central highway, park and railway belt. The southern portion is almost
completely residential except for the spacious new arena and fair grounds at the western end, and an industrial site on the eastern extremity, at the foot of Turtle Mountain. The commercial and institutional buildings are quite varied architecturally, many being fairly bright and modern, since Blairmore is relatively diversified economically and is a rather prominent trading center.

Residentially, Blairmore possesses fewer small miner's cottages, clustered close together, than does Coleman. Blairmore lacks the constricting topographic features of Coleman and is consequently more sprawling and spacious. Nevertheless, on a provincial scale of comparison, Blairmore is still a rather compact, mining town. There are many residences of good quality scattered here and there. Some homes have tin eves or roofs as a winter-time aid in snow removal. This is not uncommon in Cordilleran Canada where winter snowfall may be an excessive weight on the frail, frame roofs.

Function

Blairmore's primary function, like Coleman, is that of a coal mining center. This economic activity dominates over everything else. However, in addition to
Western Canadian Collieries' large mine, there is also a prominent sawmill and a concrete-block plant, which give economic diversity to the scene. Blairmore is the administrative headquarters for the Crowsnest Forest Reserve, the local R.C.M.P. and courthouse center, and is also a railroad point. In addition to these pursuits, the commercial "downtown" strip of Blairmore caters to a somewhat larger trading area than Coleman. Blairmore's trading area extends 20 miles eastward, to include all the eastern Crowsnest Pass country. Because of these factors, Blairmore has perhaps the most active business center in the Crowsnest Pass district.

FRANK

Situation and Site

Old Frank was partially situated under the present Frank Slide. A short distance away, out of danger from further slides, the new Frank was built. It lies in the Crowsnest River valley, at the mouth of Crowsnest Gap, on the other side of which lies Blairmore, two miles distant. The two towns almost give the impression of having grown together.
Frank is a long ladder-like, grid town. Like many coal mining towns the houses tend to be drab outwards, because of soot, smoke and so forth. The new Turtle Mountain Playgrounds is a lavish, ultramodern resort in the narrow Crowsnest Gap.

Function

Frank, like most other nucleated settlements in the Crowsnest Pass country is a coal mining town. Activity has decreased recently and the town has suffered accordingly. Frank did not regain its pre-slide glory after the great disaster. Other towns in the area became larger and dominant economically. The most recent economic asset in Frank is the Turtle Mountain Playground resort which helps draw attention to the Frank Slide, western Canada's most scenic and tragic, historical sight.

BELLEVUE-HILLCREST

Situation and Site

Bellevue lies on a terrace high above the Crowsnest River, and ironically overlooks Hillcrest Mines
apparently lower down on the other side of the valley. Actually both towns are the same altitude, but the terrace edge at Hillcrest Mines is less well marked. Westward towers slide-scarred Turtle Mountain, while on either side rise high foothills bearing mixed forest and extensive grassland. Eastward, the valley gradually widens to merge with the more open, low foothills.

**Structure**

Hillcrest Mines is a simple grid town, while Bellevue might be described as a town showing an irregular-grid, street pattern. Bellevue is constricted between a low mountain side and a sharp terrace edge, below which the coal mine, Bellevue's economic support nestles. Consequently, there has been a tendency to crowd the town toward the terrace edge, in a semi-circle adjacent to the mine, and to follow the highway in a long, arm development. The street pattern has been fitted accordingly.

Hillcrest Mines has several prominent commercial buildings and a large residential area. However, due to mine closings, many buildings have been boarded up. Bellevue, on the main highway, boasts a moderately active main street (or No. 3 highway) with a bakery and a dairy supplying the Crowsnest Pass country. The residences vary from pleasant middle class to less pretentious, little clusters of cottages. The coal mine is picturesquely situated in the valley bottom, adjacent to the railway.
Function

Bellevue, Hillcrest Mines and the cottages in between, rely on coal mining plus a little forestry as the economic foundations of their existence. Hillcrest Mines is off the main highway and has suffered economic setbacks in coal mining, with the result that it is not a very active trading center. Bellevue however, has considerable importance as a trade and supply town. However, it does not equal Blairmore or Coleman.

PINCHER CREEK

Situation and Site

Pincher Creek lies in the valley of Pincher Creek where this stream leaves its entrenched, foothills channel and passes over the western, upturned beds of the Alberta Syncline. The surrounding country is broad and sweeping. All around the land is stripped into a seemingly endless pattern of alternating wheat and fallow strips, giving the countryside a startling three-dimensional look, which is further enhanced by the gentle rise and fall of the plains.
Pincher Creek town nestles in the bottom of a broad depression half hidden among the trees on the stream flats. Low bluffs hem in the downtown core. From a distance only the church steeple stands out. The creek tends to be murky and sluggish after leaving the high, disturbed belt to the southwest. Great cotton woods shade its narrow course, but the bluffs are open and grassy.

**Structure**

Pincher Creek is a town with a multi-grid street pattern. There are two major grids, one on either side of the stream, plus a smaller residential section which has adapted its grid to follow the curve of the creek bank more closely and more conveniently.

Since Pincher Creek lacks direct railway facilities, there are no grain elevators puncturing the skyline. Instead a church steeple silhouetted against the distant Rocky Mountain backdrop, heralds Pincher Creek. Nevertheless, there is a squat, co-operative feed elevator on the stream flats, adjacent to the commercial core.

Much of Pincher Creek bears a slightly old, weather-beaten look, which gives the town a picturesque western appearance unsurpassed elsewhere in western Canada. Many prominent buildings bear evidence of a rich, old heritage. Most of the businesses are concentrated on the main street
with the tall square brick firehall tower immediately behind it on a side street. On a bluff overlooking the fairly compact, central area on the creek flats, stands the hospital. Being an old town and constricted by topography, Pincher Creek has a tight street grid and sprawls only on the residential margins, in two or three places.

**Function**

Pincher Creek is a major trading center for a large area of strip wheat cultivation and ranching, which lies near the mountain base. It is the largest town between Fort MacLeod and the Crowsnest country.

Since both the railway and the main east-west highway bypass Pincher Creek, a little satellite village has been built on the railway -- and a highway which parallels it -- two miles north of the town. Here stand three grain elevators and stock shipping facilities plus a few houses and some grages which have sprung up at the highway junction. This is the transportation nucleus of the district.

Pincher Creek is the administrative center for Pincher Creek Municipality and is a nucleus for oil and gas exploration, as well as the headquarters for the Pincher Creek Community Auction Sales Limited. All of these maintain offices in the town. The auction sales limited operates from a condemned, ex-rooming house, despite the fact that it
does a $3,000 business annually. By now, this has probably been corrected, however.206

What little trade there is from the forestry and semi-dormant, coal-mining area to the west (near Beaver Mines) flows through Pincher Creek. In season, tourists also pass through, on their way to foothills dude ranches and Waterton Lakes National Park. Otherwise, ranching and wheat support Pincher Creek's trade.

WATERTON

Situation and Site

Waterton townsite is situated along the western shore of Upper Waterton Lake. Steep mountain sides rise from the water of this fjord lake, leaving little room for towns. Waterton, however, is built on a level alluvial delta in the lake just below a waterfall spilling from a hanging valley. Behind the town, verdant, green slopes rise steeply upwards. On a moraine hill at the end of Upper Waterton Lake, and overlooking the flat town at lake level, rises the exclusive Prince of Wales Hotel and its associated structures.

206 Ken E. Liddell, This is Alberta, Toronto, The Ryerson Press, 1952.
Structure

Since Waterton townsite is a planned, tourist center for a leading national park, it presents a modern, curving, street pattern, adapted to the outline of the fan upon which the town is built.

Most of the hotels, administration buildings and some of the stores are built in picturesque log styles, reminiscent of Swiss chalet architecture. Private residences also tend to blend harmoniously with their surroundings. Large, green, playing fields lie in the heart of town. The lakeside of the commercial area is occupied by hotels, with a harbour on the lee side of the delta, opposite the morainal hill bearing the Prince of Wales Hotel. Ferry service with Glacier National Park is maintained in the summer. There is no railway communication, and only one highway connection. The highway, however, branches to various parts of the park and links outside centers north, east and south to Waterton.

Function

Waterton townsite is a tourist headquarters for a highly scenic area. Waterton National Park is administered from the town. Most of the park's tourist accommodation is located in, or near, Waterton townsite and excursions usually originate from the town. Playing fields,
golf courses, trails, and beaches cater to recreational needs.

Many southern Albertans own summer cottages in Waterton, while the park in general tends to serve local people more than Banff and Jasper do, further north in the Alberta Rockies. This is partly because a well populated area comes closer to the wild, mountain country in southern Alberta and partly because the northern parks are larger and more internationally known, thus drawing relatively more, far-away visitors.

CARDSTON

Situation and Site

Cardston is located beside Lee Creek, on the western limb of the Alberta Syncline close to the edge of the disturbed belt. This position is rather similar to that of Pincher Creek, but the surroundings lack the sweeping, heaving character of the more northerly town. The land to the east seems endlessly level, while to the west lie series of low hills and long ridges. Chief Mountain on the southwestern horizon towers above the roof tops like a guardian giant.
Cardston occupies a site on both sides of Lee Creek, where the banks are not too steep. Nevertheless, the almost perfect street grid is broken by steep, stream banks both to the west and east of the main street, which itself has an unusually low grade, since it takes advantage of the gentle, inside slope of a stream meander. The gravelly stream bed is shaded by huge, leafy cottonwoods in contrast to the otherwise open land. The most northern street coincides with the southern boundary of the Blood Indian Reserve.

Structure

Cardston was laid out by early Mormons into a perfectly square, gigantic, street grid, with wide, ample thoroughfares. The continuity of the pattern is broken only by the stream and its steeper banks. The large blocks were constructed so as to assure each Mormon home a few acres of pasture and a field of oats for the cow, as well as ample room for barns and gardens. The town resulting from this "farm-village" type of settlement gave the appearance of a collection of sprawling farmplots, each little plot surrounded by neatly cultivated rows of poplars or maples. Gradually, with increase in population and more pressure on the land, the more centrally located blocks

tended to be filled in by residences. However, lawns, gardens, shade trees and large vegetable patches still characterize Cardston. The peripheral areas, in fact, have small farmsteads to this day.

The commercial core of Cardston is a long, wide street which forms a part of highway No. 2. Many substantially built, but old, brick blocks line the street. The wide, central, commercial avenue is a trade-mark of Mormon settlements and brings to mind Salt Lake City, Utah.

Immediately uphill, to the west of Main Street, lie a number of institutional buildings including schools, post office, courthouse, town hall, fire hall, social center, swimming pool and so forth. The last two are ultra modern and indicate the community feeling typical of Mormon settlements. Unity and harmony are always the trade-marks.

On a slight rise of land, in the very heart of Cardston, stands Canada's only Mormon temple. This gleaming, white edifice, surrounded by raised gardens and splashing fountains, is reminiscent of the Mexican Maya's ancient temples. Blue spruce and poplars stand round about. An entire block is taken up by the temple, its tabernacle, powerhouse and spacious grounds. Across the street rises the new, spired Later Day Saints church, built in the traditional style.
The residential areas of Cardston give an above average look of prosperity, although some houses are slightly old. Generally they present a fresh as well as an up and coming appearance. As mentioned, gardens are not uncommon. In some ways, both Cardston and its temple grounds seem oasis-like amidst the bleak open plains and low foothills.

**Function**

Above all else Cardston stands out as the religious "Mecca" for Canada's Mormons or Latter Day Saints. The town was founded and built by Mormons and is now their spiritual capital.

Economically, Cardston is largely a trading center for a large mixed farming, grain and ranching area stretching from Waterton Lake National Park to the Milk River country. It is also the largest shipping point for grain and livestock in the area. There are over half a dozen elevators which, like the railroad itself, are located in the Blood Indian Reserve. The Indians, who largely inhabit the nearby southern portion of their reserve, frequently congregate in town and give it their trade. A spacious Indian hospital is located just inside the reserve, opposite Cardston's hospital.
WHISKEY GAP

Situation and Site

Whiskey Gap is situated in a gap passage through the Milk River Ridge, from the plains near St. Mary River to the slightly elevated plains near the Milk River. This gap is probably of glacial origin. Great meltwater streams were active in southern Alberta during the retreat of the ice sheets. The actual site of Whiskey Gap is on the level valley bottom, between the hillsides of the ridge.

Structure

Whiskey Gap is made up of three grain elevators, a few houses and what appears to be an abandoned gas station. Gas however, is probably still available. The gravelled road, passing through the settlement, forms the "street".

Function

Originally this gap was a passageway for Montana, whiskey smugglers. Whiskey Gap, however, now serves as the only rail outlet for grain and livestock from the Milk River plateaux, including the rich Del Bonita area. The railway only enters the gap and does not cross to the upper plains of Del Bonita.
DEL BONÍTA

Situation and Site

Del Bonita is located on a level, post-glacial lake-bottom which is now a more or less featureless, high plain. Northward, eastward and westward erosion has left its marks more noticeably. This whole area is part of the Milk River plateaux.

Structure

Del Bonita is a crossroads settlement with a large "country" general store, several gas, repair, and machine shops but very little else. Residences are not much in evidence. Two miles south lies the Montana border, with its customs houses.

Function

Del Bonita is a local post office, trade, and supply center in a somewhat isolated area. The rural economy is based on grain (largely wheat) and ranching. In addition, the customs house provides local employment and importance. The Montana Magrath highway and the trans-Milk River country road to Cardston cross in Del Bonita. Consequently, many travellers, although largely local, pass through the settlement from time to time.
A FEW SCATTERED FARM RESIDENCES
GENERAL STORE
HIGHWAY TO MAGRATH
TO CARDSTON
OIL & GAS FIELD

CANADA - U.S.A.
CUSTOMS

49° NORTH
LATITUDE

ELEV. 4250'

ALTA. CANADA
MONT. U.S.A.

DELBONITA
IV. CONCLUSION

To conclude this chapter on settlement a few general comments will be offered.

The settlement pattern in the landscape picture mirrors man's economic pursuits as well as his social organization and his cultural level. Man adds to the landscape and makes adjustments in it to suit his own needs. Southwestern Alberta presents a varied assortment of types in the settlement category as in all the other categories. The two obvious sub-divisions of settlement, dispersed and nucleated, are both well represented. The nucleations are chiefly supported by agriculture and mining, although forestry and tourism also play important roles. The historical backgrounds are well reflected by the town structures. Dispersed settlement likewise shows a close economic-historic link. The irrigated areas virtually coincide with the Mormon planned settlements, while the isolated type of farmstead and ranchstead characterize dry-land farming and grazing lands. Mining is a nucleated settlement industry which especially dominates the Crowsnest Pass country. The settlement pattern throughout Southwestern Alberta, although frequently planned and in harmony with the environment, tends to reflect the rugged, western individualism of the inhabitants.
THE

CULTURAL

LANDSCAPE

SEGMENT
THE CULTURAL LANDSCAPE SEGMENT

As was done for the physical landscape segment, an overall, bird's eye view of Southwestern Alberta will be taken to summarize the cultural segment of the landscape.

The wide, semi-arid Great Plains support an economy of ranching together with some dry farming on a wide spaced, settlement pattern, except where level land, available water, and human culture have combined to make irrigation possible. The irrigated areas stand out as mosaics of lush green, or tilled, brown fields set among range and strip-wheat patterns. Since the irrigated tracts in Southwestern Alberta are Mormon-settled they tend to be characterized by tall, stately poplar wind breaks, sprawling farm villages, and intensive agriculture. Cardston, with its white pyramid-topped temple and broad rectangular street-grid, is the nucleus for the Mormon populated area. The Milk River Plateaux, being somewhat higher, and with a less accessible water supply, are not irrigated. The lower, more level, alluvial center is devoted to dry-land farming, but open grazing land predominates otherwise. Likewise, the Indian Reserves contain
dry-land farming cores, surrounded by immense livestock ranges. The homes are now generally frame houses, but some tents are still in evidence. The population densities are very low in all cases, except where the land is irrigated and intensively utilized.

Below the foothills margin, and stretching up into the sweeping, lower sections of the foothills, lie the immense unirrigated, strip-wheat farms. Seemingly endless, alternating golden and black strips, focus toward the northern horizon. The rich glacio-lacustrian zone at the foothills border near Pincher Creek is especially densely settled. However, away from this rich, old core area, settlement gradually becomes more dispersed. In the east, dry-land strip-wheat mingles with irrigated fields, while westward, the wheat fields become progressively more scattered and rangeland grazing becomes the dominant human activity.

In the ranching area the effect of man is not very striking. Only the isolated, sprawling ranchsteads and a few dusty roads stand out as human marks on the rolling grazinglands. As in the case of some nearby dry-land farms, the buildings are often located in a sheltered spot, especially an entrenched stream valley, (where water for the stock is available). Obviously, the population density is lower than in the cultivated areas.
West of the grass and open parklands, the forest becomes dominant, and with it forestry assumes a leading role. In the forest reserves, only cut over hillsides, forestry camps, a few ranger stations, and one sawmill, together with a few widely scattered, temporary, trapper's cabins bear witness to human activity. The forest reserves have sparsest population of any area in Southwestern Alberta. Most of the people are there on a temporary basis.

Likewise, Waterton Lakes National Park, being preserved in a natural state, contains only tourist facilities and park administration buildings. The cultural landscape segment is poorly represented here.

The one area in the mountains which has been markedly altered by human occupancy is the Crowsnest, coal mining district. Compact, little mining towns, like tiny bits of rectangular inlay (when viewed from above), nestle one after another on the valley floor. Black, coal mine buildings and open, strip-mine gashes in the hills supply the livelihood for the towns. Most of the large population here is concentrated in the mining centers.

Throughout Southwestern Alberta oil and natural gas exploration is gaining momentum. As yet, however, only a few derricks and associated structures bear witness to this significant, economic pursuit of the future.
THE COMPLETE LANDSCAPE
THE COMPLETE LANDSCAPE

In the physical and cultural segment summaries brief, overall views were given. To best appreciate the total landscape, with the physical and cultural perfectly integrated, a number of actual landscape patterns will be presented. Each photograph is, in a sense, a "Micro-Landscape Study". Together, the pictures give a cross-section of Southwestern Alberta's sub-regions.
Southwestern Alberta

LANDSCAPE REGIONS

Legend
- High Foothills
- Rolling Range
- Subdued Sweeping
- Dry Farming Plains (Graz.)
- Milk River Plateaux (Grazing, Grain)
- Mormon Irrigated and Cultivated Belt (Level)
- Porcupines Reserves
- Porcupine Trans Northern Rockies (Coal, For., Graz)
- Southern Rockies (Scenic, Forest)

1:1,267,200
Southwestern Alberta

PHOTO LOCATIONS

Legend

Scale 1:506,880 1 inch to 8 miles

Photographs are located by number on the map.

The arrow indicates the direction of view for each photo.

Example,

97 →

Photo 97, looking east.
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National Topographic Series
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Topographical Survey

<table>
<thead>
<tr>
<th>Map</th>
<th>Location</th>
<th>Date</th>
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<tr>
<td>714 A</td>
<td>Beaver Mines</td>
<td>1943</td>
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<td>873 A</td>
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<td>1946</td>
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<td>799 A</td>
<td>Gap</td>
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<td>725 A</td>
<td>Cowley</td>
<td>1942</td>
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<td>982 A</td>
<td>Callum Creek</td>
<td>1942</td>
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1:63,360 (1 inch to 1 mile)
Canada Department of Mines and Resources, Ottawa.

Map of Crowsnest Forest and Waterton Lakes Park

Rocky Mountains Forest Reserve
Sheets 1, 2, 3, 4, and 5.
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Soil Survey of Pincher Creek - Lethbridge Sheet

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W. Odynsky
Soil Zones of Alberta
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A Forest Classification for Canada,
Canada, Forest Service Bulletin 89, 1937
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Blairmore

(1 inch to 1 mile)

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Oil and Gas Fields of Alberta

PLANIMETRIC AND BASE MAPS

Alberta
1:506,880 (1 inch to 8 miles)
Alberta Department of Lands and Forests, Edmonton.

Alberta Sheets 82-G-S.E. and
82-G-9, 10, 15 & 16
(1 inch to 2 miles)
Alberta Department of Lands and Forests, Edmonton.
Township Plans
(1 inch to 1 mile)
Alberta Department of Lands and Forests, Edmonton,

Town block-maps of parts of Coleman, Blairmore, Pincher Creek and Cardston on varying scales, and largely unpublished. (Map be viewed in town halls).

Municipal maps of some municipalities (notably Pincher Creek) on varying scales. (Map be consulted in municipal offices)

Rocky Mountains Forest Reserve, Crowsnest Forest
(1 inch to 3 miles) 1938
Province of Alberta.

I. AIR PHOTOS

Air photographs - scale 1:40,000
Department of Lands and Forests
SOURCES

Some brief comments should be made regarding the source materials for this study. The accompanying bibliography gives a specific list of references but the general character and quality, as well as quantity, warrant explanation. The sources may be broken down into the following major classes:

(1) Map -- Topographic Maps
    Geological Maps
    Vegetation Maps
    Other Specific Maps.

(2) Photo -- Air Photo
    Ground Photo.

(3) Statistics.

(4) Systematic Survey -- Geological
    Vegetation Study.
    Soil Survey.
    Town Surveys.
    Historical Writings.
    Etc.

(5) General Reading -- Books.
    Newspapers.
    Etc.

(6) Interview -- Directly with a person in the area or
with a professional person acquainted with the area. (e.g. Engineer who has made a study, or worked, in the area, or a body such as the Alberta Power Commission).

There are other sources also.

Maps

(1) **Geological** maps -- incomplete

(2) **Soil** maps -- incomplete in Rocky Mountains, Porcupine Hills and part of the North Fork country.

(3) **Vegetation** maps -- overall maps are generalized

-- detailed maps are highly incomplete.

(4) **Topographic** maps -- incomplete, outdated, and on varying scales.

Statistics

Except for human population, statistics are not available by townships, but only by the larger enumeration districts. Consequently, detailed distribution maps cannot be drawn.

Surveys

The various geological surveys, soil surveys, ecological reviews, town economic surveys and so forth are quite good -- but mapping is either absent, incomplete, or excessively generalized.

Photos

(1) **Air photos** -- complete coverage of 3,333 foot photos flown by the Alberta Provincial Government, obtainable at 80 cents per print. The scale is approximately 1:40,000.
(2) **Ground photos** - Easily made in the dry, clear atmosphere of this high-altitude area. (No part of Southwestern Alberta is less than 3,000 feet above sea level.)
LANDSCAPE SCENES

OF

SOUTHWESTERN ALBERTA

(LANDSCAPE SAMPLES)
Gentle back side (west flank) of Livingstone Range in the Crowsnest Forest Reserve. This forested area is north of the grassy Livingstone-Oldman flats.

Tall coniferous forest (probably largely composed of Engelmann spruce) forms a majestic lane for the Coleman-Kananaskis road.
The intermontane basin near the Livingstone River northwest from the Gap

Forest is only found in bands and pockets on the more favourable hillside sites. The relatively more exposed slopes of the mountains and hills are draped with grassland.

Small shrubby plants are possibly shrubby clinque foil (Potentilla fruticosa).

Looking NE. Late August

Lodgepole pine (P. contorta var. nurayana) near the river and more luxuriant grassland.

Looking NE. Late August

Festuca scabrella or variant grassland (probably Festuca-Agropyron)
Forest grassland relationships in the parallel range country

Long, high ridge parallel with the grain of the local mountains and foothills. Only the cooler north facing slopes are forested. The line between grassland and forest is very sharp here. This is one of the most striking examples of vegetation varying with micro relief and its resulting micro climate.

Looking NE. (The ridge runs north south.) Late August

Coleman-Kananaskis road just southwest of the Gap, in the Crowsnest Forest Reserve. Engelmann spruce or mixed (including hybrid) Engelmann and white spruce.

The grasses are mixed, probably near Fescue, rather than Alpine, including Agropyron spicatum, other Agropyrons, Stipa spp., Poa spp., Danthonia spp., and probably Festuca spp.

Grassy exposed hilltop with dense stand of white spruce in the valley.

Coleman-Kananaskis road near Vicary Creek. This is adjacent to the large Dutch Creek commercial spruce area.

Looking NW. Late August
Western entrance to Crowsnest Pass proper, just inside Alberta.

Sentry Mountain (a mass of semi-bare, limestone rock).

Island Lake

Looking SE.
Late April

Crowsnest Pass

Looking down through the trough of the Crowsnest Pass from between Island and Crowsnest Lakes, near the lime works.

Palaeozoic limestone mountains.

Cretaceous basin in the distance.

'C A mixture of deciduous and coniferous trees.'
Sentinel Settlement

Dry valley believed to supply the spring in the grotto which forms the source of the Crowsnest River.

Snowy Mt. Tecumseh with its protruding buttresses near the crest.

Crowsnest Lake.

Neat, clean, company houses at Sentinel.

Snow bank.

Stunted deciduous growth. (windy)

Steam power plant at Sentinel.

Looking N.

Late April

Autumn landscape near Sentinel

Limestone cliff.

Sentinel smokestack.

Sparse vegetation.

Looking N.

Arm of Crowsnest Lake at the outlet for Crowsnest River.

Early October, in the early morning.

Arm of Crowsnest Lake, a body of water dammed by alluvial material in an old melt-water channel.

Scattered coniferous growth and shrubs.

Limestone cliffs

Crowsnest Lake, a body of water dammed by alluvial material in an old melt-water channel.

Guard rail typical of Alberta highways.

Looking NE.

Late April

Wind-bent and stunted Douglas fir.

Cave from which the Crowsnest River issues.
Crowsnest Mountain
Continental Divide Range from which the Crowsnest Mountain block has been separated.

Storm clouds breaking up.

Montane floral region which is very mixed here and includes festuca scabrella or variant grassland with aspen, white spruce and perhaps some Douglas fir.

Overlooking the mountain basin west of Coleman
Central range of the Rockies south of Crowsnest Pass. Some cirques are in evidence.

Agricultural settlement. (grazing)

Crowsnest River terrace.

Meandering Crowsnest River.

Vegetation similar to above with more grass on the level bottom land. Most of the forest lies within the Crowsnest Forest Reserve.

Looking NW.
Late September 4:00 P.M., with low sun

Looking SW.
Early October
Crowsnest Basin

Rural settlement.

Meandering Crowsnest River.

Festuca scabrella or variant grassland.

The grassland is used for grazing.

Marshy area with white spruce.

Looking SW.
Late April early Map

Central Rockies range, which is entirely within Alberta here. The mountain forms are caused by sedimentary beds of varying hardness modified by glaciation.

This scene is near the one above, but further west.

Looking S.
Late April early May

There appears to be an ancient terrace here.

Rural settlement. Beef and milk cattle are grazed in the area. Some other animals (such as fowl) are also kept.
Crowsnest Mountain towers in splendid solitude above the sweeping Cretaceous plains at its feet.

Subdued Cretaceous hills in the Crowsnest area near Coleman.

Wintery clouds still linger.

Looking NE. Late April

Coal mine

Looking E. Late April early May

Snow fence used to prevent as much snow as possible from drifting onto a highway or railway etc.

Structure associated with the pumping of air to the mine.

Coal Mine at Coleman.

Looking S. Late April early May
Coleman
View from hill overlooking upper level residential area which looks down into the hollow containing the business section.

Railway station
Quonset hut
Cinema
Main Street
Hotel

Bus carriers miners to other mines outside Coleman.
Mining now is not as active as it used to be.

Coleman
(19)
Blairemore in the distant shadows.
Downtown business section
Well-to-do homes away from the railway tracks
Open basin land
Crowsnest Pass beyond the basin
Coal mine
Looking SE.
Late April, early May

Foothills lie beyond the "Gap" of the Crowsnest river
Snow draped Turtle Mountain
Coal mine
Looking SE.
Late April, early May

Carbondale
Central range of the Rockies south of Crowsnest Pass
Coal miner's cottages, many unpainted, or last painted a long time ago.

Looking W.
Late September

Store School
Looking SW.
Late April
Mixed deciduous and coniferous forest. Autumn color brings the mixture out clearly.

Striking banding of forest along some rock beds and not along others. Different drainage, topography and hardness (effecting rate of succession) cause this.

Fire and town hall

Miner's homes

Gentle western face of Turtle Mountain. The scarp face of this tilted block mountain is on the other side, above Frank.

Hotel

Business strip along the main street.

Looking SE. Early October in the low afternoon sun.

Road to Western Canadian Collieries' coal mine.

Private road climbs south to mines in the mountains. Another road runs north beyond the picture.

Residential suburb.

Business strip along north side of main street. Park and railway lie on the south side.

Conifers are probably spruce

High school.

Residential

New arena (behind tree).

Terrace above the river.

Crowsnest River.

Blairmore panorama

Seen from among scattered coniferous trees above the cemeteries.

Looking SW. Early October in the early morning with a light sun haze.
Some snow on the upper slide and in crevices. Much of the gentler back of Turtle Mountain was snow mantled at this time. This portion broke away.

Vegetation is a mixture of grassland with deciduous and coniferous trees in suitable locations. A few bushes are beginning to grow in soil pockets among the slide boulders also.

Frank town. Miner's cottages in east Frank. These were covered by the slide. The more prosperous west end of Frank largely escaped damage.
PLATE XII

Overlooking Bellevue coal mine from cliff

Crowsnest River

Railway

Limber pine

Looking down SW. Early October

Hillcrest area

This scene is from a fairly wet summer (1953) in Alberta. Note the unusual green, grassy landscape and the clouds.

Vegetation in foreground is adjacent to the railway track. These plants have been greatly affected by the railroad.

Bellevue

Miner's homes - dark, but rather comfortable.

Semi-bare and grassy hills (southern exposure) of a rougher part of the Cretaceous belt behind the Livingstone Range.

Looking N. Mid August

Low mountain with a patchy and banded growth of mixed deciduous and coniferous trees.

Looking N. Late September
Livingstone Range and vicinity

Looking W., Mid September

Livingstone Range from the East Fork Country. Note the bare, blue-gray appearance of the range.

Looking W., Late September

Coniferous, deciduous, and grassland all mixed together from the vegetative cover. The "Gap" through which the River Oldman crosses the range. Rough gravel road to the Gap.

Looking NW., Early October

Overlooking the rolling parkland at the eastern foot of Livingstone Range. Low willows in moist sheltered spots with mixed grassland. Danthonia parryi and Danthonia intermedia rather than Danthonia parryi. Forested talus slopes spread down from the mountain.

Looking W., Late October

Bare limestone rock. Row willows in moist sheltered spots with mixed grassland.
Whaleback Ridge in the North Fork Country.

Forest (coniferous) only covers the north facing slopes of the spurs.

Parkland with scattered shrubs.

Looking SW. Mid September

Open Savanna-like parkland north of Oldman River in North Fork Country.

This is Festuca scabrella grassland with a strong element of Danthonia parryi. Shrubs are probably Salix bebbiana (willows).

Looking W. Mid September

Foothill in distance shows coniferous trees occupying only the long bands of rocky outcrops. The smooth contours are grassland covered.

Looking NW. Mid September

Deciduous trees only at the water's edge below the cliff.

Truncated beds exposed along Oldman River (North Fork) east of Maycroft.
West Porcupines.
Overlooking the southern North Fork Country, from the Porcupine Hills to the distant Flathead Range.

Looking SW.
Early October

Coniferous forest patch on hill-top. These hill-tops are the crests of the type of cuesta remnants pictured below.

Submontane grassland

Agricultural settlement at the foot of the hill.

Flathead Range
Cretaceous hills. The true front range is lacking here.
Strip wheat on the valley floor
Contoured fields on the hillside.
Cattle feed on stubble and thrashing debris.

Western "cuesta" of Porcupine Hills (35)

Strip wheat on the gentle, south-facing slope.

Tilted beds at the western edge of the Alberta syncline in the Porcupine Hills. The gentle eastward dip gradually becomes horizontal.

Local road
Looking N.
Early October
Southern Porcupine Hills, near Beaver Creek. (36)

This area is in the Peigan Timber Limit.

Coniferous forest on the higher hills away from dry, warm, southern exposures.

Summer fallow (ploughed so as to be continuously bare during the year).

Grazing land

Deciduous trees and farmsteads in the protected valley.

Looking W.

Late September

Looking up Beaver Creek Valley (37)

Only the more moist and cool sites of the Porcupine Hills are forested. Johnson's sawmill is further up this valley where forest dominates more of the entire landscape scene.

Looking NW.

Late September

Oats
Air panorama of the Pincher Creek Oldman River district

High, forested Porcupine Hills
Grazing on the mesa-like tracts.

Wide, forested flats of the meandering Oldman River
Grazing land, parts of which are too erosion-rilled for satisfactory cultivation.

Entrenched meanders on Pincher Creek as it flows to join the Oldman River.

Vista south of the Porcupine Hills and north of the Oldman River.
Note the low, rather level, mesa-like beds.

Rolling strip-wheat land.

Early snow on the Rocky Mts. SW. of Pincher Creek.

Looking N. Mid September

Looking S. Late September

Old shed Grazing land.
East side of the Porcupine Hills as viewed from the grassy, level, plains to the east. The terrace-like appearance is caused by the nearly horizontal beds of rock of varying resistance being eroded away.

Note the remnants of an early autumn snowfall. This period is Indian summer.

Close up of wheat field and farmsteads. Dry south-eastern Porcupine Hills rise in the background. Rock outcrops scar their upper levels but the hills provide good grazing. Note the scattered buildings of the farmsteads. This country is uncrowded both physically and in human outlook.

Rangeland south of the high Porcupine Hills. The mesa-like plateaux rest on level, Alberta syncline, strata remnants.
Burmis

Subdued mountain or high foothill of cretaceous rock.

Autumn's bright aspens glow like golden embroidery among the sombre evergreens of the mountainside, in this very mixed, transitional, forest area.

Burmis Sawmill.
Light metal buildings.

Entrance to the Crowsnest area

Turtle Mt.

Wind bent and stunted conifers.
(This may be Douglas fir or lodgepole pine).

Frank slide
A residence
Looking W.
Late April

Alta.no.3 highway

Low mountains or high foothills
C. P. R. bridge
Low, vertical, canyon walls.

Tourist cabins.
This is an Alberta provincial park.

Lundbreck Falls

Looking SW.
Late April
Limber Pine (Pinus flexilis) in a rocky area near Beaver Mines.

Near Beaver Mines

Coniferous forest mixed with grassland in an open stand on the foothills.

Grassy foothills used as rangeland.

Bouldery stream bed below Lundbreck Falls.

New provincial no. 3 highway bridge near Lundbreck. Very attractive and well built, since this is an outstanding scenic spot in a Provincial Park.

Looking N. Early October

Rangeland

Looking SSE. Early October

Looking NNW. Late April
Castle River Valley
Livingstone Range

Threatening, autumn storm clouds.

Deciduous trees along river are probably dominated by poplar (largely balsam poplar, Populus balsamifera) with an understory and/or admixture of shrubs and small trees (such as willow).

Old bridge piers in the river

Gully-scared cliff of relatively soft material on the cut bank side of a river meander.

In the foreground is a mixed assemblage of buck brush (Synphoricarpos occidentalis), roses, grasses and so forth—perhaps chiefly the former. Utilization by animals (man included) has highly modified it, either from poplar and poplar spruce, or from grassland.

Looking W.
Late September

Conifer (probably Douglas fir) twisted and stunted by the persistent strong winds blowing from the Crowsnest Pass area to the west.

Porcupine-North Fork Country in the background. This is a grazing area above Crowsnest River near Lundbreck.

Looking NNE.
Late September at sunset.
Strip-wheat country between Cowley and Pincher Creek.

The foreground is uncultivated grazing land largely because of the stream meandering across it. Behind it, cultivation comes up to each gully but does not cross. Ploughing up gullies accelerates and increases erosion damage. The background, by the mountain front, is rangeland.

Looking NW.
Mid September

Lundbreck

Menacing storm clouds.

Grassy foothills devoted to ranching.

Lundbreck settlement

Strip-wheat

Looking NNW.
Late September

Snow streaked Livingstone Range.

C.P.R. watertower

Farm

Looking S.
Late September at sunset

Snow draped Precambrian Rockies.

Farmstead at Cowley with barns, outhouses, granaries, hay stacks and so forth.
PLATE XXIII

Pincher Creek

Edge of the disturbed foothills belt.
This slope area is grazed.

School

Skating and curling

Old one-way bridge

Good residential area.

Lumber

Strip-wheat

Religious institutions

Hospital

Feed

Pincher Creek

New westend bridge

Looking SSE.
Mid September

Main Street - Pincher Creek

Commercial

Bank

Hotel

Municipal office

Alberta Treasury Branch

Looking W.
Summer, spring or autumn

Park (Plaza)

(54)

(55)

(Photo postcard not by writer)
Looking over Halifax Flats to the Rocky Mountains near Pincher Creek.

Precambrian
Rocky Mountains

Disturbed belt (note its eastern edge).

Strip-wheat (oriented north south at right angles to the prevailing wind) on the flat Great Plains which here rest on the Alberta Syncline. The hills in the foreground are underlain by an outlier of the Porcupine Hills formation south of the Oldman River, which has not yet been eroded away.

Cretaceous infold west of Beaver Mines with the Flathead Range in the background.

Grazing land on the hills.

Two rural settlements unusually close together on Halifax flats. Both grow large quantities of grain and have vast cattle herds. Note corrals, haystacks, scattered buildings and prosperous, painted homes, autos and trucks. Green winter wheat is coming up.

Grazing

Wheat stubble with characteristic cutting pattern.

Gravel road to Pincher Creek.

Looking S. Mid September
Ranching Scene

Stream crossing southeast of Pincher Creek.

Corral

The vegetation is shrubby and grassy but lacking in tree growth.

House

Cut bank on outside of meander

Sharp, low bank

Old meander developing into an ox-bow lake.

Looking down SSE. Mid September

Gravelly stream bed showing a tendency to being braided.

Looking E. Mid September

Shrubs are largely Salix bebbiana (willows) but some may be poplar "shrubs".

Cut bank of a small stream which is all that now remains here, were once glaciers converged and meltwater streams flowed.

Forested tops of the central western Porcupine Hills.

One of the larger ranches in the North Fork country, north of the Oldman River and northeast from Maycroft.

Festuca scabrella grassland with a very strong Danthonia parryi element.
Ranch in foothills valley between Pincher Creek and Beaver Mines.

The vegetation is largely grassland with some poplar in moister pockets and conifers on rock ridges.

Looking SE. Early October

Rural settlement located in lee of cliff in the Castle River valley.

Deciduous trees here are largely poplar.

Grazing land

Cut bank (cliff) on Castle River

Looking NW. Early October

Beaver Mines settlement

General store Fire hall

Potholed road west of Beaver Mines. Looking NE. Early October
Country near Bovey Lake and Mill Creek (Provincial Park at Bovey Lake) (63)

This is in the foothills where the Cretaceous infold bulges westward to the central range of the Rockies, without any true front range.

Ranch building
Table Mountain
Field of oats
Looking SW. Late September

Valley at Beaver Mines (64)

Conifers on the hills, with poplars in choice locations in the valley.
Parkland-like with trees, rather than grass, tending to dominate the scene.

Mine at Beaver Mines
Looking S. Early October

Rocky ridge between Pincher Creek and Beaver Mines (65)

Conifers include Douglas fir on slopes and limber pine in the more exposed locations. In spring these rocky foothill ridges may be natural rock gardens, full of flowers and varied plants. Fescue or variant grassland surrounds the ridge.

Looking E. Early October
Table Mountain and vicinity (66)

View from near the edge of the forest reserve on Cretaceous rocks. Table Mountain is Precambrian. Note its almost level strata and shape. Industries are grazing, forestry and trapping.

Table Mountain
Mixed stand of coniferous and deciduous trees.
Cabin
Looking S. Late September

Foothills ranch west of Beaver Mines (67)

Barn
Coniferous forest with some deciduous trees.
Ranch road
Looking NNW. Late September

To left, across the road lies a relatively newer house, and luxuriant vegetable garden specializing in very large cabbages.

Hay wagons Old house
Rangeland west of Pincher Creek

Snowy-Livingstone Range during a period of Indian summer (after an early snow fall in September).

Festuca scabrella and Danthonia parryi grassland.

Menacing autumn clouds sweep across the northwest sky.

The smokey coloured shrubs are probably willows (Salix bebbiana).

Looking NNW.
Late September

Foothills country
Rangeland
Field view
(68)

Rocky Mountains

Menacing autumn clouds sweep across the northwest sky.

Festuca scabrella and Danthonia parryi grassland

Looking SW.
Mid September

Drywood Creek and vicinity
(70)

Pile of hay bales

Front range of the Rockies (Precambrian portion).

Looking NW.
Late September

PLATE XXIX
Southern Foothills Country

Scene near Yarrow Creek showing parkland vegetation pattern.

Ranchstead

Clarke Range

Aspen poplars

Showy, red-leafed plants are probably Dogwood (Cornus stolonifera).

Looking NWW. Late September

The mountain edge

Clarke Range (front range of the Precambrian Rocky Mountains). Note the almost bare, scarred, dark appearance of the range here in sharp contrast to the tawny grassland. Foothills are nonexistent in this vicinity.

Mt. Glendowan

Grassland is probably a Festuca-Danthonia mixture.

Looking W. Late September
Foot of the Clarke Range north of Waterton Lakes. Note the lack of foothills as well as the almost naked (of vegetation) cliffs and talus slopes. Inward, in the mountains, patches of coniferous forest dot the more gentle slopes. The cliff facing the plains is the result of the underlying fault.

Horn-like peak in the background testifies to the fact that this is a glaciated area.

Redish magenta rock outcrops, typical of the Waterton area.

Willow parkland

Grassland contains Danthonia parryi, and much Danthonia intermedia, plus several other grasses including Festuca spp. It is apparently a modified Festuca scabrella association. For many years this land was heavily grazed. This makes a difference in the present grass composition.

Blakiston Brook valley showing swampy terrain

Mt. Blakiston
Gully-scarred, gravelly bank

Forest grows only on north facing valley side. Montane floral region. The swampy area includes several vegetational types, some rather small. This is chiefly a marsh complex with sedges, rushes and coarse grasses. Willows are also very prominent.

Reflections in Lower Waterton Lake

Poplars line the lake shore. Grassland stretches behind. The mountain front is partly bare and partly draped in coniferous forest.

Looking NW. Late September

Looking NWW. Late September

Looking W. Early October
Mt. Blakiston, 9,600 ft. in elevation. The highest point in Waterton Lakes National Park. The peak is grooved by snow and meltwater, etc. In addition the type of limestone rock and its attitude (see geological chapter) are responsible for the mountain’s appearance.

The rather U-shaped Blakiston Brook Valley. North facing slope is mantled in coniferous forest. The moist valley bottom has a high percentage of deciduous trees. South facing slopes however are grass carpeted because of the more direct effective isolation received there.

Cameron Falls on Cameron Creek as it descends from its hanging valley to Waterton Lakes.

Some of the oldest rocks in the Canadian Rockies are exposed at this fall. Note the slightly arched strata. This is the central anticline of the Waterton Lakes area.

Good stands of coniferous forest.

Bridge for tourist foot traffic to Waterton townsite.

Looking W. Early October
Red Rock Canyon
Thin, slab-like pieces of strata protruding above the channel, line (78) the water-carved, vertical red walls. At this point the canyon is very narrow, mildly sinuous and quite deep.

The vegetation is rather mixed including several rare species plus some species generally found at higher altitudes. A number of micro-communities can probably be found in this canyon, each related to the varying special local conditions.

This peak's horn-like appearance is a result of glacial erosion.

High, glacially sculptured peaks in northern Waterton Lakes National Park.

Mixed deciduous coniferous forest.

Cirque-like pockets.

Note the red rocks (often red argillite) so typical of the Waterton Lakes National Park area.

Looking NW. Late September

Looking N. Late September
Waterton townsite from the moraine upon which the Prince of Wales Hotel is built.

Mont. Alta.

Fairly rich coniferous forest growth. Waterton has 28 to 30 inches precipitation annually. (Officially Alberta's highest precipitation).

Waterton is built on the delta of Cameron Creek in Waterton Lake.

Cameron Lake in a glacially carved amphitheater at the head of Cameron Creek. Snow and ice hung Mt. Custer in the background lies in Montana's segment of the International Peace Park, Glacier National Park. The lake is largely in Alberta.

On the gentler slopes the forest is luxuriantly coniferous.
Note the varied, contorted strata on the mountain side.

An anticlinal flexure crosses the lake here.

Moraine area.

Great Northern Railways' Prince of Wales Hotel; Southwestern Alberta's outstanding tourist resort.

Wimy Peak and Ridge (formerly Sheep Mountain)

The rugged, northern side of Wimy Mt. overlooks the foothills and plains for 100 miles.

Various colours of sedimentary bands are exposed in cross section. (See geological chapter).

Coniferous trees, rather limited to the mountain foot.

Upper Waterton Lake.

Looking E. Summer


A portion of Waterton townsite sprawls in the foreground.

Photo by G. Morris Taylor, Vancouver, B. C.
Parkland, with Festuca scabrella or a modified association. Willows (often Salix bebbiana) grow on the low ground, plus a few small aspen. On higher sites of this district there is also some aspen, while on the highest rocky ridges limber pine (Pinus flexilis) grows and also Douglas fir especially on locally protected slopes.

This is hummocky moraine topography with kettle lakes. The land is devoted to grazing.

Looking SW. Late September

Chief Mountain

Coniferous vegetation.

Deciduous vegetation

Isolated house in this grazing area.

Looking SW. Early October

Golden deciduous trees line the water course. The rest of the country is open grassland.

Water Gap on Lee Creek as it crosses a foothill ridge. This is virtually at the edge of the disturbed belt.

Looking NWN. Early October in the early morning.

The counter front east of Waterton Lakes (Wilson Range).

Shrubby vegetation scattered on grassland. Note the vegetation change in approaching the higher land near the mountains. Creamy-coloured, rock-outcrop ridge in the background.
Foothills ridge west of Cardston showing large, creamy, hoodo-like rock outcrops, many of which stand up in monumental fashion.

Broad valley in the outer, disturbed belt at Leavitt, a Mormon settlement.

The Rockies, like a huge necklace of glittering crystals, or like shining giant-teeth protrude above the rolling horizon.

Leavitt settlement. Mountain View lies in a very similar location to the west.

Looking SW. Late September

Cultivated fields. There is some irrigation at Leavitt. Hills in the foreground and background are devoted to grazing.

Alta. no. 5 highway

Looking SW. Late September

Poplar strip in a sheltered pocket.

Grazing

Rural settlement with a few planted trees.

Looking W. Late September

Long, rock-crested, (teeth-like) foothill ridge paralleling the mountain front but far to the east of it. This is west and slightly south of Cardston.

Grassland, vegetation

Chief Mountain

Some scattered cultivation. Many sheep are grazed nearby.

Looking SW. Late September

Note the gravelly till in the road cut. The ice-sheet, at one time, covered this entire area.
Cardston - "The Temple City" (90)

Mormon (L.D.S.) temple.
Mormon (L.D.S.) church.
School.
Cottonwoods, poplars, etc. on floodplain of Lee Creek. Great rows of poplars have also been planted by the Mormon pioneers as windbreaks and for beauty around their farms and town homes.

Mormon social center.
Grain elevators
Town hall
Main street commercial belt.
Looking NW.
Early October at sunrise

Mormon (Latter Day Saints) Temple (91)

This structure is built of white granite from Vernon B. C., and is the only Mormon temple on British soil. The grounds contain monuments, fountains, shade trees, lavish flowers beds and extensive lawns.

Looking W.
Late September
Panorama of Cardston

Temple with power house and tabernacle.

Note the numerous planted trees.

Well-to-do homes (many old)

Grain elevators and railway station.

Blood Indian Reserve.

Well-to-do homes.

Municipal office

1 of 2 hotels in the town.

Main street.

Main Street of Cardston

Looking NW.

Late September

Major business block.

A very wide main street is typical of Mormon towns. Most business establishments in Cardston are located along this main street, especially on the side shown.

Looking NW.

Late September

Main Street of Cardston

Looking NW.

Late September

(92)

(93)

(94)
St. Marys River valley at Kimball. Kimball is the beginning point for irrigation canals running northeastward.

Chief Mountain, viewed from the east, looks like the base of a broken column. Here it rises above swirling clouds at its base into the bright mildly hazy atmosphere of late afternoon.

St. Marys River and flood plain after the river has left its deeply entrenched foothills course and begins to flow in a broader valley across the plain.

Canyon on the St. Marys River as it leaves the disturbed belt.

Field of cut grain.

Looking SW. Late September

High, rolling ridges north of Carway.

No trees, only grassland. Topography is rounded but quite hilly.

Outlying barn with corral. This is range-land.

Note the remnants of snow still remaining in secluded spots on these high, sand-papered hills.

Looking S. Late April early May.
Jefferson

This center is located near the western base of the Milk River Ridge.

Grazing land on the ridge.

3 grain elevators.

Milk River Ridge in the background
Grain cultivation.

Looking E.
Late September

Scattered dwellings generally lacking trees and formal gardens.

Whiskey Gap

Storm clouds are breaking up and drifting away.

Water tower

Old gas station.

The grassland is apparently a transitional Festuca association with Stipa-Bouteloua. Not only has heavy grazing changed much Fescue grassland to spear grass, and blue gama grass, but this area is a transition zone in the virgin state. The two grassland types vary with the varied topography, Stipa-Bouteloua being more characteristic of the drier sites.

3 grain elevators at the "end of rail" on the only railway link with outside markets for a wide area.

Some willows, buckbrush roses etc. in suitable locations.

Largely Stipa spp. (spear grass.)

Gravel road to Del Bonita Looking SE.
Late September in the afternoon

This settlement is located in the narrow gap cut through the Milk River Ridge by melting glacial water. Its sides show clearly in the photo. American whiskey smugglers used this passageway in the 1800's.
Milk River Plateaux. (99)
Milk River Ridge proper on the horizon beyond the Milk River's northern branch.

Pond useful for stock watering
Farmyard showing barn, haystack etc.

Grain fields cover the heaving, high plains west of Del Bonita. Summer fallowed wheat land in the foreground.

Del Bonita Plateau (100)

Menacing storm clouds after an early snow

Looking E.
Late September

Relatively prosperous cultivated district on level glacio-lacustrian land. The native grassland tends to be Stipa-Bouteloua.

Very rolling country between Whiskey Gap and Del Bonita.

Strip wheat

Looking NW.
Late September

Grazing land
Del Bonita, viewed from in front of the General Store.

To Twin River
A modern addition—a quonset hut.
Supported wooden awning (old style).

To Magrath
Windmill for generating electricity.
International Harvester Sales catering to local rural needs.
Road to Montana (2 miles).
Road to Whiskey Gap and Cardston.
Looking SE.
Late September

Oil Field at Del Bonita
Cut wheat
Oil derrick. There are approximately 12 oil wells in the Del Bonita field.
Land in summer fallow.

Looking NW.
Late September
Blood Indian Reserve. Open unfenced grazing land lacking trees. This air view is west of Ninastoko, the administrative center of the Blood Indian Reserve.

Bullhorn coulee, steep sided and devoid of trees.

Looking down SE. Mid September

Slough. A variety of vegetational types of mixtures can occur around such sloughs. Sedges (Carex spp.), certain grasses (such as Alopecurus sp.) and Polygonum spp. (smart weeds) predominate.

Road across southern portion of the reserve.

Confluence of Waterton and Belly rivers beside Mokowan Buttes. (105)

Gully-scarred, badland-like Mokowan Buttes in the Blood Indian Reserve across the Belly River.

Vertical, almost shaft-like clay cliffs. Indians made use of such for stampeding buffalo over. "Buffalo pounds" are located nearby.

"Buffalo pounds" are located nearby.

Talus

Cumulus clouds

Belly River

Waterton River

Cottonwoods and poplars on the river flats.

Looking E. Late September

Probably stipa sp. grass. (spear grass.
PLATE XLV

United Irrigation District
Chief Mountain
Cochrane Lake
Irrigation reservoir
Irrigation canal

Hillspring district
Clarke Range
Windbreaks
Dryland (unirrigated) strip-wheat.
Looking SW.
Mid September
Irrigated pasture

Irrigated farmsteads west of Glenwoodville
Wheat, summer fallow dryland farming pattern.

Irrigation canal.
Irrigated pasture and forage.
Pile of hay bales

Farm pond
Road to Glenwoodville.

Grain stubble
Looking down N.
Mid September

Tall luxuriant poplar windbreaks on the western (windward) sides of houses.
Note the bright, new, modern homes.
This is an area settled and irrigated by Mormon agriculturalists.
Glenwoodville

Dry land strip-wheat.

Typical Mormon town structure, with generally wide streets, huge, square blocks and a scattering of small holdings each with its magnificent windbreaks.

Giant glacial erratic of quartzitic sandstone (Rocky Mt. origin) northeast of Glenwoodville.

1938 or earlier

Photo from Soil Survey of Lethbridge and Pincher Creek sheets.
Strip wheat and grazing country southeast of Pincher Creek, in the eastern part of the disturbed belt, which here presents a plain-like surface.

Chief Mountain

Strip-wheat. There is more grazing southward.

Large livestock barn

Note how ranches, and farmsteads looking S. seek the wind protection of valley sites, plus the water supply for stock in some cases.

This is in the disturbed foothills zone. Stream entrenchment is evident.

Willows, cottonwoods on flats. Note how broken and often scattered the forest band is.

Gravel

Especially noteworthy is the manner in which the vegetation pattern conforms to topography and drainage.
Farmstead in the wheat and grazing country southeast of Pincher Creek.

Sinuous, meandering coulee bed. This area is grazed.

Summer fallowed land.

Modern living house
Cut wheat land
Barn
Corral
3 haystacks
Looking down S. Mid September

Strip-wheat patterns

Strips are at right angles to the prevailing westerly winds.

Wheat
Summer fallow, land continuously plowed.

Looking down N. Mid September

These alternate every year in an effort to conserve soil and moisture.
Most of the area behind the hill lies in the Peigan Indian Reserve. The reserve's cultivated portion lies to the left. It is largely strip-wheat like the nearby areas.

Part of the Porcupine Hills.

Hill which is uncultivated because of its roughness and because of its poorer soil. The latter factor is often related to the fact that the area is a hill and good soil tends to be moved down slope.

Note the sharp even edge of cultivation.

Land is cultivated by blocks, not by natural divisions.

Looking NE.

Mid September

River valley vegetation. Waterton River south of the Peigan Indian Reserve. The river bank is low here, where the river and valley are wide after leaving the disturbed belt, immediately to the west.

Looking down N.

Mid September

Scattered deciduous tree growth with several willow species and cottonwoods including, Populus angustifolia, P. acuminata, and P. sargentii. Balsam poplar (P. balsamifera) is locally present in such places. Small cottonwood (P. angustifolia) is frequently shrub-like. Other woody species such as the Thorny buffalo berry (Shepherdia argentea) are also found.
GEOGRAPHIC CROSS SECTION
AT A MOMENT IN TIME
FORMATION OF THE EASTERN ROCKIES

ADAPTED FROM DYSON 1953

FORCE

CROSS SECTIONS

LEWIS OVERTHRUST

INFOLD OF SOFTER ROCKS POSSIBLE

OLDER HARDER ROCKS (BROWN)

NUMBERS INDICATE SEQUENCE FROM OLDEST TO YOUNGEST

YOUNGER SOFTER SHALES & SANDSTONES WHICH LIE UNDER THE PLAINS (FLESH)
Formation of Cretaceous infolds among the Palaeozoic Rockies

(A)

Palaeozoic
Mesozoic (chiefly Cretaceous)

(B)

Erosion has worn down the higher Cretaceous areas exposing the more resistant Palaeozoic rock.
GLACIAL HISTORY - CROWSNEST PASS

A
ICE ADVANCE

GLACIAL CENTER

CENTRAL RANGE OF THE ROCKIES

B
ICE MELTING

ICE DAMMED LAKE

MELT-WATER STREAMS

C
PRESENT

COMMUNICATIONS

EROSION INTO OLD LAKE SEDIMENTS

CONTINENTAL DIVIDE

ALLUVIAL FANS DAMMING LAKES

AXIS OF CENTRAL RANGE

MELT-WATER CHANNEL
PINCHER CREEK
ANNUAL TEMPERATURE CYCLE
(MEAN MONTHLY VALUES)
CARDSTON
MEAN JULY TEMPERATURE VS.
ACTUAL JULY TEMPERATURES

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MEAN
MEAN JANUARY TEMPERATURE (F)
Mean April Temperature (F)
Mean July Temperature (F)
Pincher Creek
FROST FREE SEASON
CARDSTON

PRECIPITATION VARIABILITY FROM THE MEAN

PRECIPITATION (INCHES)

PINCHER CREEK
PRECIPITATION VARIABILITY
FROM THE MEAN

PRECIPITATION (INCHES)

COWLEY

MONTHS OF YEAR

J F M A M J J A S O N D

DIRECTION

N NE E SE S SW W NW

WIND DIRECTION & SPEED DURING YEAR

AVERAGE WIND SPEED IN MILES PER HOUR

4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 M.P.H.
ANNUAL PERCENTAGE FREQUENCY OF WINDS

Cowley (Airport)
"Chinook Belt"
Alberta Montana

THORNETHWAITE CLASSIFICATION
WATER SURPLUS
SCALE 1: 2,500,000
THORNETHWAITE CLASSIFICATION

MOISTURE INDEX

SCALE 1: 2,500,000
Soil Color Zones

Source: Odynsky, Map - Soil Zones of Alberta

Legend:
- Dark Brown
- Black
- Brown
- Shallow Black
- Not Surveyed
- Largely Grey Wooded
PARKLAND ZONE

STIPA-AGROPHYRON ON SOUTH SLOPE (WARM & DRY)

FESCUE GRASS BELT

FOREST

ASPEN GROVE ON NORTH SLOPE (COOL & MOIST)

STIPA-AGROPHYRON FACIATION OF MIXED PRAIRIE

THE GRASSLAND WOODLAND ECOTONE

FOREST ENCLOSING GRASSLAND

GRASSLAND SURROUNDING TREE GROVES
BANDING OF TREE GROWTH

Along certain rock beds exposed on mountain sides, differences in rock hardness, ease of breakdown and soil formation allowing root penetration, as well as drainage and chemical composition influence plant growth and succession patterns.

Tree growth limited to long, rocky, strata outcrops in heaving, soil mantled grassland.
Southwestern Alberta
1:1,267,800

Phytogeographic Regions
Adapted from Moss 1955 & Halliday 1937

Legend

- ALPINE
- CORDILLERAN TRANSITION
- BOREAL
- COLUMBIA FOREST
- PARKLAND PRAIRIE
- SUBALPINE FOREST
- MONTANE FOREST
- MIXED PRAIRIE

"PRAIRIE" MEANS STEPPE...
AGRICULTURAL PATTERNS

Grazing land along stream

Strip-wheat cultivation in blocks avoiding entrenched watercourses

Strip-wheat on heavy-soil, level to rolling land

Grazing on hilly land with poor stony soil
NATURAL DIVISIONS OF THE
EASTERN ROCKIES FOREST RESERVES
BARN TYPES

MOUNTAIN VIEW
New barn, with a durable light all-metal roof in an area of relatively high snowfall.

PINCHER CREEK & WEST OF CARDSTON
Typical of many of the foothills ranches.

CLAresholm
New barn with metal roof. This is a farming and ranching area.

TWIN BUTTE AND INNER FOOTHILLS
Log barn.
ACCESSORY STRUCTURES

PIG BARN
WEST
OF
GLENWOODVILLE
UNITED I. D.

TYPES OF
BEE HIVES
IN THE
UNITED I. D.

HAY STORAGE
BARN WITH
METAL ROOF
AND PARTLY
OPEN SIDES.
THE HAY IS
MECHANICALLY
BALED.
UNITED I. D.

GRANARY,
A SMALL
WOODEN
STRUCTURE
FOR GRAIN
STORAGE.
THESE BUILDINGS
MAY BE ON THE FIELDS.
STRIP-WHEAT LAND
COMMERCIAL CORE
HOSPITAL
RELIGIOUS INSTITUTION
STREAM ENTRENCHMENT
MUNICIPAL OFFICE
TOWN HALL
FIRE HALL
SCHOOL
PINCER CREEK
EDGEOF THE DISTURBED BELT
ALBERTA SYNCLINE
PINCER CREEK
C.A.R. NO. 3 HIGHWAY
AIR FIELD
GRAN ELEVATORS
PINCER STATION 3771'
DISTURBED BELT
A FEW SCATTERED FARM RESIDENCES

GENERAL STORE

OIL & GAS FIELD

HIGHWAY TO MAGRATH

TO CARDSTON

CANADA - U.S.A.

CUSTOMS

TO TWIN RIVER

ELEV. 4250'

49° NORTH  LATITUDE

DEL BONITA

ALTA.   CANADA

MONT. U.S.A.
CULTURAL LANDSCAPE REGIONS

Legend:
- Strip Dry
- Other Farming
- Forest Conservation
- Indian
- Irrigation
- Coal Belt
- Range Grazing
- Mormon Belt
- Oil & Gas Fields
- Recreation Park
Southwestern Alberta

LANDSCAPE REGIONS

Legend
- High Foothills
- Rolling Range
- Subdued
- Sweeping Dry Farming Plains (Graz.)
- Milk River Plateaux (Grazing, Grain)
- Mormon Irrigated and Cultivated Belt (Level)
- Indian Reserves
- Porcupines (Graz. Forest)
- Porcupine Tran.
- Northern Rockies (Coal, For., Graz)
- Southern Rockies (Scenic, Forest)