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Departments of Economics, Political Science, and History

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January, 1928

No. 1

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## Physical and Economic Geography of Oregon

CHAPTER XIII. The Willowa Mountains and County.

BY WARREN DUPRE SMITH

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### INTRODUCTORY NOTE

The "Physical and Economic Geography of Oregon," by Professor Warren DuPre Smith, of the University of Oregon, has appeared in installments as follows in the Commonwealth Review: Introductory chapter, April-July, 1924; chapter II—Location and Political Boundaries, chapter III—The Geologic Formations and Their Structure, and chapter IV—Geomorphology and Physiographic Provinces of Oregon, December, 1924; chapter V—Hydrography, and chapter VI—Climate, January, 1925; chapter VII—Flora and Fauna, chapter VIII—The Natural Lines of Communication, and chapter IX—Population, April, 1925; chapter X—The Willamette Valley, October, 1925; chapter XI—The South-eastern Lake District and chapter XII—The Coast Range Province, April-July, 1926.

As Dr. Smith plans to compile this material into a book, it will be a great favor, personal and public, to have the corrections and criticisms that may be noted by the reader. He earnestly invites that such be sent him at the University of Oregon.—Editor, Commonwealth Review.

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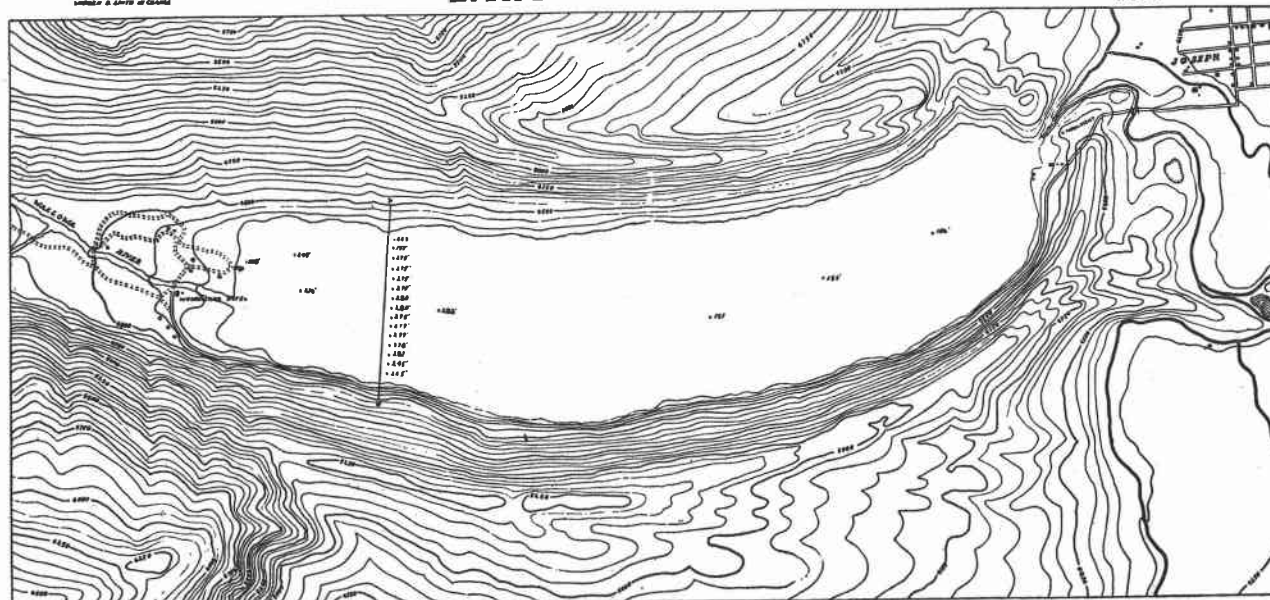
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UNIVERSITY OF OREGON  
GEOLOGY SUMMER CAMP  
JULY 1 - AUGUST 15, 1964

WALLOWA COUNTY  
OREGON



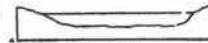
JAMES E. BROWN, INSTRUCTOR IN TOPOGRAPHY  
 H. A. HENNINGSEN  
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 SUMMER 1927

### LEGEND



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CONTAINS INTELLIGENT SOFT.



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#### LOCATIONS IN OREGON

TOPOGRAPHIC MAP OF WALLOWA LAKE AND MORAINES

(University of Oregon Summer Camp Students)

# The Wallowa Mountains and County— Geology and Economic Geography

By

WARREN DUPRE SMITH

(In Collaboration With Marjorie Clark, Herman Meierjorgen,  
and James Stovall)

Just as "All Gaul is divided into three parts," so they say Oregon is divided into three parts: Western Oregon, Eastern Oregon and Wallowa county. Wallowa county is distinctly different from any other portion of the state—indeed it resembles Switzerland more than any other part of our western country.

Before launching into the pleasant task of describing this beautiful (and we fear to many Oregonians, unknown) country, the writer should tell how he came to know it. Though he had read some geological notes relative to it by one or two fellow geologists and had listened to an enthusiastic student paint the glories of his native haunts, he had little conception of it until that active body, the Mazamas, held their annual outing in that region, July, 1918, and he was a privileged member of their camp. Again in 1927, he conducted the geology summer camp of the University department of geology and spent a month in this region.

We almost wish we could forget for the moment the vocabulary of geology and geography and be permitted to draw upon the words of Wordsworth or that we had the power of description of a Tyn-dall, or a Winchell, for truly the region we are about to tell you of merits the finest phrases in our language. As we stood more than once on the top of some natural minaret in the flush of triumph, we wished we might, in the words of Kipling, "take hold of the wings of the morning and flop around the earth 'till we're dead'," but this is permitted to the poet, the geologist must keep his feet on the ground very literally.

To the following persons we would like to make especial acknowledgement for assistance in the acquiring of data for this article: Mr. A. Bodmer, manager, McCully Mercantile Co., Joseph, Oregon,

who furnished transportation, samples of minerals and much information; Mr. H. W. Harris, former forest supervisor of Wallowa national forest, for the use of the excellent topographic folio of this reserve; N. J. Billings, present supervisor; Mr. J. Fred McClain, district forester at Joseph; Messrs. Richardson and Reade, engineers of the Baker mines, Cornucopia; Mr. Forsythe, manager of Enterprise Power company; Mr. J. H. Horner, assessor, Wallowa county; Mr. H. T. Green of Joseph; Mr. Forstrom and others too numerous to mention; to Waldemar Lindgren, also, whose article on the Blue mountains of Oregon, published years ago, while it does not include our particular territory, yet is invaluable to one making a geological study of this portion of the state; and R. M. Swartley, formerly mining engineer of the State Bureau of Mines and Geology, who has published some notes on the geology of this region and who has perhaps made the only detailed examination of the mines of this district, the writer is happy to express his indebtedness.

#### GEOGRAPHICAL POSITION

Situated in the extreme northeastern corner of the state (between  $46^{\circ}$  and  $45^{\circ} 7'$  N. Lat. and  $116^{\circ} 30'$  and  $117^{\circ} 50'$  W. Long.), near the junction of the states of Washington, Oregon and Idaho, bordered on the one side by the famous Snake river, the country we are delineating lies in the heart of the great "Inland Empire." With excellent transportation, it is in contact with such important cities as Portland, Walla Walla, Lewiston, La Grande, Baker City and Boise, it is more than a county of Oregon, it is part of a more cosmopolitan region. This is perhaps the most striking characteristic about Wallowa county, it belongs politically to one state, yet geographically, commercially, socially and in every other respect it is not limited to this state.

Second, it is ideally replete with mountains, plains, rivers, lakes and forests. Almost every variety of climate, of scenery, of soil and resources found in Oregon can be found there. This fact is of paramount importance. The beneficial effect upon the prosperity, wealth and mentality of its citizens cannot be gainsaid. The region, though old geographically, is but just emerged historically from the frontier stage and so has had time to acquire comparatively

little history or tradition and though the natural setting is there it will always lack the background of romance enjoyed by Switzerland, its physical counterpart.

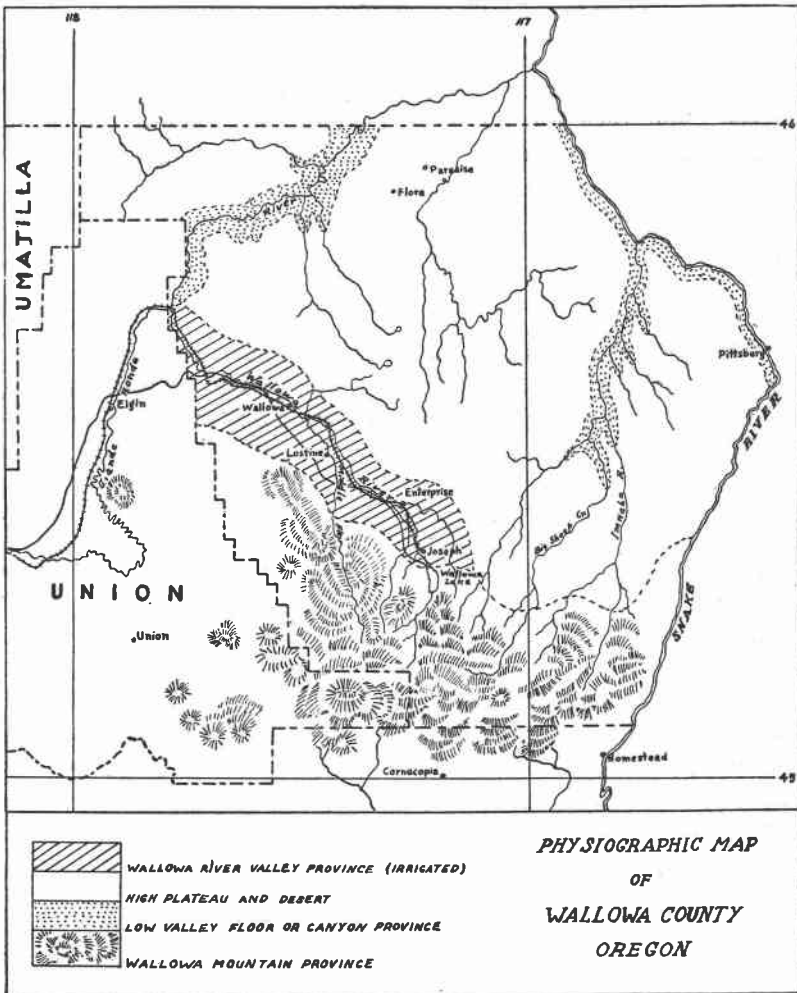


FIGURE 1  
PHYSIOGRAPHIC MAP OF WALLOWA COUNTY

Although Wallowa county is far from the sea, some of its area is rolling lava desert, which in some of its aspects and moods is



not unlike the sea. The motor car has supplanted the old prairie schooner which aforetime rocked and plunged from one lava hummock to another, and prosperous cities are located where once old camp fires burned.

One thing which is very confusing to the traveler is the way he comes into Wallowa, by the back door, as it were. He goes north-by-east, and then east-by-south, because the Wallowa range extends from west to east and the one railroad which taps this region must make an "end run," so to speak, up the Grande Ronde, and thence along the Wallowa to Joseph at the north end of Wallowa lake.

#### TOPOGRAPHY

The general topographical scheme comprises an extensive undulating plain or rather high (4500' elev.) plateau of basalt sloping up to an almost precipitous wall of mountains, so abrupt as to be explained in one way only, namely, by the fault scarp. These moun-

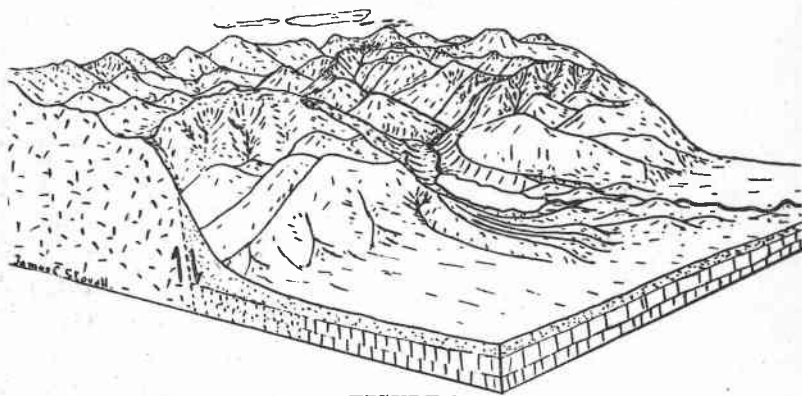


FIGURE 2  
BLOCK DIAGRAM OF WALLOWA RANGE FRONT (NORTH)  
(By James Stovall)

tains are variously known as the Wallowa mountains, the Eagle Creek mountains, or the Powder River mountains.

Figure 1 shows the location of the main points of interest in this country, cities, transportation lines, as well as the four main physiographic sub-provinces.



PLATE Ia

(Photo by Virgine)

LAKE WALLOWA—VIEW LOOKING SOUTH FROM TERMINAL MORaine  
BACK OF TOWN OF JOSEPH



PLATE Ib

(Photo by Juve)

ANEROID LAKE (WITH ANEROID PEAK, BASALT CAPPED AND OVER 9,500 FEET IN ELEVATION, AT THE EXTREME LEFT OF THE PICTURE)

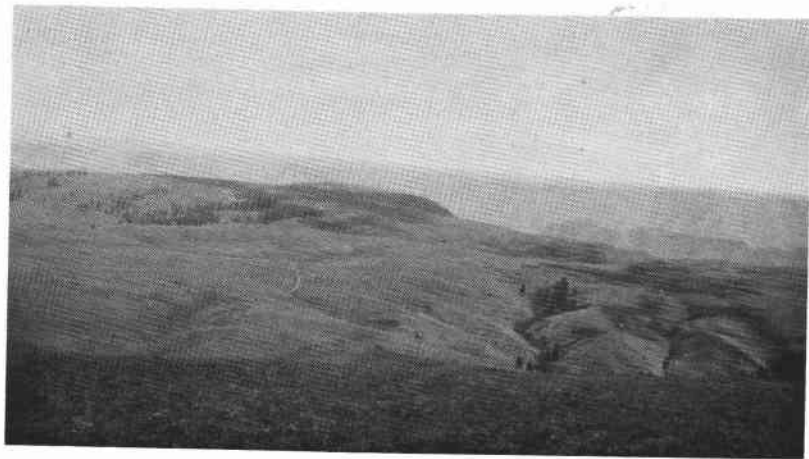


PLATE IIa  
SNAKE RIVER LAVA PLATEAU, LOOKING TOWARD IMNAHA CANYON



PLATE IIb  
ICE LAKE FALLS

(Photo by Graves)

This front mountain wall varies from two to five thousand feet high, and is cut through in several places by deep canyons through which foaming torrents hurdle their way as if glad to be released from their "high mountain cradles" and join the older and more sedate Wallowa, whose course through the lava fields is denoted by a green velvet band thrown out across the landscape. And back of this rock rampart of marble and porphyry rise other rocky peaks with here and there taller sun-kissed and cloud-capped eminences of granite, and one among all supreme, though not the highest, "Old Eagle Cap," the center of the range. Several of the central peaks\* rise to approximately 10,100 feet.\* From these the range falls away to much lower elevations on all sides.

Right in front of the largest of the openings through the range where it seems a giant axe, wielded by some Cyclops, has cleaved asunder the mass of stone, is one of Oregon's and Wallowa's chiefest jewels, Lake Wallowa. Hemmed in, in part by the canyon walls, in part by huge moraines extending far beyond the mountain portal, it lies there a beautiful sight, making a natural and ideal reservoir of water for the use of man, beast and vegetation.

The principal streams debouching from these mountains are the Wallowa and the Minam, on the north side, and on the south side, Pine and Eagle creeks; on the west side, Catherine creek, and on the east the Imnaha. None of these is navigable, but they all are a potential source of power and some, except those which flow out of mining districts, are stocked with fish.

Joseph, the railroad terminus, a town of about 1,000 people, at the gateway of the mountains, is 4,100 feet in elevation. Enterprise is the chief city of the valley and is the county seat, while Wallowa is much smaller. The Wallowa valley bottom is anywhere from 2,500 to 3,700 feet and the summits of the passes across the ranges are all close to 8,000 feet. The mountains are serrated and

---

\* The U. S. Forest Service gives the elevation of some of these as follows:

Matterhorn .....	9,800
Aneroid .....	9,700
Petes Point .....	9,700
Eagle Cap .....	9,675

Legion mountain, whose exact elevation has not been determined, is said to be higher even than the Matterhorn.

rugged, almost bare of large timber and in summer, of snow. One dwindling glacier still clings to the slopes between Sentinel Peak and Eagle Cap, a pitiful remnant of its former self.

To one who has visited Glacier National park, a striking resemblance between the two regions will be at once apparent. The scenery of Wallowa is just as fine, though there is not as much of it.

#### CLIMATE AND VEGETATION

To the dweller in Western Oregon, the land of rain and mist, of vegetation almost tropical in its rankness, of color tones dominantly green and cobalt and purple, the climate, atmosphere and vegetation of this region offer almost startling and yet not displeasing contrast. Perhaps the best way to show this is by tabular arrangement as follows:

WESTERN OREGON	WALLOWA
Vegetation—Large trees—firs, dense underbrush.	Vegetation—Smaller trees—pines and tamaracks, little or no underbrush.
Rainfall—Abundant to excess 40-130 inches, distributed over many months. Slow stream discharge.	Rainfall—Light precipitation, 10-30 inches, but concentrated in short periods, thunder showers, rapid run-off. Dry.
Humid.	Excessive sunlight.
Clouds—Excessive cloudiness.	Temperature—Extremes, 17 to 100 degrees F.
Temperature—Moderate, 10 to 100 degrees F.	Climate—Continental.
Climate—Marine.	

#### FAUNA AND FLORA

Though it is not within my province to discuss at any length in this article these two subjects, for completeness and in order to show the interdependence of the various branches of scientific knowledge of any region, some allusion must be made to them here. Geographical position, physiography and geology, as all should know, have a large share in the distribution, grouping and welfare of plants and animals.

The lighter rainfall, the steepness of the mountain slopes, the greater amount and force of the winds, the light soil covering all have influenced the character of the vegetation. The lack of undergrowth has, of course, been one, if not the chief cause, for the scarcity of animals. It is said that mountain sheep are still occasionally

to be seen on some of the more inaccessible ridges. Undoubtedly this region was once well stocked with game of the kind now to be found in the wilder portions of the Rocky mountains and formerly, too, there must have been a plentiful supply of birds, but in six weeks roaming through the woods and over the rocks of Wallowa, only one or two kinds of birds were seen, and no beast, save domesticated animals from the lowlands. A few tame elk can be seen occasionally near the head of Lake Wallowa. Undoubtedly a field zoologist working at night or with traps would see things which the layman would pass unnoticed.

Not so with plants, for in this domain even the untrained can note, in passing, their profusion and the great contrast to those in the coastal area. On the north side of the Wallows one finds among the trees mainly yellow pine, tamaracks and lodge-pole pine in much denser stands than on the south side. On the divides there is scarcely any timber at all, or if any, a sort of stunted pine.

The flowers of the lowland reaches everyone knows, but comparatively few know the rich carpets of flowers on the upland meadows. Their number and variety are legion. Of course, we know the names of a few of these, but to know their beauty is still better and so we shall leave the more scientific discussion of them to some one better informed.

#### FLORA

We are indebted to Professor Sweetser of the botany department of the University of Oregon for some valuable excerpts from a thesis on "A Comparison of the Flora of the Wallowa Region With That of the Blue Mountains in Regard to Their Geological Relations," by Mabel S. Miller. The geological considerations touched on in this paper are unfortunately not as valuable as the rest of the paper, since they are not based upon any first-hand and critical knowledge of the geology of the region involved, but the botanical data we can take as fairly reliable.

First, let us quote her general conclusions even though we may be somewhat reserved in our full acceptance of them, since they are interesting and not without some measure of scientific worth:

"This tabulated comparison of the flora of the two regions discloses the following results: The total number of species found in the Blue mountains is three hundred and twenty-three; that of the Wallowa region, one hun-

dred ninety-five. Moreover, there are only ninety-five identical species found in both regions and thirty-six species are found in the Blue mountains only.

"Facts to be adduced in the connections with the make-up of the flora of the Blue Mountains emphasize the following conclusions. A large proportion of the species whose distribution is limited to the Blue mountains are habitants of the higher granitic portions of the mountains; all forest trees are found there except *Larix lyalli* and *Thuja plicata*.

"As before stated, 'difference in geological structure seems to be directly associated with the distribution of certain plants.' For example, the central and southern portions of the Cascade system are composed of recent volcanic rocks, while the northern portion and the Siskiyou mountains are made up of older rocks, largely granite. In relation to the distribution of the plants here, we find species common between northern Cascade and the Siskiyou which are absent in the country lying between.

"Moreover, certain species occur only in the Blue mountains and the Siskiyou region.

"The only way of explaining the great difference in the flora of the Wallowa region and the Blue mountains is that it was caused by a geological variation."

Our principal comment on the conclusion in Miss Miller's last paragraph is that difference in physiographic and geologic history and not "geological variation" would more properly explain these variations in flora in the two regions.

Through the courtesy of Dr. Louis F. Henderson, curator, botany museum, University of Oregon, a representative group of trees, shrubs and herbs have been selected from Miss Miller's list, giving both the scientific and common names. The complete tabulation in Miss Miller's thesis is based upon the collections of William C. Cusick, who carried on field work in this region many years ago, and which are now preserved in the herbarium of the University of Oregon. The abbreviated list will serve to give a general floral picture of the Wallowa mountain region.

#### TREES

1. *Abies grandis*, L.—White Fir.
2. *Juniperus scopulorum*, Sarg. Sangentoor—Cliff Juniper.
3. *Picea Engelmanni*, Parry—Engelmann's Spruce.
4. *Tsuga Pattoniana*—Mountain Hemlock.
5. *Pinus Flexilis*, James—Rocky Mountain White Pine.
6. *Taxus brevifolia*, Nutt.—Western Yew.
7. *Populus tremuloides*, Michx.—Aspen, or Asp.
8. *Populus trichocarpa*, Nutt.—N. W. Cottonwood and Balm.
9. *Salix amygdaloides*, Anders.—Peach-leaved Willow.
10. *Salix melanopsis*, Nutt.—Silvery Willow.
11. *Salix lasiandra* var. *Caudata*—Black Willow.
12. *Betula occidentalis*, Hook—Black Birch.



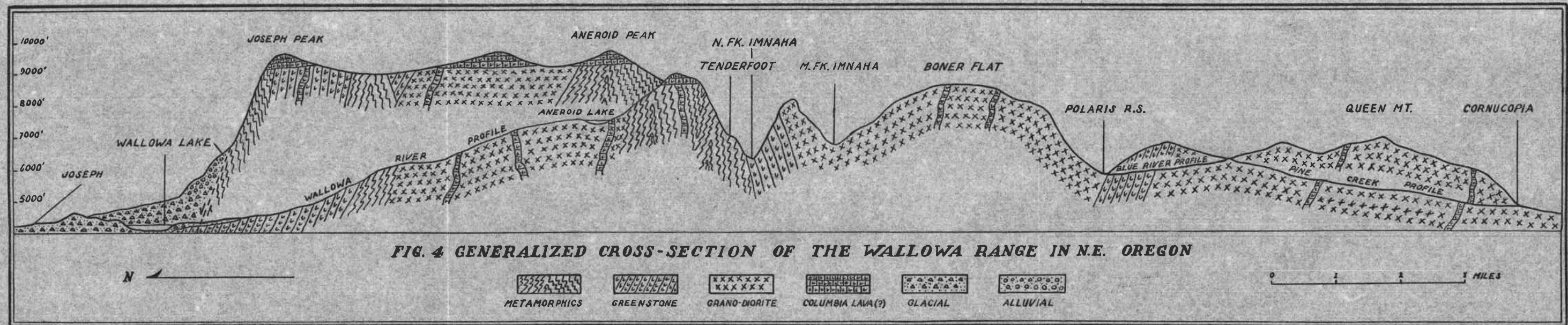


FIG. 4 GENERALIZED CROSS-SECTION OF THE WALLOWA RANGE IN N.E. OREGON

FIGURE 3  
GENERALIZED GEOLOGIC SECTION OF WALLOWA RANGE



## SHRUBS

1. *Salix Lemmoni*, Bebb—Lemmon's Willow.
2. *Salix Sitchensis*, Sanson—Bee Willow.
3. *Salix commutata*—Alpine Willow.
4. *Betula glandulosa*, Mx—Glandular Bush—Birch.
5. *Ribes lacustre*, Poir—Lake or Deep Woods—Gooseberry.
6. *Ribes irriguum*, Dougl.—Thorny Gooseberry.
7. *Ribes viscosissimum*—Sticky Black Currant.
8. *Ribes petiolare*—White-barked Currant.
9. *Philadelphus Lewisii*—Lewis' Mock-Orange.
10. *Rosa pisocarpa*, Gray—Pear-fruited Rose.
11. *Sorbus Sitchensis*, Roem.—Bush Mountain—Ash.
12. *Ceanothus velutinus*, Dougl.—Mountain Balm.
13. *Artemisia tridentata*, Nutt.—Sage Brush.

## HERBS

1. *Allium anceps*, Kell.—Two-edged Pink Onion.
2. *Allium Geyeri*, Watson—Bog Onion.
3. *Fritillaria pudica* (Paroh) Spreng—Yellow Bells.
4. *Calochortus nitidus*—Spotted Cat-ear or Mariposa.
5. *Veratrum Californicus*, Dun.—White Wild Hellebore.
6. *Zygadenus venenosus*—Death Camas.
7. *Zygadenus elegans*, Pursh—Elegant Gygadene.
8. *Sisyrinchium* (*Olsynium*) *grandiflorum*—Purple Bells, Grass-Widow.
9. *Calypso borealis*, Salis.—Calypso, Pink Lady Slipper.
10. *Cypripedium montanum*, Dougl.—White Lady Slipper.
11. *Oxyria digyna*, Campd.—High Mountain Sorrel.
12. *Eriogonum compositum*, Dougl.—Wooly-leaved Big Eriogonum.
13. *Eriogonum heracleoides*, Nutt.—Ruffled Eriogonum.
14. *Polygonum Bistortoides*, Pursh.—Marsh Buckwheat.
15. *Rumex paucifolius*, Nutt.—Marsh Sorrel.
16. *Spraguea umbellata*, Farr.—Matted Spraguea.
17. *Clematis hirsutissima*, Parsh—Pepper or Hot-weed.
18. *Delphinium menziesii*, D. C.—Lower Larkspur.
19. *Aconitum Columbianum*, Gray—Aconite.
20. *Aquilegia formosa*, Fisch.—Columbine.
21. *Paeonia Brownii*, Dougl.—Brown's Peony.
22. *Ranunculus glaberrimus*, Fl.—Early Smooth Buttercup.
23. *Corydalis Cusichii*, Wats.—Cusick's Corydalis.

No special study, as far as the writer knows, has been made of the flora of the Snake river plateau part of the country. The main timber tree in that region is the yellow pine (*Pinus ponderosa* Laws), but in the high desert region for the most part the vegetation is rather sparse. In the bottoms of the canyons on the small benches one finds in some places rather thick underbrush consisting of willows, small pines, cotton-woods, occasional aspens, etc. In the absence of more detailed information we shall dismiss the topic, letting these statements suffice for the present.

## POPULATION

The census of 1920 gives the following statistics concerning the population of Wallowa county (Table I). These are some of the

TABLE I

COMPOSITION AND CHARACTERISTICS OF THE POPULATION  
FOR WALLOWA COUNTY—1920\*

## Color or Race, Nativity, and Sex

Total Population .....	9,778
Male .....	5,375
Female .....	4,403
Native white .....	9,325
Male .....	5,025
Female .....	4,300
Native white—native parentage .....	8,286
Native white—foreign parentage .....	463
Native white—mixed parentage .....	576
Foreign-born white .....	437
Male .....	337
Female .....	100
Negro .....	1
Male .....	1
Female .....	0
Indian, Chinese, Japanese and all others .....	15

bald facts. Miss Marjorie Clark, an advanced student in geography at the University of Oregon, has prepared the following digest, from many sources, of the interesting data related to this subject. I have added some observations and interpretations to her material.

## HISTORICAL BACKGROUND

The region which now comprises Wallowa county was the habitat of the Nez Perce Indians. They were more energetic and of a higher type than the coast Indians. They were cold, taciturn, high tempered, warlike and fond of hunting. They had no well defined idea of a Supreme Being but believed in a future state of existence where they would enjoy the pursuits which in this life had given them pleasure. With them gambling was universal; manifested by racing, athletic exercises, trials of skill and games of chance. Theft was prevalent. The chief was the sole ruler, law maker and enforcer of laws.

In the early days this region was isolated, far from the usually traveled routes of early travelers, fur-traders and immigrants. The Lewis and Clark expedition in 1805 passed close to the north of

---

\* U. S. census.

it at the junction of Clearwater and Snake rivers. The men of this expedition were the first white men the Nez Perces had ever seen. They were friendly to them and assisted them through their country. In 1811 Wilson Price Hunt and the remnant of his party enroute to Astoria, tried to descend the Snake river. They lost their canoes and walked from the Snake river to the Columbia river. Their exact route is unknown, but undoubtedly they passed through what is now Wallowa county. In 1833 Captain Bonneville and his party were in this region.

About twenty-five years after the advent of Lewis and Clark, three Nez Perce Indians, together with delegates of another tribe, set out for St. Louis in quest, so the missionary journals published, of knowledge of the white man's God and Bible. As a result, missionaries were sent to Oregon. In 1834 Jason Lee established a mission in the Willamette valley. Two years later Whitman settled among the Cayuse Indians north and west of Wallowa, and Spalding among the Nez Perces, on the northeast border of Wallowa.

Wallowa was made an Indian reservation in 1855. The discovery of gold in what is now eastern Idaho brought an influx of whites and a white demand for more territory. According to the treaty then formed, the Nez Perces relinquished to the United States their title in and to the territory described in the treaty, excepting the large reservation of country defined, in which reservation was embraced the Wallowa valley.

On June 9, 1863, a supplementary treaty was concluded between the United States and several bands of Nez Perces. By this latter treaty Wallowa valley was excluded from the reservation and surrendered to the United States.

By order of the general land office, four years later, Wallowa valley and vicinity were surveyed as public lands and declared open for settlement. Eleven townships were surveyed and the plats approved. Eighty-seven preëemption and homestead claims were filed. In the years immediately following, a number of white settlers took claims in Wallowa valley. Joseph, the chief of the Nez Perces, ordered them to leave but attempted no violent demonstration. The discontent of the Indians continued to manifest itself and their conduct became more offensive, defiant and threatening. Disaffection became more and more wide-spread and assumed the

shape of organized opposition to white occupancy. The settlers complained that large numbers of Indians had gathered in the valleys, ostensibly for the purpose of gathering roots; but that they were defiant and impudent to the settlers and threatened trouble. Troops were sent in and the Indians dispersed.

In 1875 President Grant issued the executive order proclaiming Wallowa valley public land of the United States; open to settlement.

Two years later the government issued orders for the Indians to go on reservation or be put there forcibly. The Indians pretended to assent but asked for thirty days in which to prepare to move. Instead, they prepared for war. They killed defenseless women and children and rode through the country defying whites.\* They loudly proclaimed that they would not go in reservation—that the country belonged to them and that they would oppose soldiers or citizens who tried to keep them from holding it. With this a war began which lasted over four months. It ended, of course, with a victory for the whites. A small band of Indians crossed the British boundary. The remainder, between three and four hundred women and children, were transferred to the Indian territory located on the Salt fork of the Arkansas river. They have since been escorted by troops back to Idaho. A portion has returned to the Nez Perce nation. The remainder are on the Colville Indian reservation in Washington.

Wallowa county was created February 11, 1887, by the state legislature. It was formed from a part of the eastern portion of the original Union county. The name Wallowa is an Indian word meaning fish trap.† The Indians placed a fish trap in the river and the salmon failed, for some cause unknown to them, to go into the trap. They left the trap there until time to go to their winter quarters. No fish entered it, consequently they arrived at the superstitious notion that some charm had intervened to prevent the fish from going into it. Ordinarily the Indians removed their

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\* Historians disagree on some of these points. The statement made here is based upon Bancroft's version. It would be more charitable to accept Chief Joseph's own denial of these charges brought by unsympathetic white partisans.—(W. D. S.)

† Strictly, the Wallowa is the tripod support at one end of the fish trap.

traps for use the next year, but since this one was evidently taboo, they left it in the river for the floods to destroy. Thereafter the river was always called by them "fish trap" (Wallowa).

#### CHARACTER OF PRESENT POPULATION

Today the population of Wallowa is largely native born whites, only five per cent being foreign born. Practically all of the foreign born people are white. Most of these foreign born whites are Scandinavians; Canadians, Germans and Austrians come next in the order named. They are races particularly adapted to the type of country found here and consequently to the industries resulting from this environment. These industries, lumbering, dairying, garden growing, and raising of livestock, particularly lumbering and dairying, are the same as those they were engaged in in their original homes. Most of the farmers own and operate their own farms. A small per cent of the farms are operated by managers and tenants.

A few of the people are engaged in manufacturing (not more than five per cent). A very small portion of the population is engaged in mining. Wallowa is full of potential tourist resorts. With the influx of a Swiss and California population, these could be extensively developed.

Less than one per cent of the native white population is illiterate, while only about six per cent of the foreign born are illiterate.

According to the twenty-seventh Biennial Report of the Superintendent of Public Instruction of the State of Oregon (1927), Wallowa county has forty-two schools with five standard high schools operated in connection with the grades, and employs sixty-two teachers. There are no union schools because of the lack, in the past, of good roads over which to transport the children and because of the harsh winter climate. Good highways are now being built, so this condition will probably be remedied in the near future. Of late years, timber companies have secured control of a great deal of the land; as a result, several school districts have lapsed. The remaining districts are scattered over a large area. Several can only be reached on horseback or by trail. There is one negro school in the county having seven pupils, in charge of a negro teacher.

The cities of Wallowa county are small centers of agricultural and stock raising communities.

*Enterprise*, with a population of about two thousand, is the county seat. It is situated on the Wallowa river and through it runs the main highway and main railway of the county. Most of its population is engaged in agriculture and stock raising. A few of the people are employed in the flour mill and saw mill to be found in the city. This town fully lives up to its name.

*Wallowa*, with a population of about nine hundred, is also situated on the Wallowa river, north of *Enterprise*. It is a center for farmers. The headquarters of the U. S. district forester are here.

*Joseph* is at the foot of Lake Wallowa. It has a population of about eight hundred. It is a center for the stock industry and also has a milling and grain company.

*Lostine*, with a population of two hundred and fifty, is an agricultural center. It is a potential tourist and recreation center.

Aside from the facts and considerations already given, we are especially interested in observing the distinct differentiation of types of people resulting from the rather sharply defined natural regions.

First, we have the dwellers in the irrigated lands, in the small valley towns and nearby farms, all enjoying the comforts of civilization and living for the most part in comparative ease and with a relatively high degree of culture.

Second, the plateau dweller, engaged either in lumbering or stock raising out on the high ranges. This is a more physically active type living in a fair degree of comfort, but of necessity having less of the creature comforts enjoyed by those in the first group. This is naturally a physically superior type to the first, and perhaps the highest in this respect of all those represented in this region.

Third, the mountain dweller, miner, sheepherder, forester and occasional fisherman. Very few of those classes are permanent year-round dwellers. Because of the exposure, hazards attendant upon an exceedingly rugged terrain, this type probably and in spite of appearances to the contrary, does not come up to the first two in stability, longevity and productivity. We would not be dogmatic in this, we merely point to appearances. Reliable vital statistics covering these points are lacking.

And finally, fourth, there is the canyon dweller, very few in number and widely scattered, some miners, a few homesteaders, trappers and a very few bench-land ranchers. From the writer's field observations, he would judge this type to be in the most precarious condition of all four. Exceptions there are, of course, but as a general rule the environment has got the best of most of them, and to survive at all is greatly to the credit of the dwellers in these situations.

All in all, these four main types, with interesting variations as sub-groups, offer an interesting study to the human geographer, one who is primarily interested in human ecology. This theme alone would afford material for a long dissertation, which we shall have to forego in this paper. The main reason for not developing this aspect of our study further now is the all important one of lack of detailed field data, quantitative data without which unwarranted conclusions might be drawn.

#### GENERAL GEOLOGY

Just as the medical student must spend long hours in the dissecting room, so must the student, who would know the earth, its component parts and how they function, also go into Nature's great laboratory where old Earth has been rent asunder and disembowelled, as it were. The story of the earth cannot be deciphered from a mere examination of its undisturbed surface. The Wallowa mountains offer a splendid opportunity to make some of these necessary studies. Here in a gaping canyon we see a clean cut incision through the tissue of the outer integument of our old world; in another place a terrible, hardly healed-over wound where a side of the mountain has fallen away; over there an old scar where some ancient glacier scratched and gouged its way across its face, and there in the center of the range some convulsion has torn open its side, bringing the very entrails out into the light of day.

Now only the quieter processes of erosion and weathering are going on, but once in the morning of Time, there was heaving and grinding, writhing and slipping, twisting and breaking, as a result of tremendous surging from within. And now we come in the noon-time and observe, classify and interpret. What then do we find? First let us list all the different kinds of formations. Begin-

ning with the oldest, perhaps, there are some slates and quartzites with impressions of some primitive clams, called for want of better names, *Halobias*, and *Daonellas*, which indicate that comparatively remote time in the world's history known as the Triassic Period. Mingled with these are some lenses of limestone now changed to marble containing almost indeterminable corals. These certainly tell us of warm tropical seas and strange little industrious animals working away to construct fantastic dwelling places for themselves beneath the surface of the sea. We find them now thrust up and far away from their ancient home, their delicate cups rudely torn and some crushed by the ruthless ice stream which ground over them.

If we look around pretty carefully we might find some of the cause of the disturbance. There! you are looking right at it, though you don't realize that it did all the mischief, miles and miles of gleaming white granite, or granodiorite, to be more exact. This formation is part of the great Post-Jurassic batholith which is found extensively all the way from Alaska down into California, but is not so evident in Western Oregon. You will find it there, too, but only back in some of the canyons where erosion has removed the ever present basalt cover. This rock in the Cornucopia district is, according to Lindgren, a somewhat more acid type than the California rock, and has more quartz in it.

On the north and south flanks of this perhaps younger, perhaps older (we are uncertain which) lies an old, (I say old here advisedly, because there is a still younger one) lava which from its field appearance and for want of a more exact name, we call a greenstone. This is an extremely hard, dense rock, which emits a ringing sound when struck sharply with the hammer. In places it is characterized by great white feldspars an inch or more in length in a green matrix. Much of this formation is andesite. Overlying the whole mass is a series of brownish layers of more porous lava resting more or less horizontally on the upturned members of this series. This we at once recognize as similar to the well known Columbia lava of the Cascades but which in this region we call Snake river lava which also spreads out over the lower plateau regions of Eastern Oregon. Cutting all the older rocks and leading up into these overlying lava beds are great, wide sinuous dikes



of basalt by way of which the once molten rocks reached the top from the hot viscous reservoir of magma below the "roots of the mountains." Still later than these, though not always topographically above, we find the products of degradation, moraines and talus from glacier, river and landslide.

In Figure 4 is presented a generalized geologic section of the formations as one finds them in crossing the range. Most of this information was secured by the writer when he crossed the range in 1918, but this has been supplemented and corrected by notes taken from the paper by Swartley, and others furnished by Herman Meierjürgen, a member of the 1927 University of Oregon summer camp.

There are rocks in this region at least as old as the Triassic and probably much older, perhaps Archean, though the writer doubts this very much. Not a scrap of evidence in this part of the Blue mountains has been seen to support this latter assumption. It should be distinctly borne in mind, however, that the writer has not seen all this region. There are Tertiary lavas and Pleistocene moraines and recent talus deposits. The Tertiary sediments so characteristic of Western Oregon are here either hopelessly buried, unrecognizably metamorphosed, or else missing altogether. Fossils, the time markers of Nature, are few and hard to find and when found are nearly always recognizable with difficulty.

Some of the more interesting details of the geology of this region may very properly be noted here.

At Aneroid lake (Plate IV), on the property of Mr. Sieber, is a rather unusual development of garnets in a vein varying in size from an eighth of an inch in diameter to an inch or more. In spite of the weathering they have been subjected to they show very distinctly their characteristic dodekahedral shape, having twelve crystal faces each face being diamond shape. Some of these are greenish color and some a cinnamon brown.

On the right (west side) of the trail leading from Aneroid lake to the first summit, and at an elevation of about 7,500 feet, is a fine exposure of old slate, limestone, lenses, schists, etc., dipping to the northwest. These slates, which are extremely hard, emit a ringing sound when struck with a hammer, and contain index fossils of the Triassic period in geological history.

Over on the west fork of the Wallowa, well up to the source of the stream, on the claim called the "Opal," and owned by Manuel Lopez, was seen a very interesting grouping of minerals. In a pocket in the quartz vein which lay between foot wall and hanging walls of granite, we found scheelite (the ore of tungsten); almost every copper mineral known, including the principal ores of copper, pyrite and bornite; molybdenite (the ore of molybdenum and one of the chief substances used to harden steel) and phlogopite mica. Between this pocket and the footwall lay a band a foot wide of fine, green mica, in minute flakes.

Over the divide, in the Cornucopia district, one of the most distinctive geological features is the "Aplite dike," known as the "forest dike," described by Swartley. Aplite is a variety of fine-grained granite, consisting chiefly of the minerals—quartz and feldspar. The local name of forest dike has an interesting derivation. Along the cracks are fine markings, arborescent in shape, due to fine deposits of manganese oxide dissolved out of the rocks and deposited in the cracks and joints. These are not fossil moss or vegetation of any kind, as some have supposed, but the likeness is so marked that the name "Forest Dike" is a very appropriate one. The most interesting fact in connection with this dike is that the principal gold deposits so far located on the Cornucopia side of the range are found close to this dike, either on one side or the other. Some gold values even penetrate the dike itself. The dike is several feet wide and can be plainly followed on the surface for a half mile or more.

James Perrin Smith, professor of paleontology at Stanford University, California, was the first to describe fossil corals and sponges from this part of Oregon, and in a professional paper\* of the United States Geological Survey just published, he figures several genera such as *Spongiomorpha*, *Isastraea*, *Thecosmilea*, etc. These came from Eagle creek on the south side of the range.

During the University of Oregon summer camp of last summer our party found several similar forms at the Black Marble quarry on the north side of the range. Forms such as *Spongiomorpha gibbosa* (?) Frech. *S. dendriformis* Smith, and *Isastraea* sp (?) occur at this locality.

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\* Prof. Paper No. 141, U. S. Geological Survey (1927), Washington, D. C.

## PHYSIOGRAPHY OF THE WALLOWA MOUNTAINS

After the somewhat informal discussion of the geology of this region, we come naturally to say something concerning its physiography. At my request, Mr. James Stovall, another member of our summer camp of last season, has prepared the following preliminary statement, giving an interpretation of the topography of a portion of this country. This is supplemented by my own interpretations of portions of the area not visited by him.

"The Wallowa mountains are essentially an eroded igneous mass, batholithic in nature, with the characteristic radial drainage pattern and is still in a very youthful stage. The rugged mountains stand up seemingly as an island five thousand feet above the lava plateau, which has an average elevation of about four thousand feet. The ruggedness of the mass is due to its extreme youthful character which has been modified by a period of alpine glaciation. This has changed all the canyons down to the plateau and has steepened the canyon walls and left innumerable cirques and horns all over the range.

"Eagle Cap, a mountain 9,675 feet high, stands at the center of the range and all of the main canyons of the range have this peak at their head, as they radiate out from it in all directions.

"The canyons now have the typical "U"—shape of glaciated canyons (Plate IIIa) with the cirques that once formed their heads, joined to form many *cols*, and have left Eagle Cap as a *horn*\* in the center. On the north slope of Eagle Cap is the last remnant of this glaciation, which is a tiny glacier scarcely one-quarter of a mile long hanging in an oversized cirque. Its tiny subglacial stream dashes down over the rocks to enter Glacier lake, which rests in the lower part of the large cirque.

"Between the larger canyons, on the gigantic aretes, are innumerable small cirques of tiny glaciers that acted as feeders to the main glaciers, which have given rise to high serrated ridges or divides between the canyons. The main effect has been to leave many peaks, some hornlike in appearance, others halfdome in shape where they face one of the main canyons, all of which have approximately the same elevation, ranging from 9,000 to 10,000 feet.

"Looking from Eagle Cap across the accordant mountain tops one finds the peaks to the northeast capped with almost horizontal flows of basalt. Near the center of the range the peaks are predominantly granitic in nature, while to the north and to the west the peaks near the edge of the range are either marbles or slates. Many glacial lakes can be seen in the canyons and also, on the gigantic aretes, those that have been formed by the smaller tributary glaciers.

"The outstanding feature to be seen in the mountains is the glacial topography which is rapidly being transformed to one of normal stream erosion. The steep walled 'U' shaped profile is being changed to a 'V' shape by the enormous alluvial cones that have formed in the canyons at the base of the many small hanging valleys that at one time added their little bit of ice and rock to the main glaciers at a much higher elevation on the canyon wall.

"The most striking feature of the glaciation is a morainal lake

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\* Note—This is not a typical one but a half-dome.

(Frontispiece) just on the edge of the mountains where the Wallowa river rushes out of its canyon mouth to cross the comparatively flat-lying lava plateau. Two ancient glaciers extended from Eagle Cap down the east and west forks of the Wallowa river and joined just before reaching the plateau, then pushed out four miles onto the plateau past the jaws of the canyon and piled up on either side gigantic lateral moraines and a terminal moraine at its foot. Now since the retreat of the glacier, Wallowa lake, a jewel of rare beauty, fills the depression. (Fig. 2.)

"The lake is a little over three miles long, and about three-fourths of a mile wide. It extends from the mouth of the canyon northward with a curve to the west at the lower end. It is 283 feet deep at the deepest place measured, which is about a mile from the south end and midway between the two sides. The bottom of the central portion of the lake is practically flat and the sides rise from the bottom abruptly and are the prolongation of the morainal slopes under the surface of the lake. This lake, with its moraines, was mapped by our party last summer (1927) and the results can be seen in figure 6.

"The moraines rise at the highest place (near mouth of canyon) to a trifle over 900 feet above the level of the lake and slope in an unbroken line to the north end of the lake where they are about 700 feet above the lake. At the northwest end the regular aligned lateral moraines give way to the hummocky terminal moraine. The lateral moraines have a lakeside slope of 35 degrees which is rather general. The terminal moraines have a much gentler slope and extend for almost half a mile beyond the limits of the lake and beyond that there is a gently sloping outwash plain upon which the town of Joseph is situated. There is no fossa between the moraine and this plain.

"The history of the lake seems to be one of five successive periods of glacial activity which were probably very closely spaced and did not involve any great retreat of the glacier. The lateral moraines tell the story, especially those on the east side of the lake. The moraines that abut on the sides of the canyon are single and are highest at this point, but farther down towards the lower end of the lake they divide into several lobes, the east moraine into five lobes and the west into two.

"The east moraine divides into five slightly radiating lobes or fingers, each of which has a gentle swing from the north to the west in its farther reaches. The successive lobes from the one nearest the lake are each a little lower and older in appearance until the fifth one, which is the oldest, has a quite weathered appearance and yet is very definitely a moraine. The position of the moraines readily indicates their relative ages, the farthest from the lake being the oldest and each successive one is younger than the one before it until we reach the last one, which is very youthful in appearance with its linear profile and uniform slopes and its entire absence of subsequent erosion.

"The older moraines are at present much lower than the youngest and there is no way of telling whether they were ever as high as it is now. However, the evidence seems to indicate that the next-to-last moraine was built up at a time of maximum glaciation because this moraine extends almost half a mile beyond the others and there are large isolated hummocks near the end of it. Also on the west side there is evidence that at a time just before the last period the ice reached far beyond the present terminal moraine and left hummocks on what is now the west side of the town of Joseph.

"The last period was one in which the glacier piled up high moraines on either side and also deposited a terminal moraine that has very successfully dammed the lake. The ice at this last period must have been over 1,000 feet thick where it emerged from the canyon mouth.

"The glacier in its five successive fluctuations of activity in moraine building seems to have been crowded from east to west by the preponderance of material carried on the east side and which it built up into its successive moraines. The west moraine is for the most part higher than the east and is divided at a point about four-fifths of its length into a 'Y', the left arm branching off and forming the moraine contemporaneous with the fourth and longest one on the east side. The right arm of the 'Y' tapers off into the present terminal moraine of the last period. The west moraine has been successively crowded farther and farther west to its present position and represents the collected morainal material on that side for the five states which have been reworked each time until it now has the appearance of the youngest and boldest moraine in the region.

"There are no other such morainal lakes at the mouths of the other canyons. Several of the canyons show evidence of glacial activity, at or near their mouths but none has the combination of two lateral moraines and a terminal moraine with which to empond the streams and form a lake. Hurricane canyon just to the west of Wallowa lake has a single lateral moraine and a terminal moraine but lacks the second lateral to form a lake. Lostine canyon still farther west, has the remnants of two lateral moraines and a bit of a terminal moraine about two miles up the canyon, but they are not large enough to empond any water.

"The cause of the glacial activity in the Wallowa lake region, so much greater than at the mouths of any of the other canyons, is due to the converging of the two smaller glaciers in the tributary valleys of the Wallowa river which occurred about half a mile up the canyon.

"The single moraine at the mouth of Hurricane canyon previously referred to is an interesting feature and its origin can be determined by a trip up that canyon. Hurricane canyon follows the contact between the slates and the marble until it reaches a point near the Matterhorn which is a marble mountain between Hurricane canyon and the west fork of the Wallowa river; for the remainder of the distance up to Eagle Cap the stream is cutting through granite. The canyon is typically 'U' shaped and at its mouth is a lateral moraine on the west side of the canyon and this curves from the north to the east as it progresses out onto the plateau for about two miles. This glacier was evidently heavily loaded with debris on the west side and scarcely at all on the east. In going up the canyon it is readily seen that practically all of the cirques on the canyon walls are on the west side, which is the marble side of the canyon, and there is almost a total absence of any on the opposite side of the canyon.

"The heavy loading of this glacier on one side caused it to curve away from the heavily loaded side. This is also what happened at Wallowa lake, the heaviest loading being on the east side, it progressively crowded the glacier around until it has a curve to the west.

"The moraine at the mouth of Hurricane canyon compares with the fourth one at Wallowa lake in all of its features. It has none of the freshness of the last ones at Wallowa lake, and the only moraines that are contemporaneous with these are piles of morainal material that choke the canyon several miles above the mouth.

"As one approaches the Wallowa mountains from the north one cannot help but be impressed with the extremely bold front that faces the plateau. The front is practically straight for several miles and extends in an east-west direction and rises almost five thousand feet above the plateau. Along the rim-like edge of the top that is made up of several flows of basalt are many small cirques facing north. Below the cirques and extending almost to the plateau is a section of slump topography which, combined with the other physiographic features, indicate the presence of a fault with a large

vertical displacement. In the center of this front is a great notch that is cut down almost to the level of the plateau and out from either side of this notch extend the lateral moraines of Wallowa lake."

Mr. Stovall has given us a very fair representation of the physiography of this central portion of the Wallowa range front in the block diagram in Figure 2. This and the frontispiece should enable anyone to visualize quite well the salient features in the topography of this section.

Supplementing Mr. Stovall's observations, the present writer will call attention to five or six features in the physiography of the country not discussed by him.

First, there is to be considered the interpretation of the general evenness of the upland surface of the range. There is a marked accordance of the highest peaks of the Wallowa mountains not due to the remnants of Snake river lava which covers some of them. There is quite of an assemblage of high points all of which attain about the same elevation, just under or over 9,500 feet. This may mean an old "matureland," since this surface truncates the up-

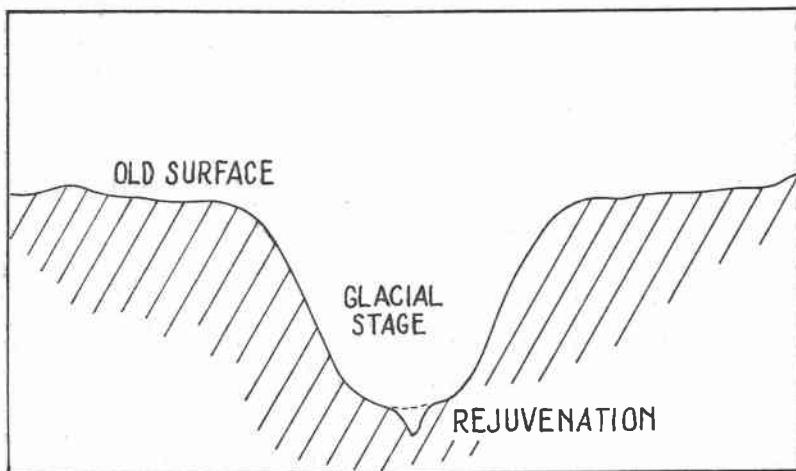


FIGURE 4  
RELATION OF OLD SURFACE (WALLOWA) TO GLACIAL AND  
PRESENT STREAM STAGES

turned edges of folded Mesozoic sediments. The age of this can be approximately placed as being Pre-Snake river lava. Since the development of this old surface, which we shall call the "Wallowa

Surface," there has been a great uplift to this region resulting in a quickened down-cutting by the streams which in many places has produced the well-known and significant "valley-in-valley" effect. All this may be represented simply and graphically in a diagram like the one in Figure 4. Before the glacial modification of the stream valleys there was a long period of slow uplift and stream dissection as pointed out by Mr. Stovall. Now since the glacial effects were produced there has been a second strong incision and entrenching by the streams.

The second noteworthy feature in the topography that should be pointed out is the marked difference in the upland surfaces near the ends of the range contrasted with that found near the center. Mt. Nebo, on which is located a U. S. forest service lookout at the head of Big Sheep and Lick creeks, is a rounded grassy mountain (Plate IIIb) quite devoid of timber whose surface is largely underlain by lava giving a topography in great contrast to that where the grano-diorites and metamorphics are exposed. This, by the way, is one of the best upland sheep pastures in the entire reserve.

In exceedingly great contrast to these upland surfaces there are the deep canyons of the Wallowa, Hurricane, Lostine and many others whose walls in many places exceed 45° slopes and extend from one thousand to three thousand feet above the stream bed.

A third topographic feature which is very striking and of considerable economic importance to the country is the *panfan* in the Piedmont areas. Technically a panfan is simply a large fan resulting from the coalescing of smaller fans where the detritus borne by the torrential mountain streams is deposited in a low cone or fan where these streams debouch from their canyons. Some of these are fairly steep and made up of coarse, boulder material furnishing not a very suitable country for farming purposes, but for the most part they are generally sloping and covered with a veneer of rich soil. As a consequence of their slope, they are exceptionally well drained and supplied with seepage water which insures great fertility of soil. Some of the best farms in Wallowa county are located on such alluvial fans. These are not always very striking at a distance but when one begins to walk or travel, even in a motor car, up these long slopes toward the mountain, one gets a full realization of their very considerable grade and

extent. One of the interesting features of them is that the country is somewhat higher near the streams, near the center of the fan, this being just the opposite of what one not versed with topographic features of this kind would expect, as he would naturally expect the lowest place to be close to the stream. In crossing these slopes parallel to the mountain front one is considerably inconvenienced by having to cross the numerous channels of the distributaries from the main stream. Some of these are merely dry beds and others may be raging torrents. So, as a rule, the only sure way of traversing them is parallel or approximately parallel to the main streams; that is, from the valley floor up toward the mountain wall rather than at right angles to this line.

A fourth physiographic feature which can only be treated in a very general way is the high plateau surface generally known as the "high desert" (Plate IIa). As a rule, this surface is a structural surface of lavas which has been modified in part by erosion causing some changes and subsequent effects which are very interesting. Some of these high plateau surfaces are so uniform and nearly horizontal (also generally treeless) that they remind one of portions of the Great Plains country of the middle-western part of the United States. However, if one studies these surfaces more closely he will find that due to long erosion followed by fairly recent uplift, there has been considerable modification of the old structural surface so that in some places we find a well developed *matureland* with more or less rounded profiles, even approaching old age conditions in certain localities, which in turn have been modified by uplift producing a rejuvenation of the streams and the superimposition of a youthful upon the older mature drainage. This plateau region is in general the stock region of the country and is also (in part) given over to dry farming. In late years both of these industries have been on the decline and when traveled over recently the high desert, even in its most favorable situations, presented a rather monotonous and abandoned aspect.

We come next to the canyon portions of the plateau where we get very deeply incised streams with the Snake river canyon as the chief example. The Imnaha and Joseph creek canyons are almost as remarkable though on a smaller scale. These are canyons



in every sense of the word, quite steep walled and having a very small acreage of productive land on occasional benches bordering the stream. Except for mining, they afford little opportunity for any other industries finding a foothold. In what is known as "Hell's canyon," the most forbidding part of Snake river canyon, the walls are almost perpendicular for a thousand feet. If one takes the cross-section of the Snake river canyon from the summit of the Seven Devils range in Idaho down to the Snake river and up the western side to the summit of the Wallowa mountains, we have a section deeper and wider than that of the Grand canyon of the Colorado. This canyon has been particularly studied by Professor D. C. Livingston, formerly of the University of Idaho and now professor in the school of mines of the Oregon Agricultural College. During 1914 the present writer made a cross-section of one side of the Oregon side of this canyon and collected a suite of samples of the lava flows from the summit to the Snake river, a distance well over half a mile vertically, and at that time saw very distinctly (what others had observed before) the great demarcation between the old Eocene surface on top of the older lavas at the bottom of the canyon with the Miocene Snake river lavas unconformably above this. This section which is best visible on looking from the Idaho side toward the Oregon side reveals very clearly how the great Snake river lava flood poured out over the pre-existing Eocene topography burying forests, canyons, and everything then existing completely from sight. Now this old topography is in process of being exhumed by the river.

For us at this time the most interesting thing about this great canyon is the fact that a very remarkable body of copper ore on the Idaho side, but only a mile from the river and state line, named the Red Ledge deposit, is being developed which when fully under way will probably be one of the largest copper mines in the United States, most certainly in the Pacific Northwest, and the development of this mine will gradually help advance the railroad which now stops at Homestead, down through the canyon towards Lewiston, Idaho. Through the development of these mines perhaps, is the only way in which this very expensive undertaking will ever become feasible.

Finally, we come to the physiographic subdivisions of the county

which is of the most importance agriculturally to the county, namely the Wallowa valley. This is in part a structural, and in part an erosional feature of the topography. The region bordering the Wallowa river, which is filled with alluvial material of a finer sort, because of its proximity to the river, can easily be irrigated, is where we find the greatest agricultural development and the location of the chief towns of the county. This strip is only a few miles wide, but extends diagonally almost across the country and furnishes thousands of acres of exceptionally productive farm land. In this physiographic subdivision we naturally find the most advanced type of civilization, the most cultured communities in the county, and a trip over the exceptionally fine highways from La-Grande through this fertile valley to Lake Wallowa is one of the great rewards for turning off of the Oregon Trail to visit this hitherto somewhat isolated portion of the state.

Some of the broader structural features of the Wallowa region are very interesting, but we do not feel from the amount of work we have done in the field up to this time that we are justified in going into the subject except in the most cursory manner. Professor D. C. Livingston, mentioned above, who has spent many years of study in this region and in western Idaho adjacent to the Wallowa mountains, has some interesting observations with reference to the broad structural features of the area which he hopes to publish at an early date, and because of this we hesitate to anticipate some of the points which he will have in his paper. In general his thesis is that the whole Wallowa region and that portion of Idaho immediately to the east have been cut up into a mosaic of fault blocks of which the Wallowa mountains represent one unit, and the drainage pattern of this entire region is definitely connected with the structure. The long escarpment on the north side of the Wallowa mountains we have already mentioned, and in Professor Livingston's general scheme this is one important line of faulting. The Wallowa river lies in a structural trough which parallels this fault of the major northwest fracture lines of the system. These observations were presented recently in a lecture before the Sigma Xi society at the University of Oregon and on these points the present writer finds himself in very general agreement with Professor Livingston. It is hoped that his

paper will shortly be published, as it will add undoubtedly very much valuable information to the general geology and physiography of this interesting part of Oregon.

There are many other very interesting physiographic considerations which might be dwelt upon in connection with this study, but for the present purpose of this article and the limits which have to be set for it we shall have to forego these, being content with this mere outline. A more technical discussion would discuss the morphology and evolution of the various land forms in greater detail.

#### THE NATURAL AND CULTURAL RESOURCES OF WALLOWA COUNTY

In the absence of certain very necessary data, the following chapter necessarily will be somewhat incomplete and tentative in its conclusions. With the assistance of Mr. Herman Meierjurgan, senior in the department of geology, the following discussion of the cultural and natural resources of the county has been prepared. The report of the United States Bureau of Agricultural Economics, in collaboration with the extension service of the Oregon Agricultural College, has been of very great assistance in the preparation of this part of the paper. The following figure gives a graphic representation of the relative magnitude of Wallowa county's cultural resources:

A brief examination of Figure 5 indicates at once the superior rank of farm crops among the county's cultural resources.

The bulk of this important item is furnished by wheat which was produced in an area of 31,150 acres. Almost two-thirds of the total acreage of thirty-one thousand, one hundred and fifty acres was planted with fall wheat and the remainder (eleven thousand acres) with the spring variety. A total of 543,000 bushels netted a return of seven hundred and seventy-one thousand, six hundred dollars. The major portion of the production was raised on the irrigated lands of the Wallowa valley.

Fifty-one thousand tons of domestic hay and one thousand, four hundred and fifty tons of wild hay brought a total of five hundred and fifty thousand, seven hundred and twenty-five dollars. By far the greatest portion of the crop was grown in the Wallowa river valley. The total acreage was 35,150.

Two hundred and forty thousand bushels of oats netted one hun-

dred dollars and the acreage for the most part was confined to the irrigated land in the Wallowa river valley.

One hundred and eleven thousand, one hundred and fifty dollars was the total 1926 income derived from barley in Wallowa county. This sum represents the returns on a production of one hundred and seventy-one thousand bushels. The total acreage approximated 5,700, most of which was confined to the Wallowa river valley.

Potatoes, though not especially adapted to the higher elevations of the county, yielded 42,500 bushels and at a market price of one dollar per bushel netted the same figure in dollars. This yield was derived from five hundred acres.

Twenty thousand, three hundred and fifty dollars expressed the value of the corn crop. The total acreage was nine hundred and twenty-five, which gave an average yield of 22 bushels per acre.

Although the more elevated and by far the greater part of Wallowa county is unfit for the cultivation of orchards, the canyon floor districts include several fruit growing tracts whose products are of the finest quality in the northwest. This is especially true in the case of peaches (Snake river) which, due to their excellence, are marketed mainly in the eastern states. Unfortunately no figures on the value of the crop are at hand. The following table, however, furnishes data on three fruits of Wallowa county:

TABLE II  
PRODUCTION OF CERTAIN FRUITS IN WALLOWA COUNTY FOR THE YEAR OF 1926

Fruit	Non-bearing Trees	Bearing Trees	Yield in Bushels	Price per Bushel	Value in Dollars
Apples .....	1,333	17,548	10,980	\$0.70	\$7,686.00
Prunes .....		1,369		0.50	1,313.00
Pears .....		2,627		0.85	1,183.65

The next item in rank of cultural products in the county is livestock, and in the writer's opinion, the data which are available on this industry are not only meager but are open to some criticism. Wallowa county is the banner county in Oregon for the raising of hogs and is enlarging this industry at a rapid rate. The following table presents all the data concerning livestock that are available at this time:



PLATE IIIa (Photo by C. E. Williams)  
GLACIATED VALLEY NEAR EAGLE CAP—VIEW LOOKING NORTH FROM EAGLE CAP

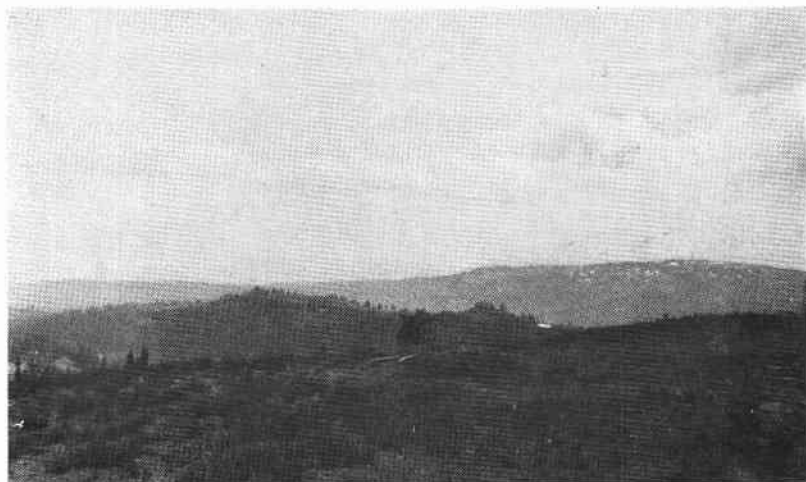


PLATE IIIb  
TOPOGRAPHY AROUND MT. NEBO, ELEVATION 7,500 FEET

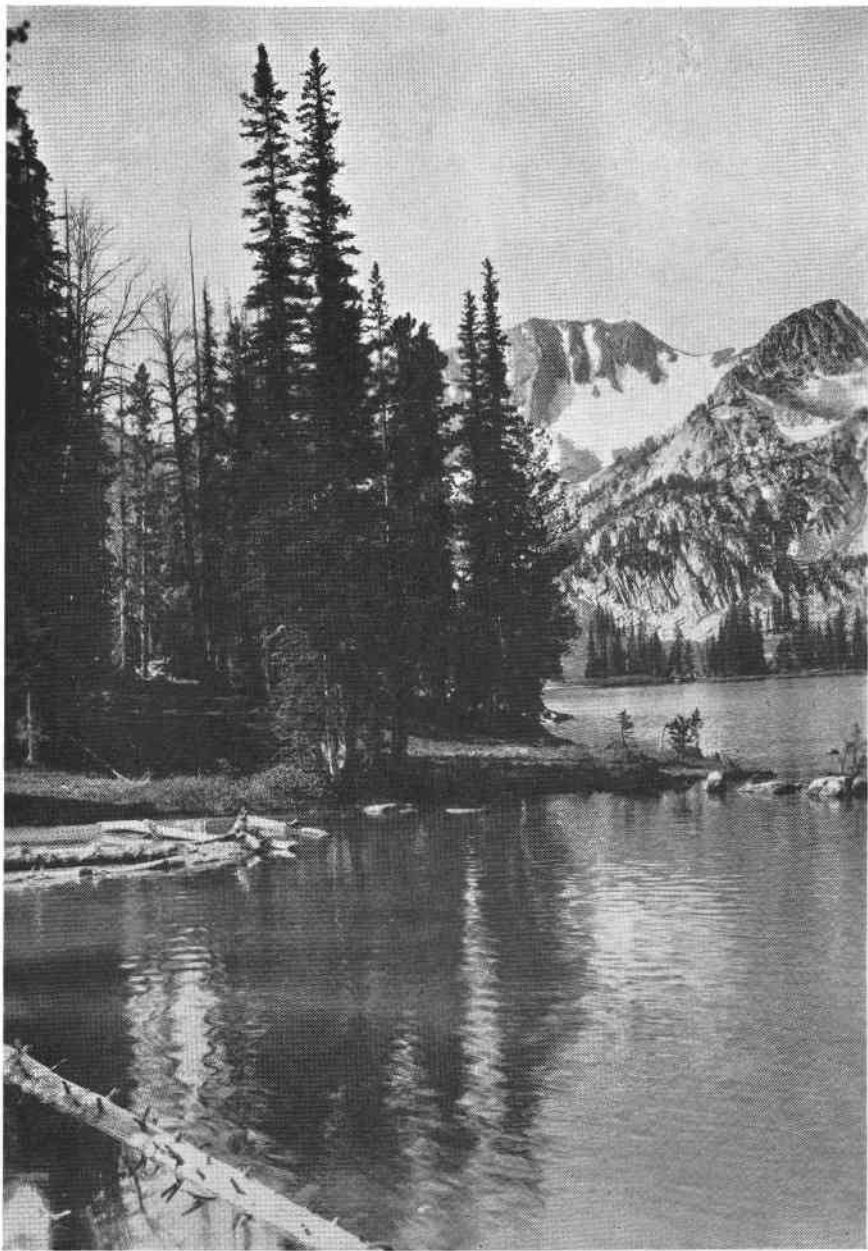


PLATE IV

ANEROID LAKE, ELEVATION 7,500 FEET. DARK VERTICAL BANDS IN  
BACKGROUND BASALT DIKES CUTTING GRANODIORITE

TABLE III  
CENSUS REPORT OF CERTAIN LIVESTOCK IN WALLOWA COUNTY FOR 1926

	No. of Head
Sheep .....	79,830
Hogs .....	21,390
Cattle—Beef .....	18,900
Horses .....	8,495
Cattle—Dairy .....	3,455
Mules .....	580

This table is necessarily incomplete and should more accurate data be secured it will probably result in the placing of livestock at the head of the cultural resources of the county rather than second, as in Figure 5.

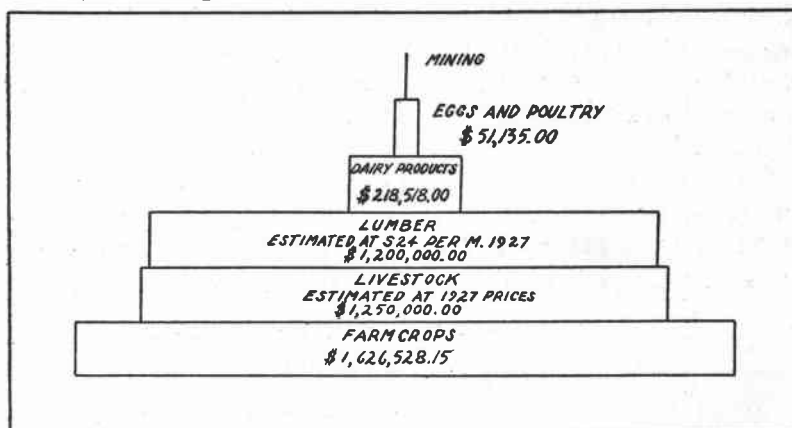


FIGURE 5  
GRAPH SHOWING RELATIVE IMPORTANCE OF VARIOUS INDUSTRIES  
IN WALLOWA COUNTY

It can be seen from Table III that sheep comprise the outstanding item in the livestock industry. The wide variation in elevation and relief of this region, from the warmer canyons at an elevation of approximately two thousand feet up to the high ranges over eight thousand feet, provide ample range for sheep throughout the year. One of the pleasing sights in the general landscape in this region is the great bands of sheep grazing in the valleys and up the mountain sides even to some of the high pastures near the summit of the range. One of the best of these high pastures is Mount Nebo at the head of Big Sheep creek, which is wide and open and provided with excellent growth of grass. One of, if not

the chief source, of revenue in the forest reserve is from the pasturage of sheep.

In close connection with livestock is the dairy industry. In this field Wallowa county has large potentialities. The Wallowa river valley constitutes one of the largest and in some respects one of the most ideal dairy regions in the state. The present status of the industry is in no way indicative of its possible magnitude. The lack of manufacturing plants for the conversion of the milk and cream into their many products is strikingly evident when one considers the fact that a generous carload of cream is shipped each day from Joseph to Portland, a distance of 381 miles. One of the criticisms frequently heard concerning this region is the long season for inside feeding, but when we recall that Wisconsin, the first dairy state of the Union, has perhaps a longer and severer winter than has Wallowa, this falls.

In 1926 the combined dairy products of Wallowa county aggregated a value of two hundred and eighteen thousand, five hundred and eighty-one dollars.

The sale of poultry and eggs netted fifty-one thousand, one hundred and thirty-five dollars in the same year.

#### THE MAGNITUDE AND RANK OF WALLOWA COUNTY'S NATURAL RESOURCES

Of all the counties of Oregon that lie east of the Cascade mountains, Wallowa county has, perhaps, next to Baker the greatest variety and potential wealth of natural resources. It is a singular fact, however, that with the exception of lumbering, she has done comparatively little toward developing these potential resources. There are several reasons for this state of affairs for which the people of the county are not altogether to blame. These will be referred to in another part of this paper.

#### LUMBERING

A conservative estimate of the county's total standing timber approximates three billion board feet. The present rate of cutting is fifty million board feet per year. About half of the timber is western yellow pine, one-fourth Douglas fir, and the remainder white fir, spruce, and lodgepole pine. The high plateau province



holds the greatest share of the timber and the Wallowa mountains and river valley the remainder. The stand in the Wallowa national forest is estimated at one billion, eight hundred million feet, but much of it is either comparatively inaccessible or not merchantable under present conditions.

#### QUARRYING

At present commercial quarrying in Wallowa county is almost at a standstill pending development work of the Black Marble and Lime company at Enterprise. This corporation has possession of a large body of black marble which is unusually high in lime content. Were it not for the somewhat seamy condition of the rock, it would furnish one of the most valuable quarries in the United States, for the marble takes the high polish so necessary in decorative stones. In this cut and polished state it is excelled in beauty by no other known marble in the world. However, its value as a source of lime has justified the modern improvements which are being installed and Wallowa county will soon enjoy an enlarged and paying industry from this resource.

This outcrop of marble which is located on the northern edge of the Wallowa mountains about six miles west of the mouth of Hurricane canyon is not by any means the only marble outcrop in the county. The Wallowa mountains hold practically an inexhaustable supply of limestones and marble. A locality which was visited by the writers during the summer of 1927, which appealed to them as possessing a body of rock at least an equivalent, if not superior to that exposed at the Black Marble quarry, is near Fraser lake. The rock is white and somewhat coarsely crystalline, but remarkably free from impurities and bad fractures. As a decorative marble it would take high rank, and were it more accessible, would be well worthy of extensive development.

Although the supply of granite in the Wallowas is almost unlimited, there has been no effort expended on either the quarrying or investigation of commercially valuable outcrops. The development of this natural resource depends upon the industrial ingenuity of Wallowa county interests and is truly worthy of attention. The market on the Pacific coast is undoubtedly small and considerable competition is to be encountered, but even so, this rock merits investigation.

Quarries, operated by the county, or contractors interested in road building, are confined in the main to basaltic flows which make up the high plateau. This material is so abundant that its use in road construction is highly practical.

#### MINING

Mining, which is, or more properly speaking was, confined to the Wallowa mountains, for the present at least is paying nothing. Considerable "hit and miss" prospecting has been done by local individuals of limited means and aside from several as yet rather undeveloped prospects, little has been done on the north side of the range in the way of opening up a mine. We should not fail to mention, of course, the Cornucopia mines on the south side, which were successful producers for many years, but are now closed down. In Snake river canyon one copper mine of importance is located at Homestead. This has been a steady producer for a number of years. With the beginning of operations at the Red Ledge on the Idaho side of the river, only a few miles below, this district will again attract the attention it merits.

Many of the promising deposits in this region are contact deposits. Some of those on Hurricane creek hold out hope through development. Other typical contact deposits are those near Aneroid lake and on Adams creek.

There is urgent need for a detailed geological study of the Wallowa mountain ore bodies and a following up of such study with a concentration of development. Nothing has been, or will be gained by blindly following idly conceived "hunches" in exploring for minerals. Cooperation in or pooling of resources to investigate the most favorable prospects is an excellent program for the various mine holders to follow, and until some such movement is started the present situation will probably continue.

To date no metal deposits of major importance have been found in the Wallowa mountains, though several good prospects are known. Besides gold and copper deposits, galena (lead) and molybdenite exist in several localities. The existing isolated and relatively inaccessible mine locations would in many cases prohibit operation under the present status of mining in western United States. The attraction of outside capital to bear upon the development of min-

ing has been greatly impeded by such confidence-destroying events as the Tenderfoot mine fraud of an earlier generation. Capital is ultra-suspicious of "wild-cat" projects, and once its faith has been destroyed, little can be done by mere persuasion to restore it. The reader of this paper who desires more detailed accounts of the mineral prospects of this region should consult Swartley's report on this subject. (See bibliography at end of this report.)

During our operations in the Wallowa mountains proper last summer we took occasion to visit a reputed coal mine near Paradise. The so-called "coal" was a very inferior lignite of very local character and practically worthless. This lignite was formed in a local swamp or bog in an irregularity in the surface of one of the many lava flows of that region. Commercial coal is rarely found under such conditions.

#### RECREATION AND SCENERY

It is with a personal reluctance, influenced only by the data at hand, that the writers place Wallowa playground and scenery in the third rank of her natural resources. Potentially this may be the greatest resource of the county, for in the matter of scenery this county has only begun to capitalize its potentialities. Wallowa lake itself is unique in Oregon and one of the finest of its type in the United States. The huge moraines which hem it in are the largest and most perfect of any which have been called to the writers' attention. Certain exaggerations with reference to this lake have been found to be quite unjustified, such as "the lake is bottomless"; as this is a fairly wide-spread notion and altogether preposterous, attention is hereby called to the accompanying map and cross-section of the lake made by the University of Oregon summer camp students last field season. The lake is comparatively shallow. Wallowa lake has naturally received the greatest amount of attention of the scenic features of this region, but we would call attention to the multitude of large and small cirque lakes, or tarns, which abound above the seven thousand foot level in these mountains. There are some very wonderful waterfalls (Plate IIb), too, in the higher elevations of the Wallowa mountains, not as large as those in the Cascades, but in many ways quite as attractive. The domes and half domes characteristic of the granite areas in the

central part of the range provide a landscape not found in other mountains of Oregon and one would have to go to the Seven Devils of Idaho or the Sierra Nevadas of California to match them.

Not the least of the scenic attractions of the county are the remarkable canyons of Joseph creek, the Imnaha, et cetera, culminating in the remarkable Snake river canyon which is less well known, but in many ways more remarkable than the Grand canyon of the Colorado. In order to facilitate the tourist in his inspection of these wonderful show places we would call attention to the desirability of extending the excellent program of the forest service so that more trails and some roads be built with the erection of rest houses and camp sites at convenient intervals. Small guide books with the scenery simply and scientifically explained with complete directions for getting about might very well be prepared and furnished the tourist. If these things are done with the right kind of advertising there is no reason why this potential resource cannot be made to take first place in the way of yielding revenue to the county.

#### HYDRO-ELECTRIC POWER

The Wallowa mountains are perhaps the greatest source of hydro-electric power in all eastern and central Oregon. With fairly extensive snow fields feeding her rivers throughout most of the year, the Wallowa mountain province is assured of a uniform source of generative power. At the present time a small but thoroughly modern plant located on the east fork of the Wallowa river, about one-quarter mile upstream from its confluence with the west fork, furnishes the simple electrical needs of the Wallowa river valley. In all, the plant probably does not represent more than one-tenth of one per cent of the accessible water power resources of Wallowa county. With this in mind, it does not seem untimely to the writers to suggest several industrial developments which are rendered highly possible by virtue of an abundant source of hydro-electric power.

1. An electric smelter would be justified in the event that local mining activities should be stimulated to a financially sound basis.

2. The cheap operation of a greatly needed system of creameries and cheese factories.

3. The efficient operation of textile manufacturing plants which would provide an excellent market for wool and mohair.

4. The electrifying of future and present railroads together with all those industries which depend upon some source of power for their operation.

#### SUMMARY

The status of Wallowa county's resources may be summarized in a few general statements:

1. The natural resources far exceed the cultural resources in value.

2. Of the cultural resources particular attention should be given to the expansion of (1) dairying; (2) livestock (especially hogs); (3) fruit; (4) sheep and goats; (5) poultry.

3. Those natural resources which demand immediate and vigorous expansion are in their order: (1) scenery and recreation; (2) a. quarrying and b. mining; (3) hydro-electric power; (4) lumbering.

4. Whole-hearted support should be given such movements as the Wallowa County Agricultural Economic Conference, and efforts should be made to adapt and expand such an organization to the entire exploration and development of all Wallowa county resources.

5. A program of scientific promotion is needed to take the place of often times ineffective booster advertising.

6. Removal of some of the petty local jealousies existing between a few of the towns of this region.

7. Improvement of some existing roads and extension of new ones to points of scenic importance.

Of course, we realize the difficulties facing a pioneer community and the fact that it is much easier to give advice than to carry out the suggestions so freely offered. Nevertheless, persons from the outside sometimes can see difficulties and short-comings not apparent to those who are too close to the subject. At any rate, all our statements are made in the interests of Wallowa county for whose people we have a genuine liking and whom we would gladly serve in any way possible.

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