Professional Paper No. 30 Series H, Forestry, 10

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

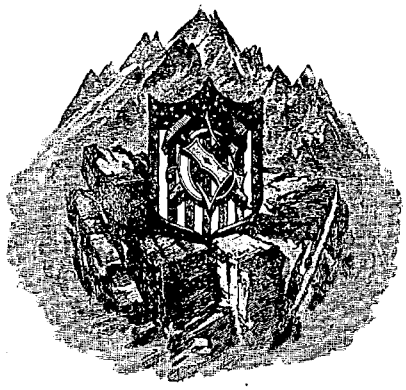
FOREST CONDITIONS

IN THE

LITTLE BELT MOUNTAINS FOREST RESERVE, MONTANA, AND THE LITTLE BELT MOUNTAINS QUADRANGLE

BY

JOHN B. LEIBERG



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[Professional Paper No. 30.]

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JULY, 1904.

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DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D C, February 10, 1904

SIR I have the honor to transmit for publication, as a professional paper, a report by Mr J B Leiberg on the forest conditions and land classification of the Little Belt Mountains Reserve and adjacent regions

Very respectfully,

HENRY GANNETT,
Geographer

Hon CHARLES D WALCOTT,
Director United States Geological Survey.

FOREST CONDITIONS IN THE LITTLE BELT MOUNTAINS FOREST RESERVE AND THE LITTLE BELT MOUNTAINS QUADRANGLE.

By JOHN B LEIBERG

LITTLE BELT MOUNTAINS FOREST RESERVE

LOCATION AND EXTENT.

The Little Belt Mountains Forest Reserve was established by Executive proclamation, dated August 16, 1902, and its boundaries described as follows

"Beginning at the southeast corner of township sixteen (16) north, range ten (10) east, principal meridian, Montana, thence southerly to the point for the northwest corner of township fourteen (14) north, range eleven (11) east, thence easterly to the point for the northeast corner of section four (4), said township; thence southerly along the surveyed and unsurveyed section lines to the point for the southeast corner of section thirty-three (33), said township, thence easterly to the northeast corner of township thirteen (13) north, range eleven (11) east; thence southerly along the surveyed and unsurveyed range line, allowing for the proper offset on the third (3rd) standard parallel north, to the point for the southeast corner of township twelve (12) north, range eleven (11) east; thence easterly along the unsurveyed township line to the point for the northeast corner of township eleven (11) north, range thirteen (13) east, thence southerly along the range line to the southwest corner of township ten (10) north, range fourteen (14) east, thence westerly along the township line to the point for the southwest corner of township ten (10) north, range ten (10) east, thence northerly to the northwest corner of said township, thence westerly to the point for the southwest corner of section thirty-four (34), township eleven (11) north, range nine (9) east; thence northerly along the unsurveyed section lines to the point for the northwest corner of section three (3), said township, thence westerly to the point for the northwest corner of said township, thence northerly along the unsurveyed range line to the point for its intersection with the third (3rd) standard parallel north; thence westerly along said unsurveyed parallel to the point for the southwest corner of section thirty-four (34), township thirteen (13) north, range eight (8) east, thence northerly along the unsurveyed section lines to the point for the northwest corner of section twenty-two (22), said township; thence westerly along the unsurveyed section lines to the point for the southwest corner of

section eighteen (18), said township; thence northerly along the surveyed and unsurveyed range line to the southeast corner of township sixteen (16) north, range seven (7) east; thence easterly along the surveyed and unsurveyed township line to the southeast corner of township sixteen (16) north, range ten (10) east, the place of beginning."

The area of the tract thus set apart amounts to 501,120 acres.

CLASSIFICATION OF LANDS.

The lands in the reserve are classified as follows:

Classification of lands in the Little Belt Mountains Forest Reserve.

	Acres.
Forested	237,810
Wooded	25,140
Nontimbered	238,170
Total	501,120

The nontimbered lands at present comprise almost 50 per cent of the reserve. As here classified they include also the temporarily deforested areas—the badly burned tracts—on which the forest has been practically destroyed by fires since the Indian occupancy of the region, and on which only a very sparse restockage has set in. The nontimbered lands are classified as follows:

Classification of nontimbered lands in the Little Belt Mountains Forest Reserve.

	Acres.
Badly burned	111,600
Agricultural	9,250
Grazing	99,070
Bare rocks	18,250
Total	238,170

If the badly burned tracts are restocked there may be an increase in forested areas of 111,600 acres, making the total forest land 349,410 acres, or nearly 70 per cent of the reserve, while the area of the nontimbered tracts will be 126,570 acres. It is not improbable that in addition to the restocking of the badly burned tracts, certain of the grazing areas, which really consist of ancient fire glades created during the Indian occupancy of the region, may, in the course of time, again come under forest cover. Should such be the case, 50,000 acres may be added to the timber land in the aggregate, giving it a grand total of nearly 400,000 acres, or 80 per cent of the reserve. This may be regarded as the possible future forest acreage of the reserve. The remainder, or 101,120 acres, will always remain in part comparatively thinly stocked woodland, and in part grazing or agricultural lands at low elevations. The bare, rocky exposures and high subalpine areas will never bear a forest, owing to absence of soil and severe climatic conditions.

TOPOGRAPHY.

RELIEF.

About half of the reserve is in the southeast portion of the Little Belt Mountains, and the other half is comprised in a secondary system of ridges which stretches northward from the main range and is variously called the Neihart Baldy-Yogo ridge or the Neihart Baldy-Porphyry Peak ridge, the names being taken from prominent elevations situated along its crest.

The main range of the Little Belts occupies the southern and a small part of the northern and central portions of the reserve. The Little Belt Range is a limestone uplift seamed by numerous dikes of eruptive rock and with extensive areas of metamorphic rocks. Toward the northeast it sends out long spurs which form divides between the tributaries of Judith River, while the ridges which radiate from the southern slope of the axis are short and steep and constitute divides between canyons draining directly into Musselshell River. The crest of the main ridge is mostly narrow, but in places it broadens and forms small plateau areas, as at the head of Lost Fork of Judith River. The high crest line is not continuous, for, beginning at the head of Spring Creek, the range is interrupted by three gaps at the head of Spring, Daisy Dean, and Haymaker creeks. These gaps divide the Little Belts into three great blocks and throw the ultimate heads of the three creeks named above, as well as the summit line of the range, into a low, marshy flat that originally formed part of the South Fork of Judith Basin, from which stream the three creeks named are separated only by low gravel hillocks 20 to 40 feet high. I have named the blocks formed by these gaps, beginning on the most easterly, as follows: Twin Peak block, Haymaker block, Daisy Dean block. The greatest altitude reached by the main range within the reserve is 8,400 feet; its mean elevation is approximately 7,300 feet.

Most of the secondary range, at least its higher areas, is formed of a mass of igneous rock. The radiating ridges on the eastern slopes of the main axis are rather long, narrow, and winding, occasionally rising in low peaks or falling away in shallow saddles. The spurs on the western slope are short and steep. The main ridge is narrow, comparatively straight, and with slight variations from the 7,400-foot level in all of its southern portions. There is, however, a gradual rise toward the north until the ridge culminates in the rough and rugged massifs which constitute Yogo Peak and Neihart Baldy, whence short, rough, and rocky spurs radiate in every direction and fill the northern part of the reserve with a mass of winding ridges and canyons. The highest point on the secondary ridge, which is also the highest point in the reserve, is reached in Neihart Baldy, 9,000

feet above sea level. The average elevation of the reserve, exclusive of the canyons and valley bottoms, is, approximately, 6,900 feet.

The canyon system consists of troughs, long and comparatively narrow in their central and lower areas, the larger usually widening into broadly elongated or semicircular basins at the heads. They often contract into narrow gorges at some point along their course, and in the limestone areas almost invariably display a line of castellated cliffs along their upper breaks. The slopes commonly are very steep and below the line of cliffs are deeply covered with rough talus accumulations.

DRAINAGE.

The principal drainage basins in the reserve are as follows: 1. The upper areas of Belt Creek, composed of (*a*) heads of main Belt Creek; (*b*) all of Dry Fork of Belt Creek. 2. Wolf Creek drainage, composed of (*a*) upper and central areas of Dry Wolf; (*b*) upper one-half of Running Wolf. 3. Judith River drainage, composed of (*a*) all of Yogo Creek, which may be regarded as the north fork of the river; (*b*) all of Middle Fork Judith; (*c*) all of Lost Fork of Judith; (*d*) all of South Fork Judith. 4. Tributaries of Musselshell River, consisting principally of Spring, Daisy Dean, and Haymaker creeks.

Most of the run-off from the reserve areas is carried by Judith River, the reserve serving as a large natural reservoir, which is of great importance owing to irrigation along the lower course of that stream. The next largest volume is carried by Belt Creek, a stream also utilized for purposes of irrigation outside the reserve areas. The other streams heading within the reserve are of minor importance, Spring and Daisy Dean creeks on the Musselshell slope being the only ones there that carry any considerable quantities of water. A large number of the smaller canyons are dry throughout most of the year. Especially is this the case where the entire length of the canyon lies in the limestone strata. The extensive fissuring to which the sedimentary rocks of the reserve have been subjected has opened cracks in all directions, through which much of the downfall is swallowed up, never to reappear, at least not on nearby areas.

The reserve contains two small lakes. One is situated on the eastern flanks of Neihart Baldy near the summit. The other lies at the head of Richmond, or Trail, Creek, in T. 11 N., R. 9 E., and is marshy, with a small grass-free place in the center.

MINING AREAS AND MINERALS.

The larger portion of the reserve is a nonmineral region or, at least, is not known to contain valuable or workable ore deposits. The mineralized areas so far opened, and either developed to producing capacity or in a prospecting stage,

are as follows The Neihart district, in T. 14 N., R 8 E , the Barker district, in T 15 N., Rs 8 and 9 E , the Wolf Creek districts, in T 14 N , R. 10 E , the Sapphire district, in T 13 N , R 11 E , the Yogo district, in T. 13 N., R 13 E , and the Spring Creek district, in T 10 N , R 10 E

Of these districts the Neihart and Barker have been important centers of ore production As they were chiefly silver camps the low price of this metal has brought on a gradual decline in their importance and activity The Barker district has practically ceased producing ore, and comparatively little is extracted from the mines at Neihart East of Barker and across the divide in the Wolf Creek drainage are a number of mining claims, mostly in the prospecting stage One or two have produced and shipped small quantities of ore, with silver as the leading value Placer claims have been worked to a limited extent in the valleys of the Dry Wolf drainage Beds of specular iron ore, said to be of considerable extent, occur in the canyons of Running Wolf Creek They have not been developed The Sapphire mine is not a placer deposit, as is commonly supposed, but a dike of eruptive rock with the gems in place The mine was being actively worked at the time the examination was made The Yogo district is a region of abandoned quartz prospects and placer locations The Spring Creek district contains several properties with copper apparently as the chief value None of the claims are developed to producing capacity

In addition to the districts enumerated there are isolated mineral deposits of small extent in various localities, principally at the heads of Middle Fork of Judith River It is not improbable that mineralized areas will be discovered elsewhere in the reserve, particularly at the head of South Fork of Judith River, where extensions of the Sapphire district may be expected to occur

AGRICULTURAL LANDS.

The lands either occupied or suitable for agricultural purposes, comprising 9,250 acres, consist of bottom lands in the different canyons and of a few small tracts in the foothill region, chiefly in T 15 N , R 11 E , where they aggregate 2,800 acres, the largest area of cultivable land in any township in the reserve Nearly all of the agricultural lands are so situated that irrigation is necessary to make them productive The areas actually under cultivation do not exceed 1,000 acres The largest proportion of them are situated in T. 15 N., Rs 9 and 10 E , and in T 13 N., R 10 E

GRAZING LANDS.

The grazing lands have an area of 99,070 acres To this may properly be added the woodlands, which are more or less completely grassed over and have long been used for pasture. Including these tracts, the available grazing land comprises a grand total of 124,210 acres, classified as follows.

Classification of grazing lands in the Little Belt Mountains Forest Reserve

	Acres
Foothills	40,000
Woodlands	25,140
Ancient fire glades, chiefly subalpine, and other nontimbered tracts in that zone, collectively called "parks"	59,070
Total	124,210

The grazing areas in the foothills are confined to tracts having an elevation between 5,000 and 6,000 feet They are situated as follows In T. 15 N , R. 10 E , the two eastern tiers of sections; in T. 10 N., Rs 10 and 11 E , the first southern tier of sections, in T 10 N , R 12 E , the two southern tiers of sections, and in T 10 N , R. 13 E., all except the north tier of sections. All these tracts are timberless, or contain only scattered trees of limber pine, yellow pine, and red fir, and occasionally some juniper scrub, they are situated below the line which marks the lower limit of forest, and owing to semiarid conditions can never become stocked with forest trees, they have been well covered with a grassy sward, but have long been too closely pastured in most localities by both cattle and sheep, and have a low grazing value at the present time

The woodlands range in altitude from 5,500 to 6,500 feet Most of the tracts are situated in T 13 N , R 11 E., but scattered areas occur throughout the southern tier of townships Originally they had a ground cover composed of bunch grass and trailing juniper, and in some localities they still retain a fair amount of grass, but, as they have long been used as cattle range and sheep runs, much of the land has been too closely pastured, particularly where the sheeping has been concentrated in limited tracts The ground cover of juniper remains and is spreading into the grassy areas

The remainder of the grazing lands consists of ancient fire glades and of tracts nearly bare of forest owing to their position near timber line. Some of the fire glades occupy portions of bottom land in the larger canyons, some are on the southern slopes of the mountains; but most of them lie on the summits of the ridges and divides, between 7,900 to 8,500 feet elevation These openings are known as "parks" Above the 7,800-foot level they are abundantly and

evenly covered with a tough, nearly continuous, sward of subalpine grasses and sedges, and on the slopes and bottoms of canyons by interrupted growths of bunch grass and weeds.

All of the valley areas belonging to this class of grazing lands have long been pastured by cattle and horses, and possibly by sheep, but only in lesser degree. Here and there they show effects of overgrazing, but in the main are in fair condition. They comprise in the aggregate 10,000 acres, of which 2,000 acres are situated in the southern tier of townships in the Musselshell drainage, 5,000 acres in the Judith River basin, and the rest in valleys of various small creeks in the two northern tiers of townships.

The subalpine portions of the grazing lands have an area of 40,000 acres. Owing to the luxuriant growth of grass they are by far the most valuable of the pasture areas in the reserve, but are utilized only by the few prospectors who annually visit them, the great number of insect pests which infest them rendering them almost useless for cattle or horse ranges. In former years they may have been used for sheep pasture, but evidently never very extensively, as none of the tracts show signs of overgrazing. The largest areas of these grazing lands occur along the summit of the Yogo-Porphyry Peak ridge, along the summit and upper slopes of the Yogo-Neihart Baldy ridge, at the head of Lost Fork of Judith River, and on the summit of the big blocks of limestone which lie along the main axis of the Little Belt Mountains, between the head of Daisy Dean Creek and Twin Peaks, in T. 11 N., Rs. 12 and 13 E., where some tracts contain several thousand acres unbroken by lines or stands of forest. All of the tracts, with the exception of 3,000 or 3,500 acres near Yogo Peak and on the summit of Neihart Baldy, owe their origin to fire and mark the site of former stands of subalpine forest.

WOODLAND.

The woodlands, with an area of 25,140 acres, are in the foothill regions in the southern, eastern, and northern townships of the reserve. They carry thin lines, small copses, and scattered trees of limber pine, yellow pine, and red fir. Practically they have no value for silvicultural purposes. They are, however, capable of bearing a larger amount of timber than they now do, but their position within areas of semiaridity or subhumidity will always preclude any close and extensive stockage of forest. These lands include the east half of T. 13 N., R. 11 E., containing 12,000 acres, and scattered, irregular tracts in the southern tier of townships, namely: 6,000 acres in T. 10 N., R. 10 E.; 1,040 acres in T. 10 N., R. 13 E., and 5,000 or 5,500 acres in T. 15 N., R. 10 E., the northeast corner of the reserve.

FOREST CONDITIONS.

COMPOSITION, AND REGIONAL AND ALTITUDINAL DISTRIBUTION.

Most of the forest in the reserve is made up of coniferous species, as follows:

Species in Little Belt Mountains Forest Reserve.

Limber pine	Pinus flexilis
Lodgepole pine	Pinus murrayana
Yellow pine	Pinus ponderosa
White-bark pine	Pinus albicaulis
Red fir	Pseudotsuga taxifolia
Subalpine fir	Abies lasiocarpa
Engelmann spruce	Picea engelmanni

There is also a small percentage of deciduous-leaved trees, mostly represented by aspen, cottonwood, wild cherry, and various species of alder and arborescent willows. The percentages of the different species, averaging the entire reserve and basing the estimates on basal diameters exceeding 3 inches, are as follows:

Percentage of species in Little Belt Mountains Forest Reserve.

	Per cent.
Limber pine	8.2
Lodgepole pine	34.2
Yellow pine	.07
White-bark pine	.009
Red fir	44.7
Subalpine fir	1.4
Engelmann spruce	11.4
Aspen and cottonwood	.021

Owing to the climatic conditions in the areas surrounding most of the reserve the arrangement and general distribution of the different species of trees are somewhat complex. A large portion of the tract consists of a narrow mountain axis flanked by areas with a moderately high mean summer temperature, which are arid or semiarid by reason of comparatively low elevation. The result of this combination of climatic conditions and geographic position is that the species which normally would remain in the lower zones of the forest are found at altitudes where they are mingled with the species of the subalpine zone. As the mountain regions of the reserve are variously influenced by the climatic features of the plains, it follows that the different portions of the reserve exhibit this intermingling of forest zone in different degrees.

The lowest fringe of forest adjoining the woodlands, or in some cases directly abutting on the nontimbered plains, consists of red fir, limber pine, and yellow pine. It lies at elevations of between 6,000 and 6,500 feet. Above the latter altitude the yellow pine soon thins out and disappears, the limber pine

becomes less abundant, lodgepole pine comes in, and the percentage of red fir greatly increases Here and there, mostly along the streams and on adjacent slopes, Engelmann spruce is mixed with other species in small or moderate proportions Above the 7,500-foot level red fir rapidly thins out—often it is entirely lacking at that altitude, especially if the slope has a northern exposure—lodgepole pine is very abundant, subalpine fir appears, and the percentage of Engelmann spruce greatly increases At an altitude of 8,200 feet red fir has wholly disappeared, lodgepole pine occurs as scattered trees, while Engelmann spruce, subalpine fir, limber pine, and, rarely, white bark pine constitute the final or subalpine forest zone

The altitudinal limit of the red fir is highest on the slopes draining into Musselshell River, in the southern tiers of townships, where it attains an elevation of 8,000 feet It is lowest in the Belt Creek drainage, in the northwestern corner of the reserve, where it scarcely reaches the 7,000-foot level The near-by warm areas of the open Musselshell Valley on one hand, and the high subalpine tracts at the head of Belt Creek on the other, cause this change in the altitudinal range of the species

The altitudinal range of the limber pine is similarly affected It is usually found in the foothills, but when it grows on ridges which front directly on the plains, or are situated within the influence of the dry, heated air currents, it becomes a member of the subalpine group of trees, and is found at altitudes of 8,300 feet, as in the Yogo Creek basin and on the areas draining into the Musselshell

The upper limit of the lodgepole pine varies from 7,800 to 8,100 feet Climatic conditions affect this species by arresting its downward extensions While the tree may be found along the streams as far as the point where they enter the plains, its range en masse stops at the 6,500 or 7,000 foot level on the slopes draining to the Musselshell, where the arid climate of the plains is felt In the interior of the Belt Creek drainage, where the dry air of the plains does not extend, the downward range of the species is as low as 5,400 feet

In the northeastern and southern townships the climatic influence of the adjacent plains causes the lower limit of the various zones of forest to rise 800 to 1,000 feet In the western and central townships, beyond the influence of the plains, the downward limit of the forest zones is extended for 600 to 1,000 feet

There is no definite timber line in the reserve If one existed it probably would lie at 9,800 or 10,000 feet None of the peaks reach above the 9,000-foot contour, and while several of the highest areas are devoid of timber, this is owing, not to their altitude, but either to past fires and deficient restockage or to stony and barren ground

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The different species are found throughout the reserve within their altitudinal limits with the exception of the white-bark pine, which is confined to the high summits of Mixes Baldy, Yogo Peak, and Neihart Baldy The heaviest and most extensive areas of lodgepole pine are in the Belt Creek drainage, where it forms 85 per cent of the forest, and in the upper portion of South Fork of Judith basin, where it forms 99 per cent of the stand on 30,000 or 35,000 acres In the Musselshell drainage it constitutes only a small percentage of the timber, its place being taken by red fir

The limber pine has a fairly uniform distribution, but is rather more plentiful in the northeast quarter of the reserve than elsewhere The yellow pine is comparatively infrequent in the Belt Creek drainage, and is more common in the lower areas of Judith River basin, although it is nowhere abundant It is found found in greatest amount on the Musselshell slopes, particularly in the valley of Spring Creek, in T 10 N., R 10 E Its relative scarcity and uniformly poor form show that this region is not adapted to its extensive development

The red fir is very abundant throughout Judith River basin and on the slopes in the Musselshell drainage In Judith River basin it is commonly associated with lodgepole pine and Engelmann spruce, forming from 20 to 65 per cent of such mixed stands On the Musselshell slopes it frequently composes 85 to 95 per cent of the forest, the remainder being limber pine, yellow pine, and Engelmann spruce

The subalpine fir occurs on all the high ridges throughout the reserve. Here it is distinctly what its name implies—a subalpine species With the exception of the white-bark pine and the yellow pine none of the trees composing the forest are more restricted in their range

The spruce occurs in all portions of the reserve, but never in pure growth stands, its proportion varying from 10 to 80 per cent The highest percentages are reached in veteran stands at middle and lower subalpine heights, the lowest percentages where the species is in mixed stands of well-stocked lodgepole pine at middle elevations. The heaviest and best stocked stands of spruce occur at the head of Middle Fork of Judith River in growths 300 to 350 years old

Aspen and cottonwood, together with various species of alder, arborescent willows, cherry, service berry, and thorn, represent the broad-leaved components of the forest Their proportion in the general mass is insignificant They form fringes in the lower areas of the different valleys, usually along the streams. Occasionally the aspen spreads over the slopes and ascends to altitudes of 7,500 feet or even higher.

The general composition of the forest as it now stands is not a normal one It has been greatly modified and altered by fires both during the time the Indian

held possession of the country and since the advent of the white man. As a result of fires the percentage of lodgepole pine has been increased and that of red fir and Engelmann spruce decreased. A forest of normal composition, such as would cover the reserve were fires wholly eliminated and cutting closely regulated during a century and a half, should consist, approximately, of 62 per cent red fir and 25 per cent Engelmann spruce, while the remainder would be made up of lodgepole pine, subalpine fir, and small proportions of limber and white-bark pine.

AGES AND DIMENSIONS OF TREES.

Most of the forest in the reserve is composed of stands in the sapling or pole stage of growth, 80 per cent being less than 150 years old. The veteran stands are almost wholly confined to the summits of the higher ridges, to the upper portion of Middle Fork of Judith basin, and to the canyons in the Musselshell drainage, but single trees or small copses of old growth are also scattered throughout the pole stands. The age of the veteran stands varies from 250 to 350 years, most of the old growth in the subalpine areas being nearer 250 years. The younger stands show a moderate degree of variation in their relative ages. Most of them occur in large bodies of nearly even age, indicating that the ancient fires, like the more recent ones, devastated large areas simultaneously. Of the forest less than 150 years of age about 36 per cent, covering in the aggregate 52,000 acres, is less than 45 years old.

The age of the timber on the slopes and summits is shown in the following table:

Age of timber on slopes and summits.

Species.	Height.	Diameter, breast high.	Age.
	Feet.	*Inches.*	*Years.*
Lodgepole pine	60–80	8–10	135–175
Limber pine (foothills)	30–40	14–16	120–150
Limber pine (7,500 to 8,000 feet)	30–40	14–16	250–280
White-bark pine	25–35	20–25	250–300
Subalpine fir	40–50	10–14	130–150
Engelmann spruce	50–75	16–25	150–200
Red fir (middle elevations)	60–80	10–14	120–150
Red fir (high altitudes)	30	8–9	120–150

Most of the timber is of slender growth even when mature. The largest specimens observed were as follows: Red fir, 5 feet in diameter; white-bark pine, 3 feet; Engelmann spruce, 4½ feet; limber pine, 3 feet. These diameters were exceptional.

Low ratios of soil humidity, induced by the not overabundant rainfall; rapid drainage, caused by steep slopes; thin soil; lack of duff or humus to prevent surface evaporation; and a sterile soil—all cause the growth to be exceedingly slow. Exceptions occur in the swales and bottom lands, where there is greater moisture and the soil is deeper, but the great body of the forest requires from one hundred to one hundred and twenty years to yield merchantable poles and from one hundred and twenty to two hundred and fifty years to supply sizeable saw timber.

CHARACTER, VALUE, AND VOLUME OF MERCHANTABLE TIMBER.

The chief value of the forest is in its effect on the conservation and regulation of the run-off. From a commercial point of view, the only product of value consists of pole and fuel timber, as there is comparatively little, at least in the easily accessible areas, large enough to furnish saw logs. The mill timber everywhere is of poor quality.

A greater volume of mill timber is obtainable from the red fir than from any other species. It has been less cut because its tough, stringy wood is not suited for mill timber, its rapid taper unfits it for poles of any considerable length, and it occurs most plentifully in areas remote from market.

The lodgepole pine comes next in volume. Owing to its abundance near mining centers it has been more largely cut than any other species, notwithstanding the fact that it is less durable and much inferior generally to other common and accessible species.

The spruce ranks after the lodgepole pine in volume of mill timber. Little of this species has been cut because the best and thickest stands are difficult of access and remote from transportation and points of demand.

The yellow pine is cut wherever accessible. The proportion of this species and of white-bark and limber pine is so small that altogether they do not enter appreciably into the quantity of mill timber that the forest is capable of supplying.

In the volume of pole and fuel timber the lodgepole pine heads the list, having nearly three times the volume of the red fir. Next in rank comes the red fir, followed by the spruce, while of the less abundant species limber pine shows a relatively large volume owing to its occurrence mostly as an old growth.

The yield of mill timber runs low everywhere throughout the reserve. It varies from 500 to 7,000 feet B. M. per acre, but the latter amount is found only in veteran stands of Engelmann spruce. The low yield of mill timber is due to the scattering and intermittent grouping of trees large enough to cut for saw logs.

On hundreds of acres large tracts of close-set, middle-aged stands of lodgepole pine and red fir will not yield a single saw log, and the subalpine areas contain only scattered trees of the necessary dimensions. When squared the average diameter of the mill timber throughout the reserve is probably $9\frac{7}{8}$ or $9\frac{15}{16}$ inches. As ordinarily cut, from 15 to 20 logs are required to produce 1,000 feet B. M.

The yield of pole and fuel timber varies from 400 cubic feet per acre in the thinly stocked woodlands to 5,000 cubic feet per acre in fully stocked lodgepole-pine stands such as occur at the head of South Fork of Judith River. The comparatively low average of this class of timber is due to the thin subalpine stands and to the large areas covered with 40 to 50 years old growth too slender and immature to be taken into the account. No timber in the reserve can at all approach the lodgepole pine in possible yield of pole and fuel timber. Were all the tracts capable of producing this species stocked to their full capacity 60 per cent of the reserve would yield at least 5,000 to 5,500 cubic feet per acre.

The total volume of mill timber in the reserve, estimated on the basis of 8 inches diameter, breast high, and 10 feet of available bole, with the amount contributed by each species, is shown in table below:

Volume of mill timber in the Little Belt Mountains Forest Reserve.

	Feet B. M.
Limber pine	1,050,000
Lodgepole pine	70,100,000
Yellow pine	6,300,000
Red fir	111,650,000
Engelmann spruce	52,850,000
Total	241,950,000

The above volume gives an average stand of nearly 1,020 feet B. M. per acre for the forested areas of the reserve.

The volume of pole and fuel timber, basing the estimates on diameters of not less than 4 inches, is as follows:

Volume of pole and fuel timber in the Little Belt Mountains Forest Reserve.

	Cubic feet.
Limber pine	14,895,000
Lodgepole pine	239,340,000
Yellow pine	400,000
White-bark pine	400,000
Red fir	113,085,000
Subalpine fir	2,520,000
Engelmann spruce	41,170,000
Total	411,810,000

The above total gives an average of nearly 1,730 cubic feet per acre. If the mill timber is converted into cubic measure on the basis of 180 cubic feet to 1,000 feet B. M., and added to the pole and fuel timber, the average is brought up to 1,914 cubic feet per acre.

CUTTING.

The tracts logged to exhaustion and those merely culled comprise 59,600 acres, or nearly 25 per cent of the forest area. Most of these logged and culled districts are situated in the northern and eastern tiers of townships. The area cut over in the southern townships is insignificant, comprising but a few hundred acres. The central areas have hardly been touched.

The largest area of cut-over forest, 30,000 acres, is in the Belt Creek drainage in T. 14 N., R. 8 E., and in T. 15 N., Rs. 8 and 9 E. In T. 14 N., R. 8 E., and T. 15 N., R. 8 E., there remain but a few hundred acres of accessible merchantable timber not culled over, while in T. 15 N., R. 9 E., 70 per cent of the merchantable forest has been cut. The large amount of cutting on these tracts is due to their proximity to the mining camps at Neihart and Barker, and also to the circumstance that Tps. 14 and 15 N., R. 8 E., are bisected by a branch line of the Great Northern Railroad, affording convenient transportation for the timber products to outside points. The cutting has been for mill timber, fuel, fencing, mine props, and smelter poles. All of these classes of timber have been exported and all have also been used locally, except smelter poles. Cutting was active until the reserve was created, since which time it has gradually declined. At present only a small amount is cut to supply the agricultural areas.

The sawmills which formerly operated in the reserve have mostly moved away or closed down. There is one mill in the canyon of Dry Fork of Belt Creek, another in Dry Wolf Canyon, and another in Spring Creek Valley, in T. 10 N., R. 10 E.—all small mills with a capacity of a few thousand feet each a day and not in active operation at the time the examination was made. With the closing of the mines at Neihart and Barker most of the local demand ceased. The Sapphire mine in T. 13 N., R. 11 E., draws on the reserve for limited quantities of mining timber, obtaining most of it from Yogo Canyon. Heretofore large quantities of mine props have been shipped to the coal mines at Belt and Sand Coulee, but this demand appears also to have fallen off since the forest-reserve regulations governing cutting came into force. Up to the winter of 1902 there was a fair demand for smelter poles at Great Falls, Mont., and very large quantities of pole timber were cut and shipped to that place. These poles are used in the copper smelter at Great Falls, being introduced with the charge to effect certain changes in the ore. They are cut 30 feet in length with diameters

varying from 5 to 8 inches at the butt, to 3 or 3½ inches, or less, at the small end. The poles are sold by weight—345 pounds being considered equivalent to one pole. They are cut from green timber, lodgepole pine being preferred because it tapers less within the 30-foot length than red fir or spruce. Most of the poles have been cut around Neihart and Barker. Owing to the Government stumpage and the rule requiring the piling of tops and limbs it is claimed that poles can no longer be shipped with a profit.

The cut-over areas have uniformly been left in bad condition. No attempt has been made to pile tops and limbs. Thousands of poles, mine props, and saw logs have been wasted by being left to rot where felled. In a few localities the earlier cut areas have been cleaned up by fire, which also burned the uncut timber, but generally the waste, both in the forest and around the sawmill settings, thickly litters the ground in all directions.

While the streams in the reserve are not drivable, as a rule, most of the really valuable merchantable timber is not particularly difficult of access. Logging roads can be constructed at moderate cost, and in those canyons where road making would be difficult and expensive, particularly in the Musselshell drainage, there is no timber worth logging.

BURNS.

The areas burned over since the advent of the white man comprise in the aggregate 111,600 acres. The devastation has been wrought during the last thirty-five or forty years, chiefly since the location of Neihart and Barker mining camps. However, during the Indian occupancy there were many fires, as shown by the age of the forest and the composition of the stands.

No large area of the reserve has remained untouched by fire during the last one hundred and fifty years. The most extensive unburned tracts are at the head of Middle Fork of Judith River and contain 3,000 or 4,000 acres. They have not been touched by fires during the last three hundred and fifty years. Since the advent of white men fires have been most severe and widespread in the two northern tiers and the most southern tier of townships, and during the last century and a half of Indian occupancy the most extensive burns were at the head of South Fork of Judith River, extending across the main divide of the Little Belt Mountains and including most of the lower slopes of the Musselshell drainage. The age and composition of the forest show that relatively more ground has been burned over during the occupancy of the region by the white man than during the last three generations of Indians, as during the forty years of the white man's occupancy 22 per cent of the reserve was laid waste, and during the preceding one hundred and ten years 58 per cent was burned over.

In this region fires almost invariably totally destroy the forest, except in the thin subalpine stands. The timber is rarely consumed by the first fire. Usually it is killed and left standing, and is later overthrown by wind and destroyed by future fires. The destructiveness of the fires is due to the vast amount of litter that accumulates in the closely-stocked stands. Below the middle of the subalpine zone all reforestations after fires begin with stands stocked excessively close. As the forest becomes older and the natural processes of pruning set in, great quantities of dead wood begin to litter the ground and furnish material for future disastrous conflagrations. There is little humus or duff on the forest floor to assist in spreading the fires, but on the northern slopes a moss cover, 2 to 4 inches in depth, is commonly present, and during the height of the dry season burns readily where at all abundant.

RESTOCKAGE.

In the woodlands and in the subalpine forest young growth is scanty and on the whole deficient, whether as restockage after fire or as the ordinary renewals in the growing stands. In the forest lying between these two zones young growth is abundant, except in the already fully stocked lodgepole-pine and red-fir stands, and in areas on which fire-killed and fallen timber has been consumed in a clean-burning fire.

The young growth in the woodlands is composed of limber pine, yellow pine, and red fir, the first-named species predominating. The growth is thin and scattering and is greatly retarded by the extensive and close matting of creeping juniper. In the upper subalpine zone there is sufficient young growth to keep the stands stocked slightly above their present percentage, as young spruce, subalpine fir, limber pine, and lodgepole pine are slowly reoccupying the grassy areas which formerly were clothed with forest. It is evident that the subalpine forest as a whole has a low reproductive ratio, and it is also clear that when entirely destroyed by fire a grassy turf takes the place of forest and remains indefinitely. Some of the grassy fire glades at subalpine elevations, into which the young growth is now slowly creeping, must have remained in their present nontimbered condition for centuries. They are full of buffalo trails and wallows, showing that they served for long periods as summer pastures. That they once were covered with forest may be inferred from the fact that similar grass tracts, in process of formation as the result of fires kindled by the white man, and showing every stage in the transformation from half or completely burned forest to grass land, are met with in many localities along all the high divides throughout the reserve.

Below the subalpine levels the forest generally is so closely stocked that little additional growth has a chance of surviving the seedling stage. On the burned-over areas in the Belt Creek drainage excessively close-set stands of lodgepole pine have taken possession of the ground. There is a fairly good restockage on the burns in the drainage basin of Dry Wolf, and partially so in that of Running Wolf Creek. But the reforestations on the burns on Taylor Peak and on the northern tier of sections in T. 14 N., R. 10 E., are extremely thin and deficient. Reforestation also is deficient on the burned-over tracts in the southern tier of townships on the Musselshell slopes.

Within its altitudinal limits lodgepole pine is the leading species in all restockages in the central and northern portions of the reserve. In the southern areas, at least on the Musselshell slopes, red fir becomes the chief species. In the central and northern portions of the reserve lodgepole pine is sure to replace the red fir in practically every case. In the southern areas red fir follows red fir, or the ground remains nontimbered, unless the seepage is considerable, in which case small quantities of lodgepole pine may accompany the red fir as well as lesser proportions of Engelmann spruce. The variations in the composition of the young growth are caused by variation in the degree of aridity, as the red fir is better able to resist arid conditions than the lodgepole pine.

In some localities where the lodgepole pine has been logged and large openings made, red fir and spruce show a marked tendency toward larger proportions than they displayed in the uncut stands, but in general the lodgepole pine has attained such proportions in the reserve that, no matter how carefully the forest is handled, it is bound to retain its superiority, at least during the next hundred years, to the exclusion of better trees.

TOWNSHIP DESCRIPTIONS.

Township 10 North, Range 10 East.

Topography.—Most of the township is situated in the valley of Spring Creek, a broad, terraced depression inclosed on the east and west by comparatively low, much-broken spurs, which stretch south from the main range of the Little Belt Mountains in the township on the north.

Mining.—Prospects on quartz ledges are scattered throughout Spring Creek Valley.

Minerals.—Copper and gold chiefly.

Soil.—Comminuted limestone débris overlain and mixed with thin loam.

Agricultural adaptability.—Small tracts in Spring Creek bottoms are cultivable. The aggregate area amounts to 250 to 300 acres.

Grazing capacity.—The south half of the district is thinly wooded and forested, and affords numerous grassy openings suitable for pasturage. It is utilized for cattle range, and as yet has not been overgrazed.

Drainage conditions.—The run-off which originates in the township is of small volume and is carried by Spring Creek. Most of the minor lateral canyons and runs are dry throughout the greater portion of the summer and fall.

Towns and settlements.—The township contains no settlements, though miners' cabins are scattered throughout the mineral-bearing districts. One small sawmill is located on Spring Creek, and two or three farms are situated on the tillable lands in this valley.

Forest conditions.—The forest consists of mixed stands of red fir, spruce, and limber pine, with small proportions of lodgepole pine on the summit of the higher ridges, and here and there lesser percentages of yellow pine. In the eastern portion of the township the stands are continuous and fairly well stocked. In the valley of Spring Creek and on its western slopes the stands are thin, grassy glades and rocky exposures breaking their continuity. The yellow pine in the district is confined mostly to the bottoms of Spring Creek. In general the timber is of slender growth, stocky and limby in the thinly stocked stands.

Woodlands.—Portions of the southern areas are thinly stocked with scattering growth of limber pine and red fir. The stands and copses are set on grassy flats and hillsides, and have only a fuel and pole value.

Cutting.—A block of forest in Spring Creek Valley 3 miles long by one-half to two-thirds of a mile wide has been culled of most of its mill timber, particularly of the yellow pine.

Burns.—Severe burns have ravaged the township during the last six or eight years, and have laid waste most of the forest.

Reproduction.—Restockage is very deficient on all the burned areas. The tendency is toward grass cover in place of forest.

Undergrowth.—Scanty.

Litter.—In the burned tracts litter, consisting of the unconsumed timber, is very heavy and is constantly accumulating. In the green stands litter is light.

Humus.—None.

Classification of lands in T. 10 N., R. 10 E.

	Acres.
Forested	6,540
Wooded	6,000
Nontimbered	10,500
Badly burned	10,200
Logged	600
Agricultural	300
Grazing (woodland)	6,000

Total stand of timber in T. 10 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		200,000	200,000
Lodgepole pine		300,000	300,000
Yellow pine	1,800,000	100,000	424,000
Red fir	5,800,000	4,000,000	5,044,000
Engelmann spruce	700,000	900,000	1,026,000
Total	8,300,000	5,500,000	6,994,000

Composition of forest in T. 10 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	1.5
Lodgepole pine	1.5
Yellow pine	2
Red fir	85
Engelmann spruce	10

Composition of the woodland growth in T. 10 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	8
Red fir	92

Township 10 North, Range 11 East.

Topography.—The township consists chiefly of the Daisy Dean block—a great uplift of limestone lying between Spring and Daisy Dean creeks on the Musselshell slope of the Little Belt Range. The block is deeply cut by numerous narrow, cliff-bound canyons, and is completely pierced by the canyon of Daisy Dean Creek.

Mining.—None.

Soil.—The soil throughout the district is thin and stony.

Agricultural adaptability.—Small tracts situated on Daisy Dean Creek near the south line of the township are tilled. They comprise in the aggregate 250 to 300 acres.

Grazing capacity.—The grazing areas are scattered throughout the township and consist of open, grassy hillsides in the southern areas, grassy fire glades in the valley of Daisy Dean Creek, and ancient burns not restocked on the summit of the uplift.

Drainage conditions.—The outflow from the township is small, and is carried mostly by Daisy Dean Creek. Most of the canyons are dry except in the spring.

Towns and settlements.—There are no settlements in the township. One settler occupies a small tract of land in section 28.

Forest conditions.—The forest consists of red fir at the lower and middle elevations, and lodgepole pine, subalpine fir, and Engelmann spruce at the highest altitudes. Most of the red fir is in the pole stage of growth. The timber is uniformly stocky and limby; is difficult of access, and has only a fuel value.

Cutting.—In the southern areas 200 acres have been culled 75 per cent.

Burns.—Most of the north half of the township, formerly well stocked with timber, has been burned over and the forest totally destroyed. The fires have been particularly destructive in the upper and central Daisy Dean drainage, where all the timber, with the exception of a few hundred acres of red fir, has been completely consumed.

Reproduction.—Young growth is scanty throughout the township. There is as yet little or no restockage on the burned-over areas.

Undergrowth.—Consists of a small amount of inconspicuous shrubs.

Litter.—There is a great amount of dead and fallen timber on the burned-over tracts.

Humus.—None.

Classification of lands in T. 10 N., R. 11 E.

	Acres.
Forested	4,040
Nonforested	19,000
Badly burned	12,000
Logged	1,200
Agricultural	300
Grazing	6,000
Bare rocks	700

Total stand of timber in T. 10 N., R. 11 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		200,000	200,000
Lodgepole pine		3,000,000	3,000,000
Red fir	3,000,000	2,500,000	3,040,000
Engelmann spruce	850,000	730,000	883,000
Total	3,850,000	6,430,000	7,123,000

Composition of forest in T. 10 N., R. 11 E., including trees of all species with basal diameters of 8 inches and upward.

	Per cent.
Limber pine	3
Lodgepole pine	8
Yellow pine	Scattered trees.
Red fir	84
Engelmann spruce	5

Township 10 North, Range 12 East.

Topography.—The township is situated on the southern or Musselshell slope of the Little Belt Mountains. The northern half consists of steep, castellated spurs and narrow, rocky canyons; the southern half comprises a rolling foothill region. The average altitude is 6,000 feet.

Mining.—None.

Soil.—Gravelly loam, with gumbo in the southern portions.

Agricultural adaptability.—Owing to lack of water and to its rolling character the region is not adapted to agricultural pursuits.

Grazing capacity.—All the foothill region and many of the slopes in the northern sections are essentially pasture land, and have been so utilized. The pasture land has been badly overgrazed.

Drainage conditions.—The outflow from the township is insignificant. Very little originates within its boundaries, and the stream beds are dry throughout most of the year.

Towns and settlements.—None.

Forest conditions.—The forest is limited to tracts in the northern areas of the district and consists of thin lines and stands of red fir in the canyons and on the northern and western slopes. Mixed with the red fir are small proportions of yellow pine, limber pine, and lodgepole pine. In the extreme northwest corner of the township the highest spurs carry small stands of lodgepole pine and Engelmann spruce. The timber is stocky and limby and is difficult of access for logging operations, owing to steep slopes and narrow canyons.

Woodlands.—The southern portion of the township carries scattered trees and small stands composed of limber and yellow pine. The growth is so sparse that it does not properly come within the woodland classification.

Cutting.—Small tracts in the foothill areas, in the scattered woodland growth, have been cut over.

Burns.—Extensive fires have devastated the northern areas in recent years, involving complete destruction of the timber on the burned-over tracts.

Reproduction.—The reproductive capacity of the forest is low. There is little young growth in the green stands and practically none on the burns. Red fir is the chief species in the restockage.

Undergrowth.—Very little.

Litter.—Light; the fire-killed timber is mostly standing.

Humus.—None.

Classification of lands in T. 10 N., R. 12 E.

	Acres.
Forested	6,400
Nonforested	16,640
Badly burned	6,000
Logged (culled)	1,000
Agricultural	None.
Grazing	10,000
Bare rocks	640

Total stand of timber in T. 10 N., R. 12 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		300,000	300,000
Lodgepole pine		80,000	80,000
Yellow pine	800,000		144,000
Red fir	6,000,000	4,000,000	5,080,000
Engelmann spruce	2,000,000	500,000	860,000
Total	8,800,000	4,880,000	6,464,000

Composition of forest in T. 10 N., R. 12 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	5
Lodgepole pine	3
Yellow pine	.3
Red fir	84.7
Subalpine fir	1
Engelmann spruce	6

Township 10 North, Range 13 East.

Topography.—This township forms the southeast corner of the reserve, and consists of a rolling foothill region on the southern slope of the Little Belt Mountains, with an average elevation of 5,500 feet.

Mining.—None.

Soil.—Thin, gravelly loam; alkaline gumbos in the valley bottoms.

Agricultural adaptability.—The tract is too rolling and has no water for irrigation purposes, and hence is not adapted to agricultural pursuits.

Grazing capacity.—The township is essentially a grazing one. It has been closely sheeped and otherwise pastured, and its present pasturage value is accordingly low.

Drainage conditions.—The run-off is insignificant. Most of the creeks and ravines are dry during the greater portion of the year, and carry water only in the spring.

Towns and settlements.—The settlements are limited to scattered sheep shacks.

Forest condition.—The township contains no forested land.

Woodland.—Small tracts scattered throughout the township bear a very thin growth of red fir and limber pine of no value except for fuel.

Cutting.—Culled over for farm use.

Burns.—None.

Reproduction.—Very scanty. The stands will, however, slowly increase in density and extent if fires are kept down and sheeping excluded, but the tract can never become forested owing to climatic conditions and soil aridity.

Undergrowth.—Extensive mats of *Juniperus procumbens* occur throughout.

Litter.—None.

Humus.—None.

Classification of lands in T. 10 N., R. 13 E.

	Acres.
Forested	None.
Woodland	1,040
Nontimbered	22,000
Badly burned	None.
Logged (culled)	800
Agricultural	None.
Grazing	22,000

Total stand of timber in T. 10 N., R. 13 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine	None.	25,000	25,000
Red fir	None.	85,000	85,000
Total	None.	110,000	110,000

Composition of woodland growth in T. 10 N., R. 13 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	15
Red fir	85

TOWNSHIP 11 NORTH, RANGE 9 EAST.

Topography.—Of this township only the east half, or 11,520 acres, is in the reserve. At the head of Richmond Creek, in the northeast corner of the township, the main range of the Little Belts breaks down into a low gap, and forms a broad flat, holding a marshy lake that discharges into both the Judith and the Musselshell drainage. The township has an average elevation of 6,800 feet.

Mining.—None.

Soil.—Deep peaty loam in the marshy area, limestone and quartzite débris elsewhere. Small quantities of bowlder drift are scattered over the slopes of the ridges and in the canyons.

Agricultural adaptability.—The district contains no arable land.

Grazing capacity.—The marshy tracts, 250 to 300 acres in all, are used for pastures and hay meadows. In addition to these there are grassy fire glades, amounting to 1,800 acres, on the summit of the main range and along its upper slopes.

Drainage conditions.—The outflow from the township is small. Most of it is discharged into the Judith drainage, only an inconsiderable portion flowing south into the Musselshell basin.

Towns and settlements.—None. Hay claims are located on the marshy tracts, but nobody maintains a residence on them.

Forest conditions.—The forest along the main range consists of scattered copses of limber pine, subalpine fir, and Engelmann spruce set in grassy fire glades. The southern slopes carry stands of red fir, spruce, and small quantities of yellow pine. On the northern slopes lodgepole pine, in nearly pure stands and very thickly stocked, is the prevailing species. The timber is small, scrubby, and limby. It is difficult of access from the northern side of the range, but is readily reached from the southern slopes.

Cutting.—Small quantities have been cut here and there on the lower slopes south of the main range and in the northeast corner of the township.

Burns.—The grassy glades on the summit and slopes of the main range represent ancient burns which have not yet been reforested. In the southern portion 50 per cent of the timber over 1,000 acres has been destroyed by recent fires.

Reproduction.—Deficient and scanty at high elevations in the subalpine forest and on the ancient burns, likewise in the close set lodgepole-pine stands on the northern slopes. There is a moderate amount of young growth on the southern slopes, where red fir forms the leading species.

Undergrowth.—Light.

Litter.—Small amount in the lodgepole-pine forest; little elsewhere.

Humus.—Very thin or altogether lacking.

Classification of lands in T. 11 N., R. 9 E.

	Acres.
Forested	9,470
Nonforested	2,050
Badly burned	1,000
Logged	None.
Grazing	2,050

Total stand of timber in T. 11 N., R. 9 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		890,000	890,000
Lodgepole pine	1,100,000	5,000,000	5,198,000
Red fir	5,000,000	2,000,000	2,900,000
Engelmann spruce	3,200,000	850,000	1,426,000
Total	9,300,000	8,740,000	10,414,000

Composition of forest in T. 11 N., R. 9 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	8
Lodgepole pine	40
Red fir	40
Subalpine fir	2
Engelmann spruce	10

Township 11 North, Range 10 East.

Topography.—The central and southern areas of the township are situated on the summit of the Little Belt Mountains. The summit is here a broad, plateau-like area. It abounds in shallow depressions and low combs and ridges, partly composed of rock in place, partly of drift material—gravel and bowlders. Along the south line of the township the plateau breaks off sharply by steep spurs and deep canyons to the Musselshell drainage. The northern parts of the

township consist of slopes with easy grades, descending from the plateau to the narrow and shallow canyon of South Fork of Judith River, which intersects this part of the district.

Mining.—None.

Soil.—Deep loam in the marshy depressions of the plateau; gravelly and stony on the ridges and slopes.

Agricultural adaptability.—No part of the township is cultivable.

Grazing capacity.—The township is forested throughout and has no grazing areas.

Drainage conditions.—The northern and central portions of the township abound in marshy depressions, springs, and points of seepage, which give rise to one of the principal tributaries of South Fork of Judith River. The southern slopes, draining into the Musselshell basin, shed very little water.

Towns and settlements.—None.

Forest conditions.—Except where ravaged by fire, the township is covered with an extremely close-set forest of nearly pure-growth lodgepole pine, varying in age from 50 to 200 years. Small amounts of red fir occur on the southern slopes of the district, but the aggregate volume of this species is small in comparison with that of the prevailing lodgepole pine.

Cutting.—None.

Burns.—In the southern areas nearly 5 sections have been burned over and the forest destroyed to the extent of 95 per cent.

Reproduction.—Practically none, owing to the excessively close-set stands which are stocked to their utmost capacity.

Undergrowth.—Very light.

Litter.—Great quantities of dead and fallen timber have accumulated in the stands of green forest, while the burned-over areas are choked with the fire-killed timber thrown down by heavy winds.

Humus.—Thin layers of pine needles.

Classification of lands in T. 11 N., R 10 E.

	Acres.
Forested	20,000
Nonforested	3,040
Badly burned	3,000
Logged	None.
Agricultural	None.
Grazing	None.

Total stand of timber in T. 11 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		500,000	500,000
Lodgepole pine	10,000,000	70,000,000	71,800,000
Red fir	2,000,000	2,000,000	2,360,000
Englemann spruce	1,000,000	3,500,000	3,680,000
Total	13,000,000	76,000,000	78,340,000

Composition of forest in T. 11 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	0.2
Lodgepole pine	91.8
Red fir	5
Engelmann spruce	3

Township 11 North, Range 11 East.

Topography.—The northern and central portions of this township comprise a plateau-like tract cut in different directions with gullies and ravines, which constitute the principal eastern water heads of South Fork of Judith River. The southern areas rise in precipitous slopes, forming the northern declivities of the Daisy Dean and Haymaker blocks. Most, or all, of the tract is situated on the northern slope of the Little Belt main range, and has a mean altitude of 6,800 feet.

Mining.—None.

Soil.—Loam of moderate depth, underlain by gravel and bowlder drift.

Agricultural adaptability.—The township contains no arable land.

Grazing capacity.—Small areas in the southern portions and grassy glades throughout the balance of the township constitute the pasture lands. No domestic animals range in this district.

Drainage conditions.—The township supplies a moderate amount of run-off to the Judith drainage, scarcely any to the Musselshell. It contains no lakes or tarns, but is well supplied with springs and marshy places.

Towns and settlements.—The township contains no settlements.

Forest conditions.—The northern and central areas are stocked with an almost pure growth of lodgepole pine, set exceedingly close. Most of it is a pole growth 50 to 60 years old. In the high southeast portion of the township the forest assumes the typical subalpine composition. The southern portions bear stands of small, scrubby red fir.

Cutting.—None.

Burns.—There have been extensive fires in southern and eastern portions in recent years, and the timber in most cases has been totally destroyed.

Reproduction.—Owing to the excessively close-set stands there is scarcely any young growth in the green forest. Restockage on the burned-over areas is as yet thin and scattering.

Undergrowth.—Light.

Litter.—Dead and fallen pole timber is present in large quantities in the green forest and on the burned-over tracts.

Humus.—None.

Classification of lands in T. 11 N., R. 11 E.

	Acres.
Forested	14,040
Nonforested	9,000
Badly burned	7,500
Logged	None.
Agricultural	None.
Grazing	1,000
Bare rocks	500

Total stand of timber in T. 11 N., R. 11 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		500,000	500,000
Lodgepole pine	9,000,000	36,000,000	37,620,000
Red fir	3,000,000	8,000,000	8,540,000
Subalpine fir		400,000	400,000
Engelmann spruce	2,000,000	3,000,000	3,360,000
Total	14,000,000	47,900,000	50,420,000

Composition of forest in T. 11 N., R. 11 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	3
Lodgepole pine	81.5
Red fir	10
Subalpine fir	.5
Engelmen spruce	5

Township 11 North, Range 12 East.

Topography.—All of the central and most of the southern areas of the district are situated on the summit of Haymaker block, an uplift of limestone with a level or gently rolling surface and which here forms the summit of the

Little Belt Mountains. Its altitude varies from 7,200 feet to 7,800 feet. In the northern part of the township the block breaks off with precipitous cliffs and scarps to the foothills of Judith River basin, forming a series of bold, prominent bluffs which are conspicuous landmarks of the region. Along the south line of the township the block is indented with the heads of ravines and canyons belonging to the Musselshell drainage. The block is cut in two near its east line by Haymaker Creek, a small stream sunk in a canyon 1,000 to 1,500 feet in depth, with sheer sides and rough, bowlder-strewn bottom. The canyon cuts through the main range of the Little Belt Mountains, almost at right angles with its axis, and constitutes a huge gap in the divide between South Fork of Judith River and Musselshell River, tributaries of the two streams named rising within a few feet of each other in the gap.

Mining.—None.

Soil.—Thin, gravelly loam, chiefly comminuted limestone débris.

Agricultural adaptability.—The township contains no arable land.

Grazing capacity.—More than half of the township is grass covered. The grassy tracts lie mostly on the summit of the block and owe their origin to ancient fires and deficient restockage.

Drainage conditions.—The district is remarkably deficient in run-off. The summit of the block is without springs, creeks, or points of seepage, and, with the exception of Haymaker Creek, the various canyons heading in the township are dry during summer and fall.

Towns and settlements.—There are no settlements.

Forest conditions.—On the summit of the block and at the higher elevations the forest consists of thin lines and small stands of subalpine fir and Engelmann spruce separated by grassy glades. On the northern slopes lodgepole pine is the prevailing tree, set in scattered stands—remnants unconsumed by fires. On the southern declivities the forest is mostly composed of red fir, with small proportions of lodgepole pine in the canyons. The timber is short and stocky and chiefly valuable for fuel. Only the southern slopes are accessible for cutting or logging operations.

Cutting.—None.

Burns.—Within recent years the northern and in part the southern areas have been swept by extensive fires, which have destroyed 80 per cent of the timber.

Reproduction.—Scanty throughout. On the burned areas there is no restockage. The subalpine stands are not extending into the ancient fire glades, and in the recent burns on the summit of the block there is a manifest tendency to grass cover rather than to forest.

Undergrowth.—Very light; chiefly trailing juniper scrub.

Litter.—On the burned areas there is a moderate amount of litter; in the green forest there is scarcely any.

Humus.—None.

Classification of lands in T. 11 N., R. 12 E.

	Acres.
Forested	5,800
Nonforested	17,240
Badly burned	4,500
Logged	None.
Agricultural	None.
Grazing	11,740
Bare rocks	1,000

Total stand of timber in T. 11 N., R. 12 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		800,000	800,000
Lodgepole pine	1,000,000	580,000	760,000
Red fir	3,200,000	2,000,000	2,576,000
Subalpine fir		250,000	250,000
Engelmann spruce	4,000,000	4,800,000	5,520,000
Total	8,200,000	8,430,000	9,906,000

Composition of forest in T. 11 N., R. 12 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	10
Lodgepole pine	7
Red fir	35
Subalpine fir	8
Engelmann spruce	40

Township 11 North, Range 13 East.

Topography.—This township occupies most of the Twin Peak block. In the central areas it comprises a plateau-like region—the summit of the block. The southern portions are cut by many canyons indenting the edge of the plateau and by broken spurs stretching south into the Musselshell drainage. The northern sections are situated on the very steep bold front with which the plateau breaks

off to South Fork of Judith basin. The average altitude of the township is 6,600 feet, the summit of the plateau in some places rising to elevations of 7,400 feet.

Mining.—None.

Soil.—Thin, gravelly loam.

Agricultural adaptability.—No arable land.

Grazing capacity.—Most of the township is essentially grazing land, all of the southern slopes and most of the high central ones being covered with grass. Portions of the township, especially the southern sections, have long been used as a range for cattle and sheep.

Drainage conditions.—The canyons are dry through most of the year. There is a small outflow after the spring break-up, lasting a month or two.

Towns and settlements.—None.

Forest conditions.—The forest consists of thin lines and scattered copses of timber on some of the higher slopes and over the summit of the plateau. It is composed of red fir at the lower altitudes and spruce and subalpine fir at the higher. The timber is of value mostly as fuel; it is generally inaccessible.

Cutting.—None.

Burns.—The summit of the plateau area in the central sections of the township has been badly burned within the last eight or ten years. The fires have spread to the northern breaks, and have consumed most of the thin forest.

Reproduction.—Restockage is deficient throughout. The tendency of the burned-over tracts is to become grassed instead of reforested. The wide grassy non-timbered areas on the plateau summit represent ancient fire glades, and exhibit no evidence of again coming under forest cover.

Undergrowth.—Very little.

Litter.—A small amount in the burned-over areas.

Humus.—None.

Classification of lands in T. 11 N., R. 13 E.

	Acres.
Forested	7,000
Nonforested	16,040
Badly burned	4,000
Logged	None.
Agricultural	None
Grazing	11,040
Bare rocks	1,000

Total stand of timber in T. 11 N., R. 13 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		500,000	500,000
Lodgepole pine		100,000	100,000
Red fir	1,000,000	800,000	980,000
Subalpine fir		100,000	100,000
Engelmann spruce	5,000,000	4,000,000	4,900,000
Total	6,000,000	5,500,000	6,580,000

Composition of forest in T. 11 N., R. 13 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	4
Lodgepole pine	1
Red fir	8
Subalpine fir	11
Engelmann spruce	76

Township 12 North, Range 9 East.

Topography.—The western parts of the district are situated on the summit of the main divide of the Little Belt Mountains, which here is a broad, flat or gently rolling tract, elevated 7,800 feet to 8,000 feet above sea level. The central and eastern areas comprise broad, swelling ridges projecting eastward into the drainage basin of Lost Fork of Judith River and of steep, narrow spurs trending northward into the basin of Middle Fork of Judith River. The canyons of the Middle Fork separating the different spurs are generally narrow and rocky, while those forming the head of Lost Fork, although narrow, have a remarkably long and gradual rise to their heads in the main range in the western part of the township.

Mining.—None.

Soil.—More or less comminuted limestone débris with thin admixtures of loam.

Agricultural adaptability.—The township contains no land suitable for agricultural pursuits, as the altitude is too great.

Grazing capacity.—The township is dotted with grass-covered glades on the summit of the main divide and on the slopes of the canyons. These glades,

without exception, mark ancient burns which have become grass covered instead of restocking with forest. Cattle are pastured in them.

Drainage conditions.—The outflow from the township is small and is carried chiefly by Lost Fork, which here is not much larger than a rivulet.

Towns and settlements.—None.

Forest conditions.—The forest is mostly a pole growth, with an intermixing of older trees. At the higher elevations it occurs in scattered copses and thin lines, mostly composed of spruce, limber pine, and subalpine fir. At the lower elevations the northern slopes carry moderately close-set and continuous stands, with red fir as the chief species, while on the southern slopes and bottoms of canyons the stands are sparsely stocked and contain varying percentages of lodgepole pine. The timber has chiefly a fuel value. It is accessible by way of Lost Fork Valley.

Cutting.—None.

Burns.—Badly burned areas occur in the northwest corner of the township in the Middle Fork drainage. The fires probably occurred about five or six years ago.

Reproduction.—The young growth is scanty at the highest elevations, and there are few extensions of the forest into the ancient burns. At the middle and lower elevations the stands are now so fully stocked that further additions are impossible.

Undergrowth.—There is a moderate amount of undergrowth, consisting largely of juniper shrubs.

Litter.—Dead and fallen timber, due to overcrowding, is present in moderate quantities in the close-stocked stands at the lower and middle elevations. In the subalpine forest there is very little litter.

Humus.—The northern slopes have a slight ground cover of moss and pine needles. Elsewhere the humus layer is lacking.

Classification of lands in T. 12 S., R. 9 E.

	Acres.
Forested	16,040
Nonforested	7,000
Badly burned	600
Logged	None.
Agricultural	None.
Grazing	6,000
Bare rocks	400

Total stand of timber in T. 12 N., R. 9 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		600,000	600,000
Lodgepole pine	1,300,000	6,000,000	6,234,000
Red fir	4,000,000	9,000,000	9,720,000
Subalpine fir		350,000	350,000
Engelmann spruce	1,000,000	1,500,000	1,680,000
Total	6,300,000	17,450,000	18,584,000

Composition of forest in T. 12 N., R. 9 E., including trees of all species with basal diameters of 8 inches and upward.

	Per cent.
Limber pine	9
Lodgepole pine	30
Red fir	50
Subalpine fir	1
Engelmann spruce	10
Aspen and cottonwood	Scattered trees.

Township 12 North, Range 10 East.

Topography.—The township is in the middle and lower portions of Lost Fork of Judith River drainage basin. At the junction of Lost Fork and Middle Fork of Judith River, near the northeast corner of the township, the canyon of Lost Fork is contracted to a narrow gorge between castellated cliffs of limestone. It soon widens, and in its course across the central portion of the township, from west to east, develops a canyon or valley three-fourths mile to 1¼ miles wide. The slopes in the township are mostly steep, and the upper breaks are generally lined with series of limestone cliffs.

Mining.—None.

Soil.—Limestone débris, with thin admixtures of loamy matter.

Agricultural adaptability.—Small meadows and glades in the bottoms of Lost Fork Canyon are tillable. No lands are actually under cultivation.

Grazing capacity.—The pasture areas of the township consist of grassy glades and hillsides in Lost Fork Canyon. They are closely pastured by cattle.

Towns and settlements.—The township contains no towns. In Lost Fork Canyon two ranchers have established themselves. They cultivate no land, apparently holding the tracts for the purpose of controlling the grazing areas of the canyon.

Forest conditions.—The forest consists mostly of red fir of small dimensions, close set on the eastern slopes and thinly stocked on the western. The trees are short and limby from base to summit. Spruce, limber pine, and lodgepole pine are mingled with red fir, particularly in the canyon bottoms and on the summits of the ridges. Near the junction of Lost and Middle forks small proportions of low, scrubby, yellow pine are mixed with the red fir.

Cutting.—Small quantities have been cut in Lost Fork Canyon for farm use.

Burns.—Badly burned areas occur throughout the township. The destruction of the forest on these tracts has been complete. A systematic attempt was made in the summer of 1902 to destroy all the forest in the Lost Fork drainage and incidentally as much more on adjacent areas as would burn. Lost Fork Valley was fired in thousands of places, but owing to sudden showers the fires did not spread.

Reproduction.—Young growth is scanty on the southern slopes throughout the district and also at subalpine heights. There is none on the burned areas. On the northern slopes there is a moderate amount of restockage. In many of the red-fir stands the trees occupy the ground so fully that no further young growth is possible. Red fir is the leading species in the restockage, followed by lodgepole pine. Young growth of yellow pine is very sparse.

Undergrowth.—Juniper scrub and sagebrush form most of the undergrowth. It is small in quantity in the better and more closely stocked stands. On the grassy western slopes bordering Lost Fork Canyon the sagebrush is often very rank and dense.

Litter.—Light except in the burns, where considerable quantities of dead and fallen timber litter the ground.

Humus.—None.

Classification of lands in T. 12 N., R. 10 E.

	Acres.
Forested	13,240
Nonforested	9,800
Badly burned	4,500
Logged	None.
Agricultural	800
Grazing	3,600
Bare rocks	900

Total stand of timber in T. 12 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		500,000	500,000
Lodgepole pine	1,500,000	6,000,000	6,270,000
Yellow pine	300,000	100,000	154,000
Red fir	7,000,000	11,000,000	12,260,000
Subalpine fir		150,000	150,000
Engelmann spruce	1,500,000	800,000	1,070,000
Total	10,300,000	18,550,000	20,404,000

Composition of forest in T. 12 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	5
Lodgepole pine	20
Yellow pine	.1
Red fir	68
Subalpine fir	1.9
Engelmann spruce	5

Township 12 North, Range 11 East.

Topography.—This township comprises a mass of low broken spurs inclosing the lower portion of the canyon of South Fork of Judith River on the north and south. The average altitude is 6,000 feet.

Mining.—None.

Soil.—Very thin gravelly loam on the slopes and summits of the ridges, deeper loam in the valleys.

Agricultural adaptability.—Small tracts in the canyon of South Fork of Judith River are arable. Outside of this valley the township has no arable land.

Grazing capacity.—Grassy glades and nonforested or thinly forested slopes afford a limited amount of cattle range.

Towns and settlements.—There are one or two ranch locations on the agricultural lands in South Fork Valley.

Forest conditions.—The forest in the northern half consists of red fir and small proportions of yellow pine. It occurs in scattered stands, separated by extensive burns, and is low and scrubby throughout. The forest in the southern tracts is set in close stands, none occupying a large acreage, and is composed of red fir, lodgepole pine, and spruce, mostly as pole growths. The timber is accessible from the valley of South Fork of Judith River.

Cutting.—The forest along the immediate valley of the South Fork has been culled 10 to 25 per cent.

Burns.—The entire township has been ravaged by fire within the last eight or ten years, and the present stands of forest are mere patches between burned areas.

Reproduction.—The restockage is scanty on the burned-over tracts. Red fir is the chief species in the reforestation.

Undergrowth.—Very light.

Litter.—There is a large accumulation of dead and fallen timber in the burned areas. In the green forest there is a moderate amount of litter.

Humus.—Lacking or very thin.

Classification of lands in T. 12 N., R. 11 E.

	Acres.
Forested	6,040
Nonforested	17,000
Badly burned	13,000
Logged (culled)	2,000
Agricultural	800
Grazing	3,200

Total stand of timber in T. 12 N., R. 11 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		100,000	100,000
Lodgepole pine		1,800,000	1,800,000
Yellow pine	200,000		36,000
Red fir	5,000,000	8,500,000	9,400,000
Engelmann spruce	1,700,000	1,000,000	1,306,000
Total	6,900,000	11,400,000	12,642,000

Composition of forest in T. 12 N., R. 11 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	1
Lodgepole pine	10
Yellow pine	.8
Red fir	80
Engelmann spruce	8
Aspen and cottonwood	.2

TOWNSHIP 13 NORTH, RANGE 8 EAST.

Topography.—The western and central portions of this township comprise level and rolling plateau-like tracts—terraces lying in the angle formed by the junction of the main range of the Little Belt Mountains and the Yogo-Porphyry Peak ridge. The terraces border the headwaters of Belt Creek. The eastern portions comprise high ridges belonging to the Yogo ridge system, which in the southern tier of sections swing to the west and culminate in Porphyry Peak at an altitude of 8,000 feet. The mean elevation of the township is about 7,000 feet. The southwest quarter is not included in the forest reserve and the estimates apply only to the 17,280 acres within its boundaries.

Mining.—None.

Soil.—Gravelly loam on the slopes and summits of the higher ridges. Many of the creeks head in swampy areas with deep peaty or boggy soil, while the flat areas of the terraces are usually well covered with loam of moderate depth.

Agricultural adaptability.—Owing to the altitude the weather is too cold and frosty for agricultural pursuits.

Grazing capacity.—Small marshy glades at the head of the larger creeks and two nonforested so-called parks, with an aggregate area of 2,200 acres, afford pasture range. The tracts are but little used.

Drainage conditions.—The run-off from the district is large, and is discharged by way of Belt Creek northward. No tarns or lakelets exist, but springs, bogs, and creeks are numerous. In this township is one of the principal heads of Belt Creek.

Towns and settlements.—None.

Forest conditions.—The forest consists of 99 per cent lodgepole pine. Along the creek occur small proportions of spruce and on the higher ridges subalpine fir and limber pine. The stands are from 80 to 150 years of age, and represent restockage after sweeping fires. There is little mill timber, the larger proportion of the forest being merely a pole growth. The timber is easy of access by way of Belt Creek and its tributaries.

Cutting.—At various times there have been three sawmills in the district, and the timber has been logged off an area approximating 5,000 acres. Most of the lumber has been used in the town and mines of Neihart, a few miles distant; some has been shipped outside to Great Falls and to other localities.

Burns.—Small tracts, altogether 200 or 250 acres, have been burned over in fires of recent years.

Reproduction.—The amount of young growth present is small. The stands are set too close for much seedling restockage to find lodgment. The lodgepole

pine stands are chiefly old growth and are slowly giving way to Engelmann spruce; most of the young growth is of the latter species.

Undergrowth.—Light.

Litter.—On the cutting areas the amount of litter left by loggers is large. There also is much dead and fallen timber in the green stands due to overcrowding.

Humus.—Scanty.

Classification of lands in T. 13 N., R. 8 E.

	Acres.
Forested	14,480
Nonforested	2,800
Badly burned	200
Logged, including culled tracts	5,000
Agricultural	None.
Grazing	2,200
Bare rocks	400

Total stand of timber in T. 13 N., R. 8 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		350,000	350,000
Lodgepole pine	12,000,000	35,000,000	37,160,000
Red fir	100,000	250,000	268,000
Subalpine fir		450,000	450,000
Engelmann spruce	3,000,000	4,000,000	4,540,000
Total	15,100,000	40,050,000	42,768,000

Composition of forest in T. 13 N., R. 8 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	0.5
Lodgepole pine	95
Red fir	.1
Subalpine fir	1.4
Engelmann spruce	3

Township 13 North, Range 9 East.

Topography.—The main topographic features are long spurs trending eastward from one of the main divides in the Little Belt Mountain system—the Yogo-Porphyry Peak ridge—which also forms the western edge of the township. The canyons are deep and narrow, heading with short, steep slopes in the main ridge. The mean altitude of the ridges is nearly 8,000 feet.

Mining.—Many mining claims are scattered through the district. With the exception of a group of copper mines near the head of King Creek they are mere prospects. The mines mentioned, although not now in operation, have in former years shipped more or less ore.

Soil.—Thin, gravelly loam.

Agricultural adaptability.—Owing to its general mountainous character the township contains no land suitable for agricultural pursuits.

Grazing capacity.—All of the higher ridges have grassy summits and are available for cattle ranges. No domestic animals are pastured in the district.

Drainage conditions.—The township forms the principal water head of Middle Fork of Judith River, and the outflow is large. The tract contains no lakes or tarns, but is well supplied with springs and creeks.

Towns and settlements.—Only miners' cabins.

Forest conditions.—The western half of the township bears forest composed in part of pure, very close-set stands of mature lodgepole pine averaging 4,000 cubic feet of wood to the acre. In places, chiefly in the creek bottoms, spruce forms over 50 per cent of the total stand, and lodgepole pine is an inconsiderable factor. The stands in which spruce constitutes over 50 per cent represent forest that has not been invaded by fire in the last three hundred years. The higher elevations carry thin and irregular stands of lodgepole pine, limber pine, and subalpine fir. The eastern half of the township is forested with composite stands of red fir and lodgepole pine at the lower elevations on the northern slopes, with red fir, yellow and limber pine on the southern slopes, and with lodgepole pine, in nearly pure-growth stands, on the summits and upper slopes.

Cutting.—Small quantities of timber have been cut by the miners in the district for local use.

Burns.—The northeast corner contains several large burned areas, while smaller tracts, wholly or partly burned over, are scattered throughout the township.

Reproduction.—The close-set stands are fully stocked, and have hardly any young growth. In open stands on the southern slopes seedling and young sapling growths are moderately abundant, and will in time assure a better stockage than the present. The grassy summits of the main divides and higher slopes are ancient fire glades and are capable of bearing forest; into these tracts subalpine species are gradually pushing their way.

Undergrowth.—Light, chiefly consisting of juniper scrub.

Litter.—All the close-set stands are choked with immense quantities of fallen timber killed by overcrowding and natural thinning.

Humus.—The northern slopes, as a rule, have a moss cover on the forest floor, 3 to 6 inches in depth. The southern declivities are mostly bare.

Classification of lands in T. 13 N., R. 9 E.

	Acres.
Forested	13,340
Nonforested	9,700
Badly burned	1,800
Logged	None.
Agricultural	None.
Grazing	7,000
Bare rocks	900

Total stand of timber in T. 13 N., R. 9 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		880,000	880,000
Lodgepole pine	8,000,000	32,000,000	33,440,000
Red fir	5,000,000	4,000,000	4,900,000
Subalpine fir		400,000	400,000
Engelmann spruce	10,000,000	6,000,000	7,800,000
Total	23,000,000	43,280,000	47,420,000

Composition of forest in T. 13 N., R. 9 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	5
Lodgepole pine	65
Red fir	6
Subalpine fir	1
Engelmann spruce	23
Cottonwood and aspen	Scattered trees.

Township 13 North, Range 10 East.

Topography.—The central areas comprise steep slopes and the summit of a plateau-like area, known as Prospect Ridge. The northern sections are cut by the narrow canyon in which flows Yogo Creek, while the southern portions of the township are situated in the valley of Middle Fork of Judith River. The slopes leading to the bottoms of the different canyons are steep. The upper breaks usually present lines of towering cliffs eroded into castellated forms, while the declivities below the cliffs are strewn with talus accumulations thinly covered with soil or entirely bare. The summit of the plateau area in the central

portions attains altitudes of 7,000 feet; the mean elevation of the canyon bottoms is 5,800 feet.

Mining.—In former years placer mining was carried on in Yogo Canyon; the diggings are now abandoned.

Soil.—Comminuted limestone débris with thin admixtures of loamy matter.

Agricultural adaptability.—Portions of the bottoms of the Middle Fork of Judith River are cultivable and are under tillage for the production of hay. The total area is 1,000 acres.

Grazing capacity.—Small glades and open, nonforested, or thinly forested hillsides constitute the grazing areas. They are utilized for stock ranges.

Drainage conditions.—Most of the lateral canyons of the Yogo and Middle Fork of Judith systems, which head within the township, are dry during the summer, or carry only insignificant quantities of water. The outflow from the township is large, but it originates elsewhere; the extensive fissuring of the limestone strata causes most of the water which falls within it to be absorbed before it has a chance to enter any of the main channels of flow.

Towns and settlements.—Settlers occupy the agricultural lands in the Middle Fork of Judith Valley. The tract contains no towns.

Forest conditions.—The forest consists of mixed stands of red fir, lodgepole pine, spruce, and, on the southern slopes, small proportions of yellow pine. The stands vary in age from 20 to 150 years. Except in the bottoms of the larger canyons the timber is of slender pole dimensions. On the northern declivities the stands are well stocked and close set, while on the southern slopes they occur in irregular blocks separated by grassy tracts. Along the summits of the ridges and on the upper slopes the growth is very low and limby, due to excessive sterility of soil. The more valuable tracts of the forest are readily accessible by way of Yogo and Middle Fork of Judith canyons

Cutting.—The eastern areas of the Middle Fork of Judith Valley have been logged for mill timber, the cut amounting to 75 per cent. Small tracts along Yogo Creek have been more or less culled of the mill and pole timber, the cut varying from 5 to 40 per cent.

Burns.—The eastern areas of the township have been badly burned during the past thirty-five years. Large areas on the plateau tract were destroyed by fire thirty-five years ago; they have been restocked and again burned over within the last seven or eight years.

Reproduction.—Young growth is lacking on the burned-over tracts owing to the denuding effects of the forest fires. In the close-set stands there is a

moderate amount of seedling and young sapling growths. Red fir is the leading species in the restockage.

Undergrowth.—Light.

Litter.—In all of the close-set stands there is a large amount of litter, due to excessive crowding. On the burned tracts most of the fire-killed timber is still standing.

Humus.—On the northern slopes there is a moss cover 3 to 5 inches in depth. On slopes with southern exposure this is lacking.

Classification of lands in T. 13 N., R 10 E.

	Acres.
Forested	16,040
Nonforested	7,000
Badly burned	4,000
Logged	2,200
Agricultural	1,100
Grazing	1,500
Bare rocks	400

Total stand of timber in T. 13 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine	----------	1,000,000	1,000,000
Lodgepole pine	2,400,000	12,000,000	12,432,000
Yellow pine	900,000	----------	162,000
Red fir	9,500,000	13,000,000	13,710,000
Engelmann spruce	6,000,000	4,000,000	5,080,000
Total	18,800,000	30,000,000	32,384,000

Composition of forest in T. 13 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	7
Lodgepole pine	15
Yellow pine	1
Red fir	52
Engelmann spruce	25

Township 13 North, Range 11 East.

Topography.—The eastern and the central portions consist of rolling foothill lands—long broad swells separated by shallow ravines and gullies. In the western portion, radiating eastward from the mountain areas around Yogo Baldy, are

spurs which to the north rise to altitudes of 7,000 feet, while to the south they become mere low combs and sink into the rolling foothills of the central sections.

Mining.—Active mining operations are carried on at Sapphire in the eastern areas of the district.

Minerals.—Sapphires.

Soil.—Thin, gravelly loam.

Agricultural adaptability.—Small areas along the canyon bottoms in the central portions of the township are tillable and are used as hay ranches.

Grazing capacity.—The central and eastern divisions of the township are moderately well grassed and have long been used as a range for cattle and sheep.

Drainage conditions.—Scarcely any run-off originates within this township, as the streams flowing through it rise outside its boundaries. The ravines, gullies, and creeks are dry through most of the year. The lower portion of Yogo Creek and South Fork of Judith River flow across the township in the northern and central areas. These streams are of importance on account of the volume they add to the main Judith River.

Towns and settlements.—In the eastern portion, around the sapphire diggings, are a half-dozen buildings for the accommodation of the employees. Sheep shacks are found in the central and eastern areas, while two or three ranch locations occupy the small amount of tillable land in Yogo Canyon.

Forest conditions.—The forest is limited to the western sections. It consists of small-growth red fir and scrubby limber pine fit only for fuel and pole wood.

Woodlands.—The central and eastern areas carry scattered trees and lines and copses of limber pine. The timber has only a fuel value.

Cutting.—The lower slopes of the ridges in the forested areas have been culled and cut over and 60 to 95 per cent of the timber taken. The cutting has been for fuel, mine props, and mill timber.

Burns.—The southeast quarter of the township has been burned over within the last six or seven years and the timber totally destroyed.

Reproduction.—Abundant on northern slopes, deficient elsewhere. The burned-over tracts are not yet restocking. The woodlands are capable of carrying more extensive and better stocked stands, and young growth is slowly extending the timbered areas into the grassed tracts.

Undergrowth.—Underbrush is not abundant. It is chiefly composed of juniper shrubs.

Litter.—Light.

Humus.—None.

Classification of lands in T. 13 N., R. 11 E.

	Acres.
Forested	5,100
Wooded	13,100
Nontimbered	4,840
Badly burned	3,840
Logged	1,200
Agricultural	300
Grazing (woodland)	11,000
Bare rocks	700

Total stand of timber in T. 13 N., R. 11 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine	250,000	3,000,000	3,045,000
Red fir	750,000	2,500,000	2,635,000
Total	1,000,000	5,500,000	5,680,000

Composition of forest in T. 13 N., R. 11 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	45
Yellow pine	1
Red fir	54

Composition of woodland growth in T. 13 N., R. 11 E., including trees of all species from seedlings up.

	Per cent.
Limber pine	90
Red fir	10

Township 14 North, Range 8 East.

Topography.—The topographic features of the township comprise a mass of steep, rocky ridges rising to elevations of nearly 9,000 feet and centering in the peak known as Neihart Baldy, just east of the township line. The low relief is formed by many narrow, rocky canyons and by the valley of Belt Creek, which cuts through the district from south to north along its west line.

Mining.—The township was formerly an important mining center, but the low price of silver and possibly the exhaustion of the richer deposits have very much reduced the output, and comparatively little mining is now carried on.

Soil.—Thin loam resting on hard, coarse débris material. Extensive talus slopes, lacking every vestige of loam cover, occur in many places on the steeper slopes.

Agricultural adaptability.—The tract contains no arable land except a few small patches in the canyon of Belt Creek.

Grazing capacity.—A few small glades along Belt Creek and tracts of non-timbered hillsides in different localities constitute the pasture lands of the township. The aggregate acreage is small.

Drainage conditions.—The outflow originating in the district is small. There are numerous creeks, but aside from Belt Creek, which receives them all, none carries a large volume.

Towns and settlements.—There is only one town, Neihart, situated in the canyon of Belt Creek. Formerly a place of considerable importance, owing to its mines, it is now nearly deserted since the larger properties have suspended operations. Numerous miners' cabins are scattered throughout the hills on the different prospects or mines, and more or less extensive developments are in progress in several places. The township contains 4 miles of the Neihart-Great Falls Railroad line.

Forest condition.—The forest consists almost wholly of lodgepole pine, of which 80 per cent represents reforestations after fires which occurred thirty or thirty-five years ago. Near the summit of the ridges are scattered trees of limber pine and red fir, and along the creeks small proportions of spruce.

Cutting.—All of the more accessible areas, with the exception of the head of Carpenter Creek, have been logged and 80 per cent of the merchantable timber taken. The township now contains no mill timber and only inferior dimensions of pole growths. The timber has in part supplied Neihart, and in part has been shipped to Great Falls as smelter poles or to other localities as fuel, mine props, and the like.

Burns.—The northwest quarter of the township has been badly burned in spots here and there within the last five or six years.

Reproduction.—The sapling stands, 30 to 35 years old, are so fully stocked that further additions are impossible. The logged areas are abundantly restocking, but the burns show very little young growth as yet. The restockage in almost every instance is composed of lodgepole pine, though the forest, which the early prospectors burned, was largely composed of red fir. Lodgepole has taken its place and will hold it for the next one hundred and twenty years at least.

Undergrowth.—Light.

Litter.—There is a vast amount of litter throughout the stands. In part it consists of tops of trees and other kinds of woody débris left by the loggers. In part it is the unconsumed remains of fire-killed trees of a former forest.

Humus.—None.

Classification of lands in T. 14 N., R. 8 E.

	Acres.
Forested	15,360
Nonforested	7,680
Badly burned	2,000
Logged	11,000
Agricultural	150
Grazing	1,200
Bare rocks	4,330

Total stand of timber in T. 14 N., R. 8 E.

Species.	Pole and fuel timber.	Total volume of all timber.
	Cubic feet.	*Cubic feet.*
Limber pine	50,000	50,000
Lodgepole pine	2,000,000	2,000,000
Red fir	50,000	50,000
Subalpine fir	20,000	20,000
Engelmann spruce	80,000	80,000
Total	2,200,000	2,200,000

Composition of forest in T. 14 N., R. 8 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Lodgepole pine	99
All other species	1

Township 14 North, Range 9 East.

Topography.—In the central and western portions is a mass of high, rocky spurs and divides belonging to the Neihart Baldy-Yogo Peak system, reaching elevations of 8,500 to 9,000 feet. The eastern sections comprise a broad basin, forming the head of Dry Wolf Creek, and steep, rocky ridges hemming in the basin on the north and south.

Mining.—Numerous prospect shafts and tunnels occur throughout the township. No active mining operations are carried on.

Minerals.—Silver.

Soil.—Gravelly loam. Most of the township is covered with coarse limestone débris or with detritus derived from the hard eruptive rocks. Thin loam overlies or is mixed with the débris near the surface.

Agricultural adaptability.—A small tract known as Big Park in the central areas of Dry Wolf Creek, near the eastern side of the township, contains a few hundred acres of arable land. None of the land elsewhere is tillable.

Grazing capacity.—The pasture lands consist of small glades and openings in the forest and of the bald summits of the main divides in the central areas. Stock is pastured in Dry Wolf Valley, but not on the high, open ridges.

Drainage conditions.—Despite the altitude of the region the outflow is small. Small springs and rivulets abound near the summits of the higher ridges, but much of the discharge sinks before reaching the main channels. Small quantities of snow remain on the northern slopes near Neihart Baldy during most, if not all, of the summer season.

Towns and settlements.—Two settlers are living on the agricultural lands in the Dry Wolf Creek bottoms, while miners' cabins are scattered through the mineral-bearing central and western tracts of the township.

Forest conditions.—The western portion is stocked with lodgepole pine, in stands of nearly pure growth, 25 to 35 years old. They are reforestations, after fires which occurred about forty years ago. The summit of the main divide in the central areas carries scattered, thin stands of the subalpine type of forest. The timber is low and scrubby, suitable only for fuel, and practically inaccessible. The eastern areas are stocked with stands of lodgepole pine, spruce, and red fir. One-half of this growth is 30 to 35 years old; the remainder is from 100 to 150 years old. Most of this forest grows in blocks, surrounded by extensive burned areas.

Cutting.—The forest has been closely culled in all of the more accessible places in the western and eastern areas. The cut has been largely for the purpose of obtaining smelter poles.

Burns.—A strip, 2 miles wide, along the northern line of the township and a portion of its southeast quarter have been burned over in recent years and the timber totally destroyed.

Reproduction.—On the burned areas restockage is as yet almost wholly wanting. The close-set lodgepole-pine stands in the western areas are so fully stocked that further additions to the growth are impossible. Elsewhere there is a moderate amount of young growth, lodgepole pine prevailing on some tracts, red fir on others.

Undergrowth.—In most places light.

Litter.—There is a large amount of fallen timber in the burned areas and in most of the close-set sapling stands. At high elevations in the green forest litter is light.

Humus.—Northern slopes bear in some places a light moss cover; southern slopes have none.

Classification of lands in T. 14 N., R. 9 E.

	Acres.
Forested	8,960
Nonforested	14,080
Badly burned	7,680
Logged (culled)	3,000
Agricultural	300
Grazing	3,200
Bare rocks	2,900

Total stand of timber in T. 14 N., R. 9 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		100,000	100,000
Lodgepole pine	6,000,000	12,480,000	13,560,000
White-bark pine		400,000	400,000
Red fir	4,800,000	1,200,000	2,064,000
Engelmann spruce	1,800,000	1,000,000	1,324,000
Total	12,600,000	15,180,000	17,448,000

Composition of forest in T. 14 N., R. 9 E., including trees of all species with basal diameters of 8 inches and upward.

	Per cent.
Limber pine	0.5
Lodgepole pine	80
White-bark pine	1
Red fir	15
Subalpine fir	.5
Engelmann spruce	2.5
Aspen and cottonwood	.5

Township 14 North, Range 10 East.

Topography.—The main topographic feature is a mass of steep ridges with narrow and often precipitous crests, separated by canyons which have no great width.

Mining.—No active mining is carried on at present. Many mineral claims are located in the northern half of the township.

Minerals.—Silver lead ores and specular iron ores.

Soil.—Gravelly loam, with small proportions of loam.

Agricultural adaptability.—There is no arable land.

Grazing capacity.—The township contains numerous small grassy glades and nonforested summits which are utilized to some extent for cattle ranges.

Drainage conditions.—There is a large outflow from the tract, chiefly by way of Running Wolf Creek, which is important in the irrigation of agricultural lands in townships outside the reserve.

Towns and settlements.—The deserted mining village of Yogo is situated in the south-central portion, while miners' cabins are scattered throughout the township.

Forest conditions.—The forest chiefly consists of mixed stands of red fir and spruce. Small quantities of lodgepole pine occur on northern slopes at low and middle elevations. Limber pine forms most of the timber on the crests. The timber is largely a pole growth. In the northeast quarter of the township the stands consist almost wholly of sapling growth 25 to 30 years old. At the lowest elevations yellow pine forms an insignificant proportion of the timber, occupying a narrow belt and disappearing completely a few hundred feet above the canyon levels. The central portions of the district are difficult of access. The southern areas can be reached by way of Yogo Gulch; the northern from Running Wolf Canyon.

Cutting.—The timber has been culled in all the more easily accessible gulches, the cut varying from 10 to 95 per cent.

Burns.—Almost the entire northeast quarter has been burned over. Numerous smaller burns are scattered throughout the remainder of the township.

Reproduction.—Restockage on the burned-over areas is deficient or lacking. There is a moderate amount of young growth in the green forest. Red fir predominates in the restockage.

Undergrowth.—Moderate in quantity; composed chiefly of juniper scrub and *Shepherdia.*

Litter.—There is a large amount of dead and fallen timber on the burned areas. In the green forest the quantity is small.

Humus.—On northern hillsides there is a moss cover 3 to 4 inches in thickness. On southern slopes the humus is either lacking or consists of a very thin layer of pine needles.

Classification of lands in T. 14 N., R. 10 E.

	Acres.
Forested	12,000
Nonforested	11,040
Badly burned	8,900
Logged (cut and culled)	2,000
Agricultural	None.
Grazing	940
Bare rocks	1,200

Total stand of timber in T. 14 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		400,000	400,000
Lodgepole pine		1,000,000	1,000,000
Yellow pine	300,000	200,000	254,000
Red fir	12,000,000	9,200,000	11,360,000
Engelmann spruce	3,000.000	300,000	840,000
Total	15,300,000	11,100,000	13,854,000

Composition of forest in T. 14 N., R. 10 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	14.7
Lodgepole pine	15
Yellow pine	.3
Red fir	60
Engelmann spruce	10
Aspen and cottonwood	Scattered trees.

Township 14 North, Range 11 East.

Topography.—Only the western half of this township is in the forest reserve. The region consists of steep fronts of spurs which form portions of the divide between Running Wolf Creek and Yogo Gulch, and attain altitudes of 7,000 feet. The crests are narrow and rocky, while the slopes are deeply scored with narrow ravines and canyons. The portion of the township outside the reserve areas is a ridgy, rolling foothill region.

Mining.—None.

Soil.—Limestone débris with thin admixtures of loam.

Agricultural adaptability.—The lands within the reserve are not suitable for agricultural pursuits owing to their mountainous character. The eastern portion of the township contains more or less agricultural, as well as a large amount of grazing, land.

Grazing capacity.—None.

Drainage conditions.—Scarcely any permanent outflow originates in the district. The central areas are cut by Sage Creek, which has its headwaters in the next township on the west. Most of the canyons and ravines are dry during the greater portion of the year.

Towns and settlements.—None.

Forest conditions.—The forest consists of mixed stands of old-growth red fir, yellow pine, and limber pine, with small proportions of lodgepole pine at the

highest elevations. In Sage Creek Canyon the stands are of medium density; elsewhere they are thin. The timber is all third class. It is easy of access in Sage Creek bottoms, but difficult to reach in other localities owing to steep slopes.

Cutting.—On the accessible slopes and in Sage Creek bottoms 60 per cent of the timber suitable for mill use has been cut. The burned ridges and northern declivities of Woodhurst Mountain in the northwest corner of the township in some cases have been totally denuded of their timber by fuel cutters.

Burns.—Large areas in the northwest corner have been totally laid waste by fire within the past five or six years.

Reproduction.—There is a moderate amount of young growth in the living forest. On the burned-over areas the restockage is very scanty or wholly lacking. Red fir is the chief species in the young growth.

Litter.—Abundant both in the green stands and on the burned tracts.

Undergrowth.—Small quantity.

Humus.—None.

Classification of lands in western half of T. 14 N., R. 11 E.

	Acres.
Forested	8,320
Nonforested	3,200
Badly burned	2,600
Logged	4,000
Agricultural	None.
Grazing	None.
Bare rocks	600

Total stand of timber in western half of T. 14 N., R. 11 E.

Species.	Mill timber.	Pole and fuel timber.	Total stand of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine	800,000	3,300,000	3,444,000
Yellow pine	2,000,000	.....	360,000
Red fir	8,000,000	6,000,000	7,440,000
Total	10,800,000	9,300,000	11,244,000

Composition of forests in western half of T. 14 N., R. 11 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	40
Lodgepole pine	5
Yellow pine	2
Red fir	53

Township 15 North, Range 8 East.

Topography.—In the south are steep spurs radiating from the mountain areas around Neihart Baldy, in the center is the valley of Dry Fork of Belt Creek, while on the north are the long slopes and ridges of Barker Mountain. The altitude varies from 6,000 feet for the valley levels to 8,200 feet for the summits of Barker Mountain and the ridges in the southern portion.

Mining.—The tract formerly supported several mining camps. Mining locations abound in the eastern portion.

Minerals.—Chiefly silver, lead, and small quantities of copper.

Soil.—Thin, gravelly loam mixed with much limestone débris.

Agricultural adaptability.—Tracts in the central portion of the township in Dry Fork Valley are suitable for agricultural purposes, and are occupied by farmers. The remainder of the township is not tillable.

Grazing capacity.—Small glades on the southern hillsides and in the canyons. The area of grass land is insignificant.

Drainage conditions.—The run-off originating in the township is small in volume. Most of the lesser creeks are dry during portions of the year.

Towns and settlements.—Two mining villages, Barker and Hughesville, formerly existed in the township but both are now abandoned. Farmsteads are located on the agricultural lands and are occupied continuously.

Forest conditions.—The forest consists of mixed stands of lodgepole pine, red fir, and Engelmann spruce, mostly of small and slender growth, limby and knotty, and fit only for fuel and pole timber.

Cutting.—The forest has been logged throughout, the cut averaging 65 per cent.

Burns.—Extensive fires have devastated the forest in the northern and southwestern portions. Most of the green stands are fire marked. On the burned-over areas all the timber has been killed, but not consumed.

Reproduction.—Restockage is scanty on the larger burns where the slopes face the south. On the northern slopes it is abundant, except on very recent burns, where seedling growth is still lacking. On the cut-over areas the young growth is abundant. Lodgepole pine and red fir compose most of the restockage, the former species prevailing.

Undergrowth.—Light.

Litter.—There is a large amount of litter, consisting of the débris left by loggers and unconsumed by fire.

Humus.—Very light or altogether lacking.

Classification of lands in T. 15 N., R. 8 E.

	Acres.
Forested	14,000
Nonforested	9,040
Badly burned	6,400
Logged	12,000
Agricultural	1,500
Grazing	500
Bare rocks	640

Total stand of timber in T. 15 N., R. 8 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		100,000	100,000
Lodgepole pine	4,000,000	7,800,000	8,520,000
Red fir	500,000	4,300,000	4,390,000
Engelmann spruce	50,000	60,000	69,000
Total	4,550,000	12,260,000	13,079,000

Composition of forest in T. 15 N., R. 8 E., including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	2
Lodgepole pine	58
Red fir	36
Subalpine fir	.3
Engelmann spruce	3.2
Aspen and cottonwood	.5

Township 15 North, Range 9 East.

Topography.—The general relief of the township consists of moderately steep, high ridges, inclosing broad canyons. The eastern half is intersected by high ridges, radiating in a northerly direction from Yogo and Neihart Baldy and serving as dividing lines between the waters flowing into Judith River basin and Belt Creek. The western half of the township includes valleys and spurs radiating from different centers, such as Mixes Baldy and Barker Mountain. The general elevation is about 7,000 feet.

Soil.—Gravelly loam mixed with more or less finely comminuted limestone débris.

Mining.—Formerly the township was the scene of active mining operations, but since the cessation of work in Barker camp, in the township adjoining on the west, mining has come to a standstill. Numerous prospects and mines in different stages of development are located throughout the western half.

Minerals.—Various combinations of silver, lead, and copper.

Agricultural adaptability.—Small tracts in the northern portion at the northern foot of Mixes Baldy and on tributaries to Dry Wolf Creek are tillable and in part occupied.

Grazing capacity.—The grazing areas are limited to bare summits on the high ridges in the eastern portion. They are but little pastured, if at all.

Drainage conditions.—The outflow is of moderate volume and is carried in part by Barker Creek and in part by Mill Creek. Both empty into Belt Creek and supply about one-fourth the volume of that stream.

Towns and settlements.—The township contains no villages. There are two or three settlers on the agricultural lands in the northern and eastern areas. A small sawmill is located in the central portions of the district on Mill Creek. Miners' cabins and claims are scattered through the mineral areas.

Forest conditions.—Most of the merchantable forest consists of veteran stands of red fir and Englemann spruce. The lodgepole-pine stands are confined chiefly to the northwest, west-central, and southwest portions, and are mostly composed of sapling growths. At the highest altitudes the forest consists of limber pine, white-bark pine, subalpine fir, and small proportions of spruce. The red fir is of the slender eastern Montana type. The spruce generally is stocky and limby. Most of the timber is comparatively easy of access from the different canyons.

Cutting.—A large amount of timber has been cut. It has been used at Barker mining camp, in the agricultural districts north of this township, and at the copper smelter at Great Falls. Most of the canyon bottoms and their lower slopes have been cut over, the cut varying in different localities from 20 per cent to total.

Burns.—Burned-over areas occur in the northeast and east-central regions. The burns date back ten or fifteen years, and totally denuded the land of its living timber.

Reproduction.—Restockage is deficient on the burned-over areas. It is mostly composed of lodgepole pine instead of the former growth of red fir. In the green stands there is sufficient young growth to maintain the present stockage of the stands. On the logged areas seedling and young sapling growths are abundant, consisting of red fir and spruce in about the same proportions as existed in the former forest.

Litter.—The burns are littered with a great deal of unconsumed débris, in part fallen, in part standing, while on the cutting areas the ground is littered with unpiled masses of tops and limbs. On the logged tracts in the southern areas of the township thousands of smelter poles, mine props, and sawlogs have been cut and left on the skidways and in the forest to rot.

Humus.—At the higher elevations humus is practically lacking. At lower altitudes the forested canyon floors and northern slopes have a cover of moss and pine needles 3 to 4 inches in thickness.

Classification of lands in T. 15 N., R. 9 E.

	Acres.
Forested	15,600
Nonforested	7,440
Badly burned	3,640
Logged	6,800
Agricultural	1,200
Grazing	2,000
Bare rocks	600

Total stand of timber in T. 15 N., R. 9 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		400,000	400,000
Lodgepole pine	13,000,000	8,700,000	11,040,000
Red fir	20,000,000	11,200,000	14,800,000
Subalpine fir		200,000	200,000
Engelmann spruce	5,550,000	2,800,000	3,799,000
Total	38,550,000	23,300,000	30,239,000

Composition of forest in T. 15 N., R. 9 E., including trees of all species with basal diameters of 8 inches and upward.

	Per cent.
Limber pine	5.5
Lodgepole pine	30
White-bark pine	.5
Yellow pine	Scattered trees.
Red fir	52
Subalpine fir	.6
Engelmann spruce	11
Aspen and cottonwood	.4

Township 15 North, Range 10 East.

Topography.—In the western and southern portions are steep mountain spurs and ridges reaching altitudes of 7,000 feet. The eastern portion is a foothill region, consisting of limestone terraces and basin-like depressions, the terraces rising 250 to 500 feet above the floors of the intersecting ravines and canyons.

Mining.—The tract contains many prospects in various stages of development. No active mining is carried on.

Soil.—Thin, gravelly loam, chiefly limestone débris.

Agricultural adaptability.—The bottom lands in the gulches constitute the agricultural areas. The most important are in North Fork of Spring Gulch, in Dry Wolf Canyon at and below Big Park, and in the different basin-like depressions in the extreme eastern portion of the township. About 500 acres are under cultivation, producing hay.

Grazing capacity.—The east half of the township is largely a grazing area, and is used as such.

Drainage conditions.—The outflow from the district is small in amount. It is discharged by way of the Dry Wolf, a stream which is dry in its lower half during most of the year. The smaller canyons and ravines are dry runs except during and immediately after the spring break-up. There are few springs.

Towns and settlements.—The agricultural lands are settled. There are no towns. Miners' cabins are scattered throughout the mineral-bearing western and southern portions of the tract.

Forest conditions.—The forest consists of mixed stands of lodgepole pine and red fir, with spruce, limber pine, and subalpine fir in the higher canyons and on the upper slope of the ridges. In the eastern areas the stands become thin and scattering and merge into the woodlands. In the northern portion of the township the stands form compact bodies where not invaded by fire within recent years. The timber throughout the district is generally low and scrubby, even in the close-set stands, owing to aridity of the soil and climate. The northern half of the township is easy of access, the southern half moderately so.

Woodlands.—The woodlands are situated mostly in the northeast quarter of the township, covering nearly all of that tract. They are lightly timbered with small stands, copses, and isolated trees of limber pine, red fir, yellow pine, and occasionally lines of small and slender lodgepole pine. The timber has only a fuel and pole value.

Cutting.—All the readily accessible portions of the township have been cut over, the cut varying from 10 to 95 per cent. On some of the burned-over tracts, especially along Dry Wolf and Spring creeks, and between Running Wolf Creek and Woodhurst Mountain, most of the fire-killed timber has long since been cut and removed.

Burns.—Nearly all the western areas of the district have been burned over. The timber on the tracts has been killed, but not consumed, and where not cut is mostly still standing. The fires date back ten to fifteen years.

Reproduction.—Restocking of the burned areas is slowly progressing. On the northern declivities the young growth is mostly red fir, elsewhere lodgepole

pine. The forested areas in the eastern sections of the township have a moderate amount of young growth in their stands, which, in some few localities, shows a slight tendency toward extensions into the woodlands.

Undergrowth.—There is present a moderate amount of undergrowth. It consists of juniper scrub, *Shepherdia*, service berry, and various smaller species of shrubs.

Litter.—Dead and fallen timber is plentiful in most of the green and fire-killed stands.

Humus.—Generally lacking, but here and there a thin moss carpet covers the forest floor.

Classification of lands in T. 15 N., R. 10 E.

	Acres.
Forested	6,000
Wooded	5,000
Nontimbered	12,040
Badly burned	5,200
Logged	6,500
Agricultural	2,800
Grazing	3,600
Bare rocks	440

Total stand of timber in T. 15 N., R. 10 E.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine		200,000	200,000
Lodgepole pine	800,000	3,000,000	3,144,000
Red fir	6,000,000	1,500,000	2,580,000
Subalpine fir		200,000	200,000
Engelmann spruce	500,000	350,000	440,000
Total	7,300,000	5,250,000	6,564,000

Composition of forest in T. 15 N., R. 10 E., including trees of all species with basal diameters of 8 inches and upward.

	Per cent.
Limber pine	2
Lodgepole pine	30
Yellow pine	Scattered trees.
Red fir	62
Subalpine fir	1
Engelmann spruce	5

LITTLE BELT MOUNTAINS QUADRANGLE.

The Little Belt Mountains Forest Reserve is represented on portions of the Fort Benton and Little Belt Mountains sheets of the topographic atlas of the United States. The reserve includes 3.75 per cent of the Fort Benton quadrangle, and 20 per cent of the Little Belt Mountains quadrangle. Estimates were made of the classes of land and the amount of timber in the Little Belt Mountains quadrangle. The detailed description of the silvicultural conditions given in the account dealing with the Little Belt Mountains Forest Reserve applies equally to the forested areas situated beyond the boundaries of that reserve within the quadrangle.

LOCATION, EXTENT, AND CLASSIFICATION OF LANDS.

The Little Belt Mountains quadrangle occupies a tract of country in the State of Montana, situated between 46° and 47° north latitude, and between 110° and 111° east longitude, and has an area of 2,108,614 acres. The region presents a great diversity of mountain, plain, and valley, timbered and nontimbered, the acreage of the different classes of land being shown in subjoined tables.

Classification of lands in the Little Belt Mountains quadrangle, Montana.

	Acres.
Forested	812,208
Wooded	25,000
Nontimbered	1,271,406
Total	2,108,614

The nontimbered lands consist of grazing and agricultural lands, with tracts of bare rock at alpine or subalpine heights. The acreage of each class is as follows:

Classification of nontimbered lands in the Little Belt Mountains quadrangle, Montana.

	Acres.
Agricultural	194,680
Grazing	989,496
Bare rock and high alpine	87,230
Total	1,271,406

TOPOGRAPHY.

RELIEF.

The high relief of the region is formed by outlying ranges of the Rocky Mountains, more or less closely and directly connected with that system, or isolated and surrounded by plains areas. The mountain areas of the north half

of the quadrangle are formed by the main axis and the flanking spurs and ridges of the Little Belt Mountains, which strike through the quadrangle from northwest to southeast. The mean elevation is 7,300 feet, the highest points reaching altitudes of 8,200 feet.

The high relief of the central areas is formed by Castle Mountains, a detached outlier of the Little Belt Range, covering only 50,000 acres. Its mean altitude is 7,400 feet, the culminating point of the tract reaching a height of 8,600 feet.

The orographical features of the southern areas are centered in the Crazy Mountains, a rough, rocky, steep tract of country—a southward continuation of Castle Mountains, with which they connect through high, broad, nontimbered ridges. The mean elevation of the region is 7,800 feet, many points in the central portion of the system reaching altitudes of 10,000 feet, while the culminating point of the entire mass is 11,180 feet above sea level.

The lower portion of the quadrangle consists of small tracts of rough and broken foothill region, and of wide, rolling plains and areas of nearly level table and bench lands. The plains are dotted with numerous isolated buttes, intersected with low combs and irregular rocky ridges, and are cut by a multitude of ravines and canyons. The flood valleys are comparatively broad, and are bordered with several tiers of terraces and benches. The mean altitude of the low portion of the quadrangle is 6,000 feet.

DRAINAGE.

The northern part of the region lies partly within the drainage of Judith River and partly within the Musselshell basin. The southern areas drain into Yellowstone River through various small creeks and the larger Shields River. A tract in the west-central regions sends its drainage into the Missouri, in a westerly direction, through Sixteen Mile Creek and Smith River. None of the streams except Shields River carry any considerable volume of water, except during flood times. Outside the mountain areas the streams are not rapid, and meander through valleys of soft alluvial deposits. Most of the outflow originates in the Little Belt ranges. The Crazy Mountains discharge moderate quantities from their northern slopes into the Musselshell. The outflow from the Castle Mountains is small, and the rolling plains region gives rise only to small and intermittent creeks.

AGRICULTURAL LANDS.

The cultivable lands amount to 10.1 per cent of the quadrangle and are so situated as to be easily irrigable. It is not improbable that much of the grazing lands can be reclaimed by means of storage reservoirs and high-line ditches. The

lands cultivated at the present time consist wholly of bench lands on the lowest terraces, which can be irrigated from the various streams that course through them without much expense or labor. The soil in the bottom lands varies from a deep, rich loam to a thin topping of alluvial silt on coarse gravel and bowlders. When once under ditch the lands yield good crops of hay and grain. There are no agricultural lands in the mountain areas worth noting.

GRAZING LANDS.

The range lands consist of plains, foothills, and high timberless or sparsely forested mountain areas. The plains have long been used as cattle and sheep ranges; originally covered with luxuriant growths of grass, they have been grazed so closely that where not fenced their grazing value is exceedingly low. Much of the land in the more level plains areas is now owned or leased by private parties and within fence, allowing the grasses a measure of recuperation. The foothill areas have been used very much like the plains and their pasturage value is but little higher. The alpine and subalpine grazing areas are situated above the 7,800-foot contour line. The tracts which are situated within the limits of forest growth represent ancient fire glades where restockage has failed. Above the 10,000-foot level, grassy alpine tracts begin and continue to the highest elevations. Alpine areas occur only in the Crazy Mountains; no point in the Castle or the Little Belt Mountains is higher than timber line, 9,300 feet. The high areas are sheeped wherever accessible except within the limits of Little Belt Mountains Forest Reserve. They are covered with a tough, close sod composed largely of subalpine species of sedge, and have not greatly suffered from the sheeping to which they have been subjected. The grazing lands constitute the class having the largest acreage in the quadrangle, including nearly 51 per cent of the total area.

WOODLANDS.

The woodlands occupy less than 1 per cent of the quadrangle, occurring chiefly on the eastern slope of the Little Belt Mountains where a small tract of foothill country is stocked with broken and intermittent stands characteristic of this class of lands. Red fir, limber pine, and yellow pine thinly scattered in copses and narrow lines or as isolated trees form the growth. The volume of timber which they carry is insignificant, and owing to their proximity to the arid plains no considerable addition to their stockage can be expected.

FOREST.

Generally speaking, all the areas in the quadrangle situated above the 7,000-foot contour and below the 9,300-foot level bear forest, the lands of this class constituting very nearly 40 per cent of the entire area. The growth is almost wholly coniferous, not more than 0.5 per cent belonging to broad-leaved species. The subjoined table exhibits the percentage of each species composing the forest.

Composition of forest in the Little Belt Mountains quadrangle, Montana, including trees of all species with basal diameters of 3 inches and upward.

	Per cent.
Limber pine	3
Lodgepole pine	30
Yellow pine	.1
White-bark pine	.1
Red fir	55
Subalpine fir	1.4
Engelmann spruce	10
Aspen and cottonwood	.4

The forest presents three more or less clearly defined zones or divisions, which present a general uniformity in aspect and composition throughout the quadrangle. In the lowest of these zones, between the 7,000 and the 7,400-foot contours, red fir is the dominant species, limber pine, yellow pine, and lodgepole pine constituting not more than 10 per cent of the growth. Above this zone, and extending to altitudes of 8,300 feet, is the middle division, containing the great mass of the forest. It is made up of lodgepole pine as the dominant species in all the interior and more humid portions of the mountains, with red fir as the leading species on the warmer and drier southern slopes. Associated with these species are varying proportions of Engelmann spruce and limber pine. Above the middle zone subalpine tracts begin. In the stands at this altitude Engelmann spruce forms the larger proportion, subalpine fir and white-bark pine seldom exceeding 20 per cent.

The forest at its lower levels is generally thinly stocked, except in localities where plenty of seepage exists. Its average capacity in timber of all sorts seldom exceeds 1,900 cubic feet per acre. In the middle zone is often a heavy and very close stockage, especially in the lodgepole-pine stands of pure or nearly pure growth, where the yield frequently runs as high as 6,000 to 7,000 cubic feet per acre. The subalpine forest is thinly stocked, and will not average 1,000 cubic feet per acre.

The volume of timber in the quadrangle is shown in the appended table, trees less than 4 inches in basal diameter being excluded from the estimates:

Total stand of timber in the Little Belt Mountains quadrangle.

Species.	Mill timber.	Pole and fuel timber.	Total volume of all timber.
	Feet B. M.	*Cubic feet.*	*Cubic feet.*
Limber pine	4,050,000	20,195,000	20,924,000
Lodgepole pine	159,300,000	398,940,000	427,614,000
Yellow pine	11,800,000	7,400,000	9,524,000
White-bark pine	----------	900,000	900,000
Red fir	287,650,000	613,935,000	665,712,000
Subalpine fir	----------	12,120,000	12,120,000
Engelmann spruce	81,750,000	104,660,000	119,375,000
Aspen and cottonwood	----------	6,000,000	6,000,000
Total	544,550,000	1,164,150,000	1,262,169,000

Extensive fires have swept large areas in the quadrangle during the last thirty-five or forty years. In the aggregate 160,000 acres have been burned over, involving total destruction of the forest. The greatest acreage of burned forest is in the Little Belt Mountains Forest Reserve. Portions of the central areas of the Castle Mountains and of the lower slopes of the Crazy Mountains likewise have suffered severely.

Restockage is abundant throughout the middle and lower zones of the forest, except on the southern slopes, in nearly pure red-fir stands where fire has run. Lodgepole pine leads everywhere in the reforestations. In the subalpine forest reproduction is scanty. When the stands are destroyed by fire at the high elevations a grassy turf takes their place and apparently persists for a century or two.

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