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ADA SOUTH OF 40TH PARALLEL. [BULL. 208.]

hland and Snake ranges. This implies a great erosion gap.

the writer crossed the valley which lies on a district where there are abundant exponian and Silurian rocks. At the western in the foothills fossiliferous strata, appar-e series, from which, however, he collected ling farther west he found the whole moun-ssive limestones, with intercalated shales belong to the Cambrian. A few miles t Bristol, Mr. Walcott found the Eureka the western base of the mountains, and 5 miles south of Stampede Gap on the road iko. Both these places occupy the same sternal base of the range. Between these Cambrian rocks of the main range there t, bringing about juxtaposition of strata graphic succession are separated by nearly nents. This is believed to be the same ed farther north, and it may be either a

s to cut the range transversely at a point Ely in the Egan Range. To the north fold which exposes probable Silurian or uth only the eastern limb of the fold is sents the western limb being cut off. On y Devonian fossils.

e road which crosses the range between eeks<sup>a</sup> observed, in 1900, a strong north-und interior valley. Cambrian rocks on t are brought against Ordovician strata across the entire range.

le cross fault near the north end of the this fault is continuous with a probable ter on the Egan Range, just to the west. es north of this, what is perhaps a par-y a deep transverse valley in the Egan to the gap which separates the Schell nd Range. The displacement of these s probably very considerable.

r of intersecting faults, some belonging m and some to a northeast-southwest rved by the writer runs through the orthwest direction. It is marked by a

to the writer.

Hundredth Meridian, Vol. III, p. 243

SPURR.]

# EGAN RANGE.

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ITEM 3

47

deep gulch, and has the Cambrian quartzite on the northeast side and the Cambrian shale and limestone on the south. This fault has at least 1,000 feet of vertical separation and may have much more. Other faults are parallel to this, and there are a number of northeast-southwest cross faults with considerable displacement. The effect of these is to cause a certain degree of checkering of quartzite and lime-stone. The northeast gulch in which Pioche lies seems to mark one of these faults.<sup>a</sup>

## EGAN RANGE.

The Egan Range is the next important range west of the Schell Creek and Highland ranges. Its north end lies just north of the fortieth parallel and is included in the maps of the Fortieth Parallel Survey. It extends due southward nearly 150 miles.

## TOPOGRAPHY.

Throughout nearly its whole course the Egan Range consists of a single well-defined central ridge, from which the slopes to the valley on both sides are comparatively steep. In the neighborhood of Ely the ridges are slightly broken up, but this is apparently due largely to the presence of igneous rocks. At the extreme south end, also, the main range splits up into several low ridges.

The range is cut through at intervals by transverse valleys connect-ing the valleys on either side of the range and very little higher than they. Such valleys are found at Egan Canyon and at Ely. Near the southern end of the range there are other deep transverse gaps, which, however, do not cut clear down to the level of the valleys.

## ARCHEAN ROCKS.

Mr. S. F. Emmons<sup>b</sup> has described the rocks in an outlying ridge on the east side of the range, just south of the eastern end of Egan Canyon. Here the lowest formation exposed is a mica-granite, which is overlain by quartzites and quartzitic schists referred to the Cam-brian. The granite is referred to the Archean.

## SEDIMENTARY ROCKS.

### CAMBRIAN.

As above noted, Mr. Emmons found overlying the granite at the eastern end of Egan Canyon several thousand feet of quartzites and quartzitic schists, together with a 50-foot bed of argillite. These quartzites are overlain by limestones.

The same locality was observed by the writer from a distance, and on account of the stratigraphy was referred with little hesitation to

<sup>a</sup> These observations are in accordance with those previously made by Mr. Howell (U. S. Geog. Surv. W. One Hundreth Mer., Vol. III, pp. 257-261), as the writer discovered since writing the above.

<sup>b</sup> U. S. Geol. Expl. Fortieth Par., Vol. II, p. 488.

the Cambrian. The rocks were not visited, but at the base are heavy beds dipping to the west at an angle of about  $30^{\circ}$  and striking north and south. These massive beds resemble the Cambrian quartzite and limestone, while above them come more easily eroded limestones, which correspond in thickness and position to the Silurian Pogonip formation. Above the Pogonip on the east face of the main ridge (which is separated from the spur above mentioned by a trough of erosion) is exposed the Eureka quartzite, which is traceable along the range for several miles northward. The identification of this Silurian makes the reference of the easterly rocks of the outlying spur to the Cambrian safe.

Mr. F. B. Weeks<sup>a</sup> reports that in the summit of the range, about 10 to 12 miles south of Egan Canyon, the following Upper Cambrian fossils, determined by Mr. Walcott, were collected:

- Obolus (*Lingulella*) *discoidensis* H. & W.
- Obolus (*Lingulella*) *manticulus* White.
- Obolus (*Lingulella*) *punctatus* Walcott.
- Ophileta?
- Agnostus, 2 sp.
- Ptychoparia, 2 sp.

Along the southern part of the Egan Range the west face, which confronts the southern part of Sierra Valley, exposes some magnificent sections of strata. These also were not visited any farther north than the vicinity of Adams's ranch on White River, near which point they were found to be Devonian. Farther north, however, a thick section of rocks, striking northeast and dipping southeast at an average angle of  $30^{\circ}$ , was exposed, and the circumstance that the strike is diagonal to the north-south face of the range brings it about that progressively lower beds are exposed going north. About 2 miles north of the vicinity of Butterfield Spring what was taken to be Eureka quartzite was seen at a distance; below this occurs a great thickness of more easily eroded limestones, which were referred to the Pogonip formation; and beneath these again massive limestones, which perhaps represent the Upper Cambrian. Only a comparatively slight thickness of the latter limestones is exposed, when the dip of the section is reversed and becomes northwest, so that the section begins to ascend toward the north.

#### SILURIAN.

Mr. Emmons<sup>b</sup> noted the finding of Silurian fossils in the limestone in the neighborhood of Egan Canyon. The writer, who crossed the range at this point from Cherry Creek westerly, did not succeed in finding any good fossils, but identified the formations on lithologic and stratigraphic grounds as notably belonging to the Pogonip, the

<sup>a</sup>Personal communication to the writer.

<sup>b</sup>U. S. Geol. Expl. Fortieth Par., Vol. II, p. 488.

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Expl. Fortieth Par., Vol. II, p. 488.

Eureka, and the Lone Mountain formations of the Silurian as exhib-  
ited in the Eureka section. In the easterly spur of the mountains  
just south of Egan Canyon, as above noted, the whole thickness of the  
Pogonip strata is exposed, occupying a valley of erosion between this  
spur and the main ridge. On the easterly face of the main ridge the  
Eureka quartzite is exposed, and may be traced across Cherry Creek  
and still farther north. Above the quartzite, in ascending from  
Cherry Creek westerly, dark-blue crystalline limestones, similar lith-  
ologically to the Lone Mountain limestones of Eureka, and carrying  
indistinct fossils, were observed.

The probable exposure of the Eureka quartzite on the western face  
of the range, near its southern end, has already been noted in con-  
nection with the probable Cambrian exposures. It is probable that  
along here not only the Eureka quartzite, but the whole Silurian sec-  
tion, is exposed.

Crossing the separate low ridges which constitute the connection  
between the southern end of the Egan Range and the Pahroc Range,  
what is almost certainly the Eureka quartzite was found about 25  
miles northwest of Pioche. Here was found a white vitreous quartz-  
ite, rather coarse grained and upward of 100 feet thick, above which  
lie dark-gray, comparatively thin fetid crystalline limestones, with  
the fossils too much altered to be recognizable. This is perhaps the  
Lone Mountain limestone. These Silurian rocks are exposed only  
along the eroded axis of an east-west anticline, and to the north  
and south are overlying rocks from which Devonian fossils were col-  
lected. The general structure of the beds at this point makes it  
probable that a little farther northeast a greater thickness of Silurian  
rocks is exposed, in the valley midway between this point and the  
Highland Range.

#### DEVONIAN.

The western face of the Egan Range about 8 or 10 miles north of  
Cherry Creek is composed of stratified rocks dipping very gently  
northwest. These stratified rocks are limestones whose appearance  
suggests the Nevada formation of the Devonian. A short distance north  
of these, also on the west face of the range, black, shaly, fetid lime-  
stones carrying Upper Carboniferous fossils were obtained, while  
south of the supposed Devonian rocks, in the neighborhood of Cherry  
Creek, there are exposed Silurian formations, as already mentioned. It  
is more than probable, therefore, that the intervening rocks are really  
Devonian. Mr. Emmons has made the same suggestion.<sup>a</sup>

In the canyon which cuts through the range at Ely limestones carry-  
ing Lower Carboniferous fossils were found. In these limestones are  
siliceous beds which may perhaps represent the Diamond Peak  
quartzite of the Eureka section, beneath which there is a slight

<sup>a</sup>U. S. Geol. Expl. Fortieth Par., Vol. II, p. 488.

exposure of shaly limestone which may represent the White Pine formation. No fossils, however, were procured from these beds, and their identification as Devonian is only provisional.

At the northern end of the curving spur which joins the main range near this point (Pl. V, A), where it passes under andesitic flows just south of Summit stage station *Cyathophyllum* sp. was found, and was referred to the Devonian by Dr. George H. Girty.

This Devonian area, however, is small, since at a distance of 2 miles farther south similar limestones carrying Carboniferous fossils were found.

Devonian rocks make up nearly the whole of the series of low ridges which constitute the extreme southern end of the Egan Range, so far as these rocks were examined by the writer in crossing diagonally from northwest to southeast. In crossing the pass which cuts through the western and main ridge of these mountains, about 10 miles due southeast from Adams's ranch, comparatively thin-bedded fetid limestones were found folded into a syncline striking diagonally to the trend of the pass, and carrying the following Devonian fossils, as determined by Dr. George H. Girty:

*Amphipora*? sp.  
*Cladopora*? sp.  
 Stromatoporoid coral.  
*Chonetes macrostriatus*.  
*Spirifer utahensis*.

The corals obtained here make up the greater bulk of the rock, which appears, therefore, to have been a Paleozoic coral reef. Both the fossils and the nature of the inclosing rocks are identical with the fossils and rocks found in the Golden Gate Range, directly west of here and about 15 miles distant.

Following the road from here southeastward to Pioche, Devonian fossils were again obtained about 12 miles south of the first locality, as follows:

*Amphipora*? sp.  
 Stromatoporoid corals.  
*Spirifer maia* (small variety).

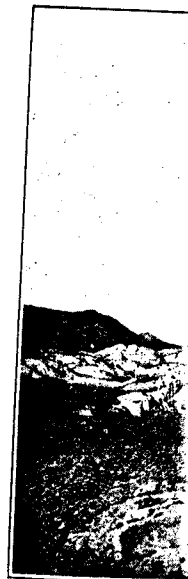
Again about 6 miles farther southeast the following Devonian fossils were collected:

Fucoid.  
*Productella subaculeata*.  
*Rhipidomella* sp.  
*Spirifer disjunctus*.  
*Spirifer utahensis*.  
*Spirifer strigosus*?  
*Ambocoelia umbonata*.  
*Camarotoechia sappho*.  
*Modiomorpha obtusa*?  
*Grammysia minor*?  
*Loxonema*? sp.

U. S. GEOLOGICAL



A. EAST FA



B. TERTIARY V

SOUTH OF 40TH PARALLEL. [BULL. 208.

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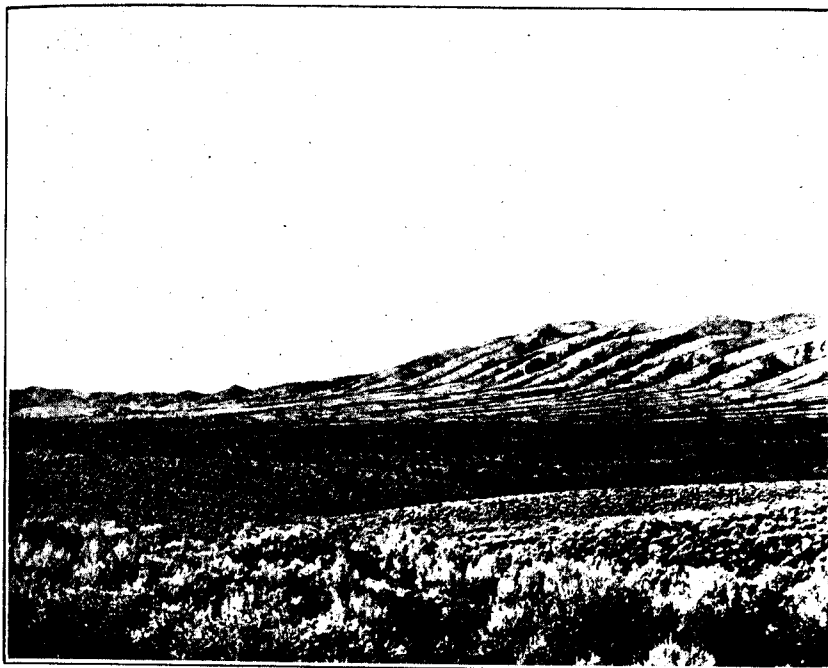
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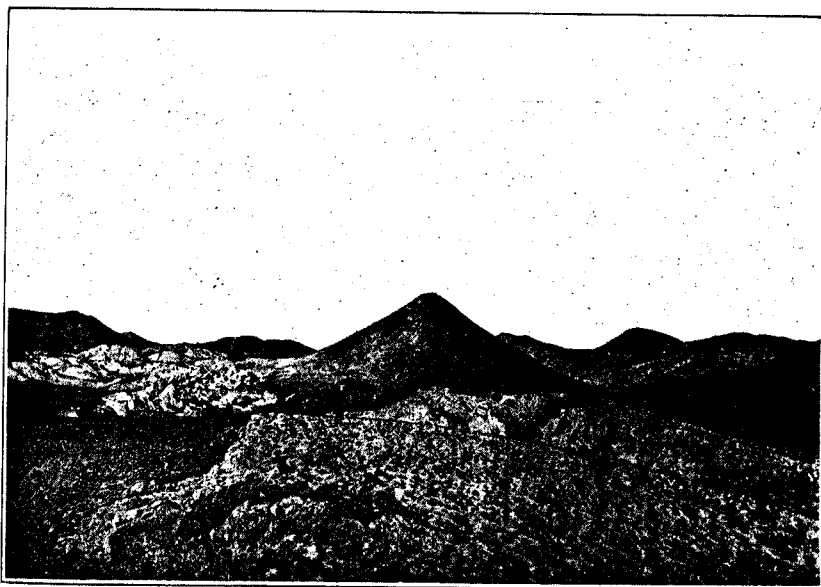
southeast the following Devonian fos-

U. S. GEOLOGICAL SURVEY

BULLETIN NO. 208 PL. V



A. EAST FACE OF LOW MOUNTAIN RANGE WEST OF EGAN RANGE AT ELY.



B. TERTIARY VOLCANIC CONE, PANCAKE RANGE, EAST SIDE OF HOT CREEK.

Exposed by denudation of overlying lavas and tuffs.

The structure of the surrounding ridges makes it probable that most of them are Devonian.

## CARBONIFEROUS.

In the extreme northern end of the Egan Range Mr. Emmons<sup>a</sup> collected probable Carboniferous fossils. On the western front, about 12 miles north of Cherry Creek, the following fossils were collected by the writer and identified by Dr. Girty:

*Orbiculoidea missouriensis?*  
*Marginifera splendens?*  
*Productus n. sp.*  
*Spirorbis sp.*  
*Euomphalus catilloides.*

Between Egan Canyon and Ely it is probable that the Carboniferous rocks cover a considerable area. Near Ely, Carboniferous limestones are abundantly exposed. About 2 miles south of Summit Springs, on the road between Ely and Hamilton, massive semicrystalline limestones are found which carry a probably Upper Carboniferous fossil that was determined by Dr. Girty as *Zaphrentis sp.*

About 6 miles east of here, on the east side of the narrow valley separating the minor ridge, in which the above fossil was obtained, from the main range, were collected the following Upper Carboniferous fossils:

*Seminula subtilita?*  
*Lithostroton? sp.*  
*Fusulina cylindrica.*

Two miles southeast of the last-named locality, near the western entrance of the canyon which cuts through the range at Ely, dark-gray carbonaceous fetid limestones were found which carry the following Lower Carboniferous fossils:

*Zaphrentis sp.*  
*Orthothetes inaequalis.*  
*Rhipidomella michelini.*  
*Productus semireticulatus var.*  
*Productus n. sp.*  
*Spirifer centronatus.*  
*Straparollus luxus.*  
*Proetus peroccidens.*

The black shaly limestone which carries the Lower Carboniferous fauna at the last-named locality passes into a belt of red, yellow, and orange weathering shales, with occasional beds of gray, shaly limestone. The thickness of these shales is estimated at from 800 to 1,000 feet. Farther east in the canyon beds of cherty and siliceous limestones also occur in this same series. It is probable that the lowest of these shaly beds are Devonian, but to the south of Ely, above

<sup>a</sup>U. S. Geol. Expl. Fortieth Par., Vol. II., p. 487

the shales, the more massive limestone comes in above again and extends for 5 or 6 miles at least, striking east and west and dipping gently south.

On the southeastern slope of Hamels Peak, some miles south of Ely, the fossils named below were collected by Mr. F. B. Weeks,<sup>a</sup> and were determined by Dr. Girty. Regarding this collection, Mr. Girty states "The fauna has a similar facies to that of the Marion formation of the Kansas section, which Prosser regards as a true Permian fauna, and it probably can be safely correlated with the Marion."

*Productus* sp.  
*Nuculana* cf. *obesa*.  
*Pleurophorus* ? sp.  
*Schizodus* ? sp.  
*Straparollus catilloides*.  
*Pleurotomaria humerosa* ?  
*Bulimorpha peracuta*.  
*Murchisonia*, near *marcouiana*.  
*Naticopsis ventricosa* ?  
*Bellerophon* sp.  
*Domatoceras* ? sp.  
*Ostracoda*.  
*Bakewellia parva*.

#### IGNEOUS ROCKS.

##### LAVAS.

On the west side of the Egan Range, just north of Egan Canyon, a series of low hills are composed of basalt. One of these hills has a conical shape practically unmodified, and, from the circumstance of this slight erosion, the age of the lava must be very recent.

Farther south, also on the west side of the range, is a considerable mass of volcanic rock which has filled up the valley between the southern end of the Long Valley Range and the Egan Range north of Ely. This is, in general, a dacite-andesite and has been deeply eroded, indicating greater age for it than for the basalt.

At the southern end of the range, in the separate low ridges which form the connection of this range with the Pahroc Range, there are large areas of quartz-latite which seem to be continuous with similar lavas occurring in the northern end of the Golden Gate Range and on the easterly side of the Grant Range in the same latitude. As in the other cases described, it is plain that these outflows occurred subsequent to the formation of the deep valleys between the limestone ridges, for the volcanic rock either fills up such valleys or has been poured into them without quite filling them up and now forms their floor. Nevertheless, this volcanic rock is also deeply eroded, and therefore its age is not recent. It may be considered as very late Tertiary or early Pleistocene.

<sup>a</sup>Personal communication to the writer.

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At the western end of the range, at Ely a dike of limestone is exposed east in the canyon. The limestone dikes probably continue to form the crest of the range.

Just west of the range, which are apparent farther north. Sp. quartz-monzonites.

The extreme north end of the range present an anticline from the general trend north of Egan Canyon and has the same structure as the anticline to the east. The eastern side of the anticline dip to the west. The growth less to the west. Cherry Creek, and the strata constituting the anticline.

Between the Canyon and the same formation only a few miles to the west occupying Steptoe.

From Egan Canyon of stratified rocks of the beds at Egan mountains north of the general structure of the western limb of the range lying just south of Hamilton. These mountains are folded.

From Ely south of the range, the whole southern end of the range or 15 miles south of Ely begins to split up into northeast, at an angle of the mountains. The fault strike of the strata.



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#### DIKES.

At the western entrance of the canyon which cuts through the range  
at Ely a dike of hornblende-tonalite-porphry was noted. Farther  
east in the canyon occur a number of other siliceous dikes. These  
dikes probably connect with a larger body farther south, which seems  
to form the crest of the range in the vicinity of Howells Peak.

Just west of the town of Cherry Creek occur a number of dikes  
which are apparently connected with a larger igneous body a little  
farther north. Specimens of these dikes show them to be chiefly  
quartz-monzonites.

#### STRUCTURE.

#### FOLDING.

The extreme northern end of the range is said by Mr. Emmons<sup>a</sup> to  
present an anticlinal fold striking northeasterly, and so diverging  
from the general trend of the mountains. Farther south, but still  
north of Egan Canyon, the general structure is plainly synclinal,  
and has the same northeasterly trend. This syncline must succeed  
the anticline to the southeast. In the vicinity of Egan Canyon, on the  
eastern side of the range, the strata on the eastern limb of this syn-  
cline dip to the west at angles of from 30° to 45°, which gradually  
grow less to the west until, at a point about 8 or 10 miles north of  
Cherry Creek, and on the west side of the range, easterly dipping  
strata constituting the other side of the syncline are found.

Between the Cambrian rocks on the eastern side of Egan Canyon  
and the same formations on the west face of the Schell Creek Range,  
only a few miles to the east, there is probably an anticlinal fold  
occupying Steptoe Valley.

From Egan Canyon south the Egan Range may be seen to consist  
of stratified rocks as far as Ely, but the general northeasterly trend  
of the beds at Egan Canyon changes to a northwesterly one in the  
mountains north of Hercules Gate, about 10 miles north of Ely. The  
general structure of the mountains at this point seems to be synclinal,  
the western limb of the fold being exposed in the Devonian limestone  
lying just south of Summit stage station on the road between Ely and  
Hamilton. These limestones dip to the east at an angle of 20°.

From Ely south for a number of miles the strata are not conspicu-  
ously folded, but dip gently in various directions, chiefly to the south.  
The whole southern end of the range, however, from a point about 10  
or 15 miles south of Ely as far as the point where the main range  
begins to split up into several, shows beds which strike uniformly  
northeast, at an angle with the general north-south trend of the  
mountains. The farther south one goes the more easterly becomes  
the strike of the strata, until, in the series of low ridges at the south-

<sup>a</sup> U. S. Geol. Expl. Fortieth Par., Vol. II, p. 486.



ern end of the range, it swings around to east-west and then to south-east, and so runs into the Pahroc Range, where it becomes due north and south.

In this southern part of the range many parallel open folds are exposed. On the west face, about 30 miles north of Adams's ranch, in Sierra Valley, the axis of a broad syncline may be traced, with the rocks on both sides dipping from  $10^{\circ}$  to  $30^{\circ}$ . This is followed to the south by a slight anticline and this by a broad syncline, whose axis cuts the mountains about 10 miles southeast of Adams's ranch, at the pass through which runs the road to Pioche. South of here the succeeding anticlines and synclines are frequent and regular. Since their strike is transverse in general to the trend of the ridges and since different ridges are composed of the same rocks, the folds may be traced from one to the other for long distances. Thus, south of the synclinal fold above described a broad anticline was observed, which comprises the rocks for a distance of about 10 miles to the south and which has in general an east-west trend. South of this a comparatively narrow syncline exists, and south of this again an anticlinal fold, which after swinging from an east-west to a southeasterly direction, appears to change still more, till it enters the Pahroc Range with a north-south trend and constitutes the chief fold of these mountains.

In general, therefore, the Egan Range consists of open and symmetrical anticlines and synclines, with the rocks rarely dipping more than  $30^{\circ}$ . In general these folds trend more easterly than the general trend of the mountains, and thus a number of succeeding folds are exposed.

#### FAULTING.

In the southern part of the range several deep transverse valleys suggest fault lines, but the examination was too hasty to be sure of their existence.

#### ORES.

At Mineral City, just west of Ely, lead, silver, and gold, with some copper, are obtained. At this locality a number of siliceous dikes cut up through the limestone, and seem to be connected with the mineralization. In the neighborhood of Ely there are considerable ore deposits. At Cherry Creek also the dikes have perhaps brought about the deposition of the minerals. Some of the ore deposits here run comparatively high in gold and silver.

#### LONG VALLEY RANGE.

Long Valley Range consists of low limestone mountains. Its southern end, just east of Hamilton, is united with the White Pine Range by a series of connecting north-south parallel ridges. On the north it extends up into the area of the Fortieth Parallel surveys, where it is represented by a series of detached low limestone mountains and finally dies out in the valley.

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ine exists, and south of this again an  
winging from an east-west to a south-  
change still more, till it enters the  
uth trend and constitutes the chief fold

gan Range consists of open and sym-  
es, with the rocks rarely dipping more  
ds trend more easterly than the general  
hus a number of succeeding folds are

#### FAULTING.

range several deep transverse valleys  
amination was too hasty to be sure of

#### ORES.

Ely, lead, silver, and gold, with some  
locality a number of siliceous dikes cut  
seem to be connected with the miner-  
d of Ely there are considerable ore  
the dikes have perhaps brought about  
Some of the ore deposits here run  
silver.

#### VALLEY RANGE.

low limestone mountains. Its south-  
is united with the White Pine Range  
south parallel ridges. On the north  
he Fortieth Parallel surveys, where it  
tached low limestone mountains and

#### TOPOGRAPHY.

The Long Valley Range consists in general of a single main ridge, on both sides of which the ascent from the base is comparatively gentle. The interrupted form of the northern end of the range, resulting in detached clumps of hills, has probably been brought about by erosion, which has cut deep into the ridge and formed valleys which were afterwards filled up with detrital material, on a level with that of the main valleys between the ranges. On the eastern side of the south end of the range a great flood of andesitic lava has filled a former valley to a height equal in general to that of the pre-existing ridges.

This andesite itself has been considerably eroded. The valleys which have been cut in it, being younger than the main valley into which the lava was poured, are instructive as to the manner of the formation of desert valleys in general and their filling up with detrital accumulations. Each of these narrow valleys in the lava, often only a few hundred feet wide, presents in a small way all the characteristics of the larger valleys which separate the ranges. In the middle is a flat sage-brush plain, and on the sides long gentle slopes of wash proceed from the gullies which cut up the adjoining ridges. In these deposits of the smaller valleys, as in those of the larger valley, there is no trace of deposition in the presence of water, but the valleys have filled up evenly and smoothly with dry material, distributed perhaps in part by rivulets and by wind storms.

#### SEDIMENTARY ROCKS.

##### CARBONIFEROUS.

At the south end of the range a section was followed along a portion of the road between Hamilton and Ely. The rock here is a limestone, often cherty or aphanitic. Under the microscope the chert shows cross sections of organic forms. The western edge of the section yielded the following Upper Carboniferous fossils, which were determined by Dr. Girty:

- Marginifera muricata?*
- Productus prattenianus.*
- Productus inflatus?*

Farther east the following Upper Carboniferous fossils were collected from the same limestone at a horizon several hundred feet higher than the above:

- Fenestella? sp.*
- Campophyllum torquium?*
- Productus prattenianus.*
- Fusulina cylindrica.*
- Rhombopora lepidodendroides.*
- Fistulipora? sp.*
- Productus semireticulatus.*

Only about 1,000 feet of strata are exposed in this section, owing to the low dip of the rocks.

On the north end of the range the separated groups of low mountains above mentioned appear to be almost entirely composed of Carboniferous limestone. They are so shown on the maps of the Fortieth Parallel Survey. The writer collected two lots of Upper Carboniferous fossils at the northern end of the limestone mountain which lies just east of Franklin Lake and the northern end of Ruby Lake. This is practically the northern terminus of the Long Valley Range, although in the Fortieth Parallel maps it is given under the head of the Ruby Group of Mountains.

According to Dr. Girty's determination, the first locality yielded *Marginifera splendens*?

The second locality afforded the following:

*Chonetes flemingi.*  
*Productus subhorridus.*  
*Productus multistriatus.*  
*Spirifer cameratus?*  
*Spiriferina pulchra.*  
*Seminula mira.*

South of the lava area which fills the valley between the Long Valley Range and the Egan Range, on the road from Hamilton to Ely, there is a narrow spur of mountains running from the neighborhood of Summit stage station to the Egan Range, south of Ely. This may be considered as an outlying spur of the Egan Range, but yet may extend beneath the lava and so form a connection with the Long Valley Range. From the rocks of this spur at a point just south of Summit station a Devonian coral was obtained. Farther south in the same ridge are Carboniferous fossils, as described under the head of the Egan Range (see p. 51).

#### IGNEOUS ROCKS.

##### LAVAS.

The great mass of lava which flanks the eastern side of the Long Valley Range proper at its lower end has already been mentioned. The extent of this patch of lava to the north is uncertain, but probably is not more than 10 or 15 miles. To the south it passes under the Pleistocene accumulations of Sierra Valley, while to the east and to the west it abuts against the limestones of the Egan and the Long Valley ranges. As noted above, this lava has been considerably eroded. Thin sections of the rock show it to be in general a dacite-andesite, the prevalent type being a dacite containing augite, biotite, and hornblende.

#### STRUCTURE.

##### FOLDING.

A section taken at the southern end of the range shows a monoclinical structure for the main ridge. In reality, however, this is the

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of strata are exposed in this section, owing to the range the separated groups of low mountains appear to be almost entirely composed of Carboniferous. They are so shown on the maps of the region. The writer collected two lots of Upper Carboniferous from the northern end of the limestone mountain Franklin Lake and the northern end of Ruby Lake. The northern terminus of the Long Valley Range is given under the fortieth Parallel maps it is given under the name of Mountains. The writer's determination, the first locality yielded the following:

which fills the valley between the Long Valley Range, on the road from Hamilton to Ely, and the mountains running from the neighborhood of the Egan Range, south of Ely. This may be a spur of the Egan Range, but yet may be a separate range and so form a connection with the Long Valley Range. The rocks of this spur at a point just south of the mouth of the river was obtained. Farther south in the valley the fossils, as described under the head of

#### IGNEOUS ROCKS.

##### LAVAS.

which flanks the eastern side of the Long Valley Range, the lower end has already been mentioned. The lava to the north is uncertain, but probably extends 15 miles. To the south it passes under the mountains of Sierra Valley, while to the east it passes against the limestones of the Egan and the Ruby Mountains. Above, this lava has been considerably scaped. The rock shows it to be in general a dacite, being a dacite containing augite, biotite,

#### STRUCTURE.

##### FOLDING.

The northern end of the range shows a monoclinal ridge. In reality, however, this is the

#### SPURR.]

#### GOLDEN GATE RANGE.

57

east side of an anticline whose axis lies in a narrow valley to the west of the main ridge and whose easterly limb is exposed in the next ridge to the west (see fig. 1, p. 66).

The spur of Devonian-Carboniferous rocks described on page 56 is separated from the main ridge by Pleistocene deposits and by lava, and the structural connection is not shown, but in itself it exhibits a series of somewhat closely compressed regular open folds with north-south strike, changing to a northwest-southeast strike as the spur approaches the Egan Range. In this minor ridge there is exposed, beginning with the most westerly fold, an anticline, a syncline, a second anticline, and a second syncline.

For the main ridge of the Long Valley Range the general strike is seen to be parallel to the general trend of the mountains; that is, a little east of north. At the north end of the range, at the fossil localities, a slight syncline with a general north-south strike was observed in the Carboniferous limestone.

#### GOLDEN GATE RANGE.

The Golden Gate Range scarcely deserves a separate name, on account of its comparative insignificance. This name is applied to a connected series of low mountains which lies to the east of the Grant Range, and properly has a north-south extent of not more than 25 miles, with an average width of 3 or 4 miles. On the south the Golden Gate Range is connected by low hills with the northern extension of the Hiko Range, while on the north the range dies away into the Sierra Valley. Twenty-five miles north of the north end of the range there is a chain of low hills running north and south and lying midway between the White Pine Range and the Egan Range. These hills might perhaps be considered as the northern continuation of the Golden Gate Range, the intervening portion being covered up by the Pleistocene accumulations of Sierra Valley.

#### TOPOGRAPHY.

The mountains which make up the Golden Gate Range are entirely detached from one another, and are separated by narrow stretches of Pleistocene valley deposits, on a general level with the valleys on both sides of the range. The separate groups are sometimes composed of stratified rocks and sometimes of lava. The hills of stratified rock are scaped along the axes of anticlinal folds. They are therefore scaped on both sides when they are synclinal, while when they are anticlinal they have in general smooth sides with a sharp downcutting in the center. The groups which are composed of volcanic rocks have naturally a milder and more uniform topography.

#### SEDIMENTARY ROCKS.

##### SILURIAN.

An isolated butte at the northern end of the Golden Gate Range, not very far from Adams's ranch on White River, exposes a very inter-