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Lower and Middle Ordovician Stratigraphic Sections in the Ibex Area, Millard County, Utah

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ABSTRACT.—In 1965 the Ordovician Pogonip Group, originally subdivided by Hintze in 1951, was remeasured and redescribed in the Ibex area as part of a program undertaken by a group of cooperating paleontologists to document fossil occurrences in this important reference section. All subsequent fossil collections have been keyed to the remeasured sections. Revised formational thicknesses, oldest listed first, are: House Limestone, 500 feet; Fillmore Formation, 1,800 feet; Wahwah Limestone, 250 feet; Juab Limestone, 160 feet; Kanosh Shale, 560 feet; and Lehman Formation, 210 feet; giving a total thickness of 3,480 feet for the Pogonip Group in the Ibex area.

Designation of the Fillmore is changed from Fillmore Limestone to Fillmore Formation to better reflect its larger proportion of shale and calcareous siltstone. Since the Fillmore Formation nowhere exposes its complete thickness in a single measurable stratigraphic section, it is subdivided into six informal members to facilitate lithic correlation between partial sections. These are: (1) basal ledge-forming limestone member, 485 feet, (2) slope-forming shaly siltstone member, 320 feet, (3) light gray ledge-forming member, 194 feet, (4) brown slope-forming member, 324 feet, (5) calcarenite member, 310 feet, and (6) *Calathium* calcisiltite member, 170 feet thick.

The Kanosh Shale has also been subdivided into informal members: (1) lower olive shale and calcarenite member, 105 feet, (2) silty limestone member, 40 feet, (3) upper olive shale and calcarenite member, 140 feet, (4) sandstone and shale member, 135 feet, and (5) calcisiltite member, 140 feet thick.

Fossil collections that were obtained during the 1965-70 reexamination of the Pogonip Group in the Ibex area and that have been, or are in process of being, described establish this section as one of the world's most important Lower Ordovician reference sections in terms of variety of fossils present.

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INTRODUCTION

In the ten years following the establishment of detailed trilobite zones in the Lower Ordovician rocks of Utah by Ross (1951) and Hintze (1952) it became apparent that the Ibex area of western Utah contained, in addition to trilobites, some of the most abundant and diverse faunal assemblages to be found anywhere in the world in rocks of this age. Accordingly, funds were obtained from the National Science Foundation (Grant GB-3154) that enabled restudy of the Ordovician stratigraphic section in the Ibex area. Most of my old sections (Hintze, 1951) were remeasured, and additional sections were documented. The present paper contains the results of the new stratigraphic descriptions which add to, and slightly modify, some of my earlier work. Help was sought to fully document the Lower and Middle Ordovician fossils from this sequence. Conodont samples were sent to David L. Clark and Raymond L. Ethington who were involved in a concurrent study of conodonts throughout the Great Basin. Preliminary zonation of Ordovician conodonts has been published (Ethington and Clark, 1971), and detailed zonations of conodonts across the Cambro-Ordovician boundary have been made (Miller, 1969). Graptolites were collected by Lee F. Braithwaite (1969) from the Pogonip Group at Ibex. In addition to recognizing several graptolite zones, Braithwaite described several ontogenetic sequences from the exceptionally well-preserved specimens from western Utah. Cephalopods from the Ibex area have been collected by Rousseau H. Flower, who has already described some (Flower, 1963) and who has many others currently under study. The following fossil groups from the Ordovician section at Ibex have been documented: brachiopods, Ronald G. Jensen (1967); bryozoa, Robert W. Hinds (1970); crinoids, N. Gary Lane (1970); cystoids, Christopher R. C. Paul (1972); pelecypods, John Pojeta (1971); and trilobites, Eugene J. Demeter (1973), Forrest M. Terrell (1973), and George E. Young (1973). In addition, work is in progress on the following groups: sponges: J. Keith Rigby (1959, 1966) of Brigham Young University assisted by Stephen B. Church, who is studying sponge—algal-patch reef associations; ostracods, Jean Berdan of the U.S. Geological Survey; gastropods, Ellis Yochelsen of the U.S. Geological Survey; starfish, Jon W. Branstrator of the University of California (Davis). Preliminary results of fossil zonations have been reported at national (Hintze et al., 1967) and international (Hintze et al., 1968, 1972) meetings.

I acknowledge the enthusiastic support given the project of documenting the Ordovician of western Utah by all of the above mentioned people. In addition, my sons, Paul and Wayne, served cheerfully as unpaid field assistants

in much of the work. Financial support for three summers was provided by the National Science Foundation under Grant GB-3154, and Demeter, Terrell, and Young were partly supported by the National Science Foundation Undergraduate Research Participation Program. Additional financial support has been provided by Brigham Young University and by the Society of Sigma Xi. Most of the paleontologists listed in the preceding paragraph have contributed their time and the support of their institutions.

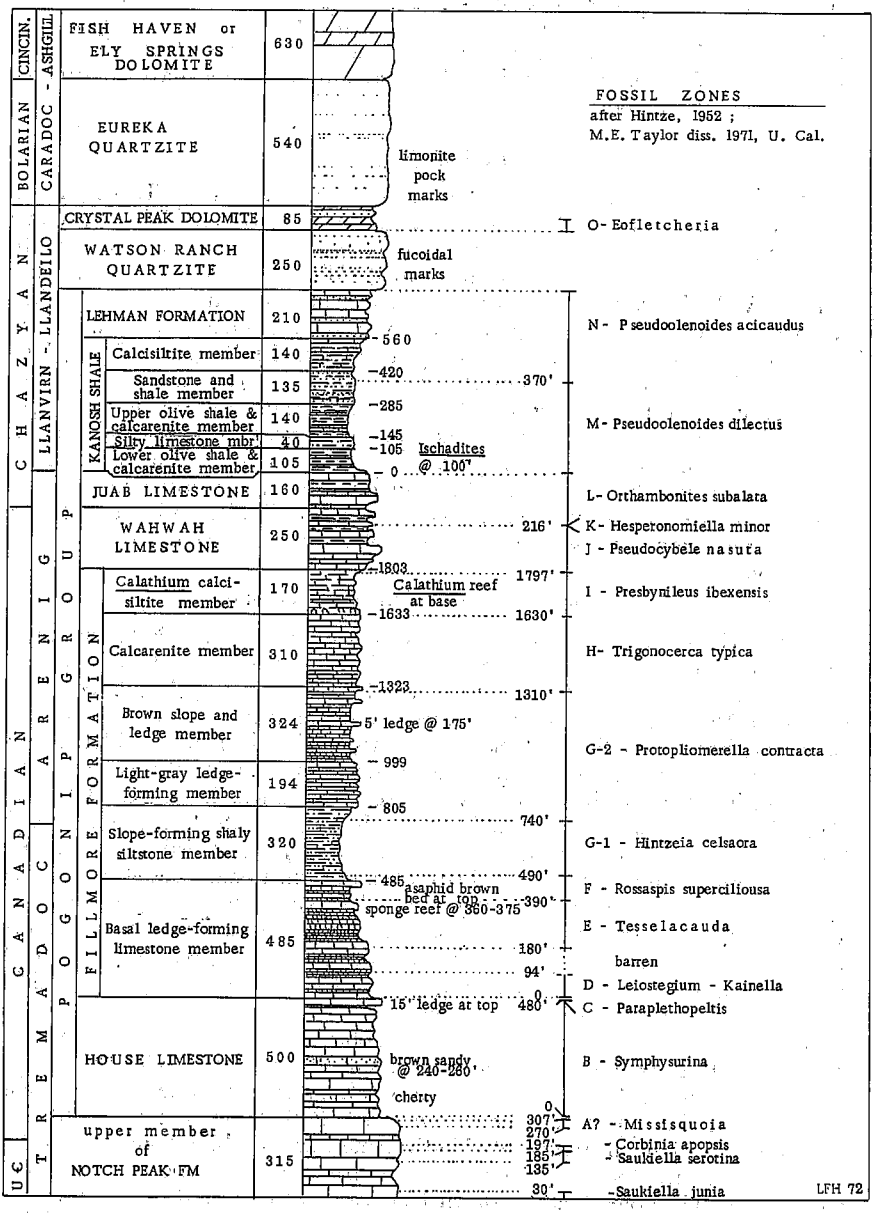
STRATIGRAPHY

Ordovician stratigraphy in the Ibex area is summarized on Text-figure 1. Measured sections upon which this is based are shown on Table 1. Older measurements by Hintze (1951) have in some cases been superseded by the 1965 measurements described in this paper. All sections have been marked with yellow highway paint so as to be identifiable for continued study. Subdivisions of the Pogonip Group were established by Hintze (1951) and have been utilized as map units by scores of students in the Brigham Young University Geology Department Summer Field Course, which mapping has been subsequently compiled by Hintze (1973). The purpose of the present paper is to make available the results of the new measurements and to add to the definitions of certain formations, particularly the Fillmore Formation and the Kanosh Shale, which herein have been subdivided into informal members as shown on Text-figure 1. Summarization of faunal studies beyond that indicated in the introduction, not being the purpose of the present paper, awaits future publication.

Upper member of the Notch Peak Formation

In the House Range between Skull Rock Pass and Notch Peak, the upper 160 feet of the Notch Peak Formation are largely medium to dark gray algal stromatolitic limestone in massive beds that form rounded cliffs. Placement of the House-Notch Peak lithologic contact is no problem in the Notch Peak quadrangle because of the contrast of the massive algal beds of the Notch Peak Formation with the medium gray nonalgal limestone beds of the House Limestone which occur mostly in beds two to four feet thick. In the Crystal Peak, Wahwah Summit, and Barn quadrangles, the upper 300 feet of the Notch Peak Formation are composed of a medium-dark gray calcisiltite, calcarenite and calcilutite, with a few thin beds of intraformational conglomerate; the upper 25 feet are cherty. In this area the Notch Peak Formation does not contrast as sharply with the House Limestone as in the area described above, but the two formations can be differentiated because the Notch Peak Formation is generally darker gray and forms steeper ledges and cliffs than does the overlying House Limestone.

Taylor (1971) has recognized four trilobite zones in the upper member of the Notch Peak Formation, as shown on Text-figure 1. He regards the *Missisquoia* zone as Ordovician, and the *Corbinia apopsis* zone as latest Cambrian. Hence, the upper member of the Notch Peak Formation is regarded as Cambro-Ordovician in terms of North American trilobite zonation. Miller (1969) has zoned the same interval on the basis of first appearance of conodont species. He notes that major first appearances of conodont species occur within each of the *Corbinia apopsis, Missisquoia,* and *Symphysurina* trilobite zones. Conodonts are perhaps the more ubiquitous, and hence more useful, fossils in this section.



TEXT-FIGURE 1.—Ordovician formations in the Ibex area, Millard County, Utah. Footages to the right of the rock column are cumulative from the base of each formation. Footage range of fossil zones is indicated in right third of diagram.

TABLE 1
SUMMARY OF ORDOVICIAN SECTIONS MEASURED IN THE IBEX AREA, UTAH

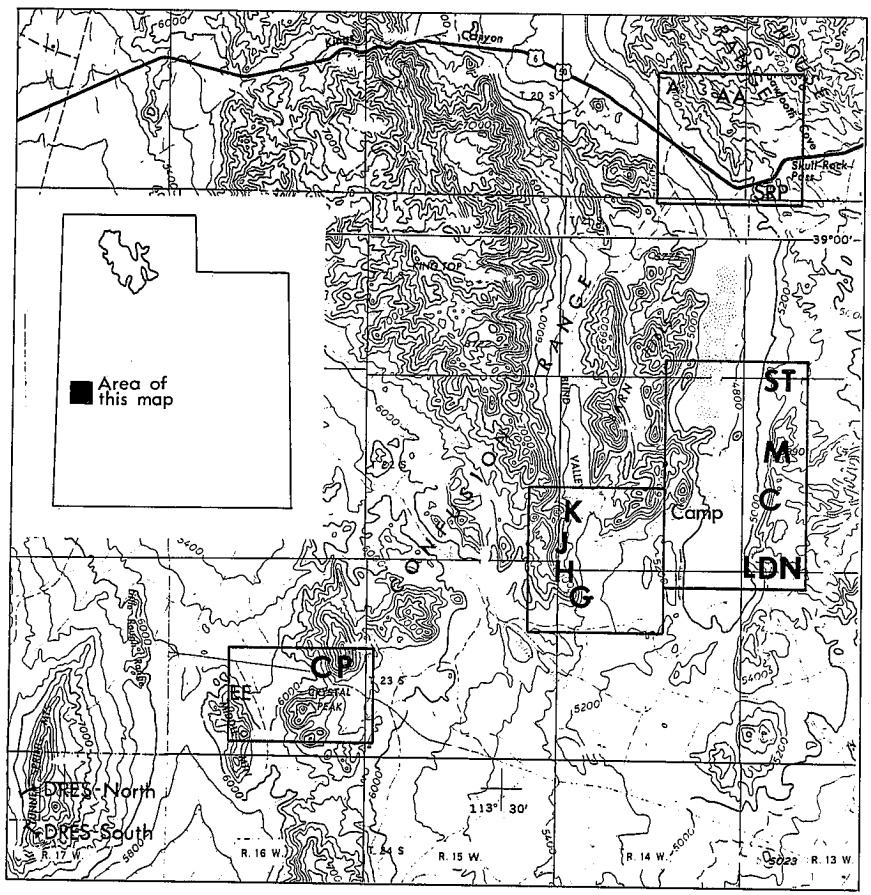
Measured section	HOUSE LIMESTONE	FILLMORE FORMATION	WAHWAH LIMESTONE	JUAB LIMESTONE	KANOSH SHALE	LEHMAN FORMATION	WATSON RANCH QUARTZITE	CRYSTAL PEAK DOLOMITE	EUREKA QUARTZITE
A	**515** 475								
B	343+								
Lava Dam North	**445**								
1951-C		603+							
D		584+							
1965-C		**965+**							
Mesa		**865+**							
Square Top		**420+**							
Skull Rock Pass		**585+**							
E	421+	314+							
G		**962+** 864+							
H		**920+** 730+	227						
J			**255** 192	**157** 139	**615?** 381+				
K-South					**564** 550	**205** 195			
K-North					**494+**	**212**			
L					271+	**220** 196	243+	85	537
Camp					**120+**	**205**			
Crystal Peak					**320** 245+	**168** 169	207	89	560
DRES					**400+** 355+	**215** 180	174	140	419

Bold face indicates sections described in this paper. Other sections are described in Hintze (1951). All measurements in feet. "+" means base or top of unit not exposed.

House Limestone

The House Limestone is a medium gray, quartz silty, sparsely cherty, finely crystalline, nonalgal limestone that occurs in beds mostly between two and four feet thick. It erodes to ledges less massive than the underlying Notch Peak Formation but more resistant than the overlying Fillmore Formation. A brown-weathering quartz sandy zone more than 20 feet thick occurs near the middle of the formation. Silicified *Symphysurina* zone trilobites are common on bedding surfaces, particularly in the upper third. The uppermost 15 feet consist of a massive limestone ledge with a *Syntrophina-Paraplethopeltis* coquina at its base.

Remeasurement of the type section (A of Text-figs. 2, 3) in 1965 gave a total thickness of 515 feet for the interval shown as 475 feet by Hintze (1951, p. 31). The 1965 measurement is believed to be more accurate, but the earlier

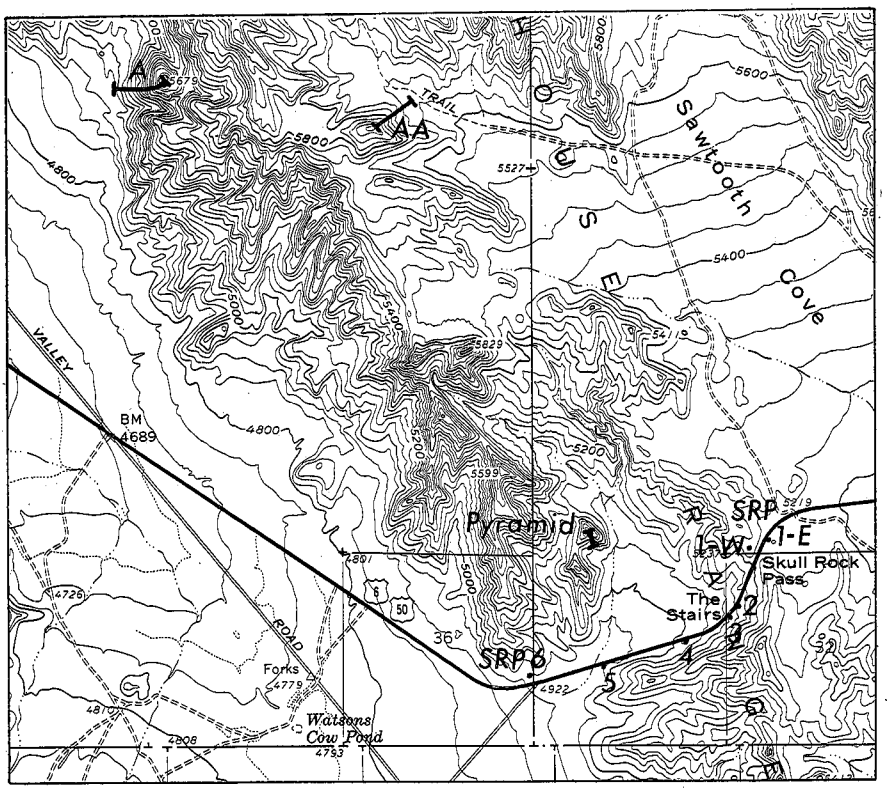


TEXT-FIGURE 2.—Index map showing locations of Ordovician measured sections. Those described in detail in this paper are shown in bold face. Locations are shown in greater detail on Text-figures 3-6, which cover the areas outlined on this map.

rock descriptions are adequate. An additional complete section 500 feet thick, measured at Lava Dam North (Text-fig. 4) is included herein.

Fillmore Formation

This formation was defined (Hintze, 1951, p. 14) to include all beds between the top of the House Limestone and the base of the Wahwah Limestone. Inasmuch as the entire thickness of the formation is exposed in no one section, Ibex sections D, G, and H were designated as the type localities for various portions of the formation. Restudy of the Fillmore interval has made possible some refinements of the original definition. First, it is thought that the term "formation" would be more accurate than "limestone" as a designation for the interval, the lithologies being much more heterogeneous than originally suspected. Road cuts along Highway 50-6 at Skull Rock Pass have revealed substantially more interbedded shale within the section than was noticed before the road cuts were made. The shale slakes readily and in weathered ex-



TEXT-FIGURE 3.—A portion of the Notch Peak 1:62,500 topographic map showing locations of sections measured in the vicinity of Skull Rock Pass. AA is the location of the lowest 400 feet of Fillmore Formation collected by Terrell (1973). Pyramid and Skull Rock Pass (SRP) sections yield graptolites described by Braithwaite (1969).

posures is usually concealed by talus of thin-bedded intraformational conglomerate slabs. Second, subdivision of the section, measured in 1965, into informal members has made more specific designation of type areas possible. Table 2 shows thicknesses of the six members as represented in five measured sections. The 1965 C-section is designated as the principal type section of the Fillmore Formation, and the Mesa section and H section are designated as reference sections for the middle and upper parts of the formation. Type locality for the lower two members of the Fillmore Formation is the 1965 C-section; for the middle two members, the Mesa section is the designated type; and for the upper two members, the H section is the reference type.

Basal ledge-forming limestone member.—This is the most resistant portion of the Fillmore Formation. Even so, it is not as resistant as the House Limestone and is bounded by a change in slope at its base and again at its top where it is overlain by a slope-forming unit. Except for abundant silicified asaphid trilobites in the brown-weathering siliceous beds of the upper 100 feet of this member, it is the least fossiliferous portion of the Fillmore Formation. Terrell (1973) made special efforts to find all possible fossil horizons within the lower 400 feet of this member. Although most of this member is comprised of siliceous clastic limestone, certain beds are mostly organic in origin and structure. Sponge-algal patch reefs occur sporadically in the Pogonip Group between this member and the Juab Limestone. One sponge-algal bed, from 367 to 379 feet above the base of this member in the 1965 C-section, forms a prominent, continuous light gray marker bed in the section. At Skull Rock Pass and in the G section this horizon consists of small separate sponge-algal patch reefs.

Slope-forming shaly siltstone member.—Silty limestones and calcareous siltstones comprise most of this member, with an olive gray fissile shale horizon in the middle; intraformational conglomerate comprises less than 40 percent of

TABLE 2

PORTIONS OF THE FILLMORE FORMATION INCLUDED IN FIVE PARTIAL SECTIONS MEASURED IN THE IBEX AREA, UTAH

FILLMORE FORMATION - INFORMAL MEMBERS	Sections measured in 1965					Maximum or best figure
	C	Mesa	Square Top	G	H	
Calathium calcisiltite member	-	-	158	-	170	170
Calcarenite member	-	50+	260+	-	310	310
Brown slope and ledge member	-	324	-	199+	370?	324
Light-gray ledge-forming member	160+	180	-	194	65+	194
Slope-forming shaly siltstone member	320	312	-	309	-	320
Basal ledge-forming limestone member	485	-	-	261+	-	485
Total thickness (in feet)	965	865	420	963	915	1803

No single section exposes the entire formation. "+" means base or top of member not exposed. Type localities for the various members are underlined.

the member. From a distance this member forms a silvery gray slope, easily distinguished from the ledge-forming units above and below.

Light gray ledge-forming member.—In the Mesa section this member consists of six cycles of thin-bedded calcareous siltstones capped by two- to five-foot ledge-forming calcilutite beds. Thin beds of intraformational conglomerate are interbedded with the calcisiltite cycles. The entire member is somewhat more resistant than the Fillmore members above or below it.

Brown slope and ledge member.—This member is cyclic like the member below it, except that intraformational conglomerate, not siltstone, comprises the bulk of the unit. The most distinctive beds within the member are the widely spaced ledge-forming calcilutite beds, one of which (170-175 feet above the base of the member in the Mesa section) is believed to correlate with a ledge of similar appearance in the G-section, 8 miles to the southwest. Beds distinctive enough to be correlated at this distance apart are rare in the Fillmore Formation.

Calcarenite member.—Silicified hash of disarticulated and broken parts of the trilobite *Trigonocerca* are so conspicuous in this member as to constitute a ready means for its identification. Interbeds of calcarenite and intraformational conglomerate, with minor calcareous siltstone comprise most of the member. Algal patch-reef limestones constitute a minor part of the lithology. All evidence points to high-energy, shallow-water deposition.

Calathium calcisiltite member.—The large tubular spongelike fossil *Calathium* (*"Receptaculites elongatus"* of Hintze, 1951) forms such a conspicuous 10-foot bed at the base of this member that I have used its name to help identify the unit. For the most part, the units consist of thin-bedded, slope-forming calcisiltite. The top of the unit is marked by the basal, more massive ledges of the overlying Wahwah Limestone.

Wahwah Limestone

In contrast to the slope-forming topographic expression of the Fillmore Formation, the Wahwah Limestone forms a series of ledges. It is chiefly a quartz-silty calcisiltite with interbeds of thin-bedded calcarenite and intraformational conglomerate and a few beds of light olive fissile shale. A few small sponge-algal patch reefs are present in the H and J sections. A *Hesperonomiella minor* brachiopod coquina (Hintze zone K) forms an easily identifiable marker horizon 2 feet thick, 215 feet above the base of the formation. Silicified trilobite fragments and other fossils are abundant throughout the formation.

Juab Limestone

Whereas the Wahwah Limestone has a brownish gray weathered aspect, the Juab Limestone is characteristically medium gray. Its fossils are not silicified, and the most prominent ones are orthid brachiopods rather than the ubiquitous trilobite fragments of the Wahwah and upper Fillmore formations. Juab Limestone erodes to ledges and slopes in a manner somewhat similar to that of the Wahwah Limestone but contrasting greatly with that of the easily eroded Kanosh Shale above.

Kanosh Shale

This predominantly olive shale formation is one of the most distinctive formations, lithologically and topographically, of the Pogonip Group. The K-South section (Text-fig. 5) is the only place where a complete unbroken Kanosh Shale sequence is exposed. Here the formation has been subdivided into five informal members. These members are not of regional extent but serve only to highlight the vertical variation of Kanosh Shale lithology.

Lower olive shale and calcarenite member.—This is a dark olive gray shale with interbeds of thin-bedded fossiliferous calcarenite. This member is commonly expressed as a slope. Brachiopods, ostracods, and trilobites are abundant in the limestone but are rare in the shale. Fossils are almost never silicified in this formation.

Silty limestone member.—This unit forms a steeper slope than do the beds above or below. It consists of thin-bedded calcisiltite, calcarenite, and some intraformational conglomerate, with interbeds of calcareous shale.

Upper olive shale and calcarenite member.—This is similar to the lowest member of the Kanosh Shale, except that thin-bedded calcarenite becomes the predominant lithology towards the top of the member.

Sandstone and shale member.—Orange-weathering, fine-grained, calcareous sandstones are the most distinctive beds in this member, although they constitute less than 20 percent of the entire thickness. The sandstone beds range from one to four feet thick and are interbedded with fissile olive shale and fossiliferous thin-bedded calcarenite.

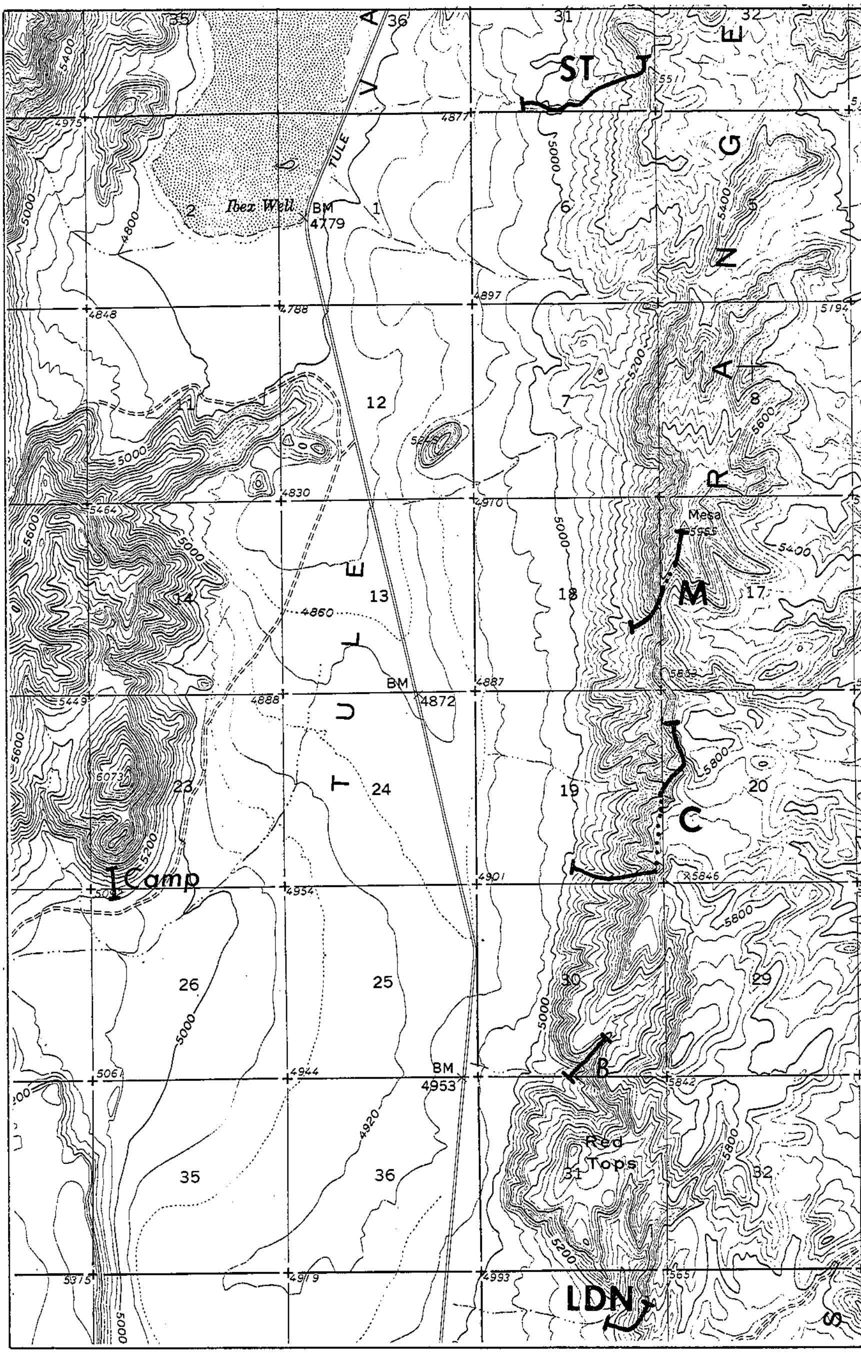
Calcisiltite member.—The upper member of the Kanosh Shale is a silty calcisiltite with nodular bedding. In the K-North section it includes interbedded thin beds of fossiliferous calcarenite in the upper third. The top of this member is placed at the base of a massive quartzite ledge, about 10 feet thick, at the base of the Lehman Formation.

Lehman Formation

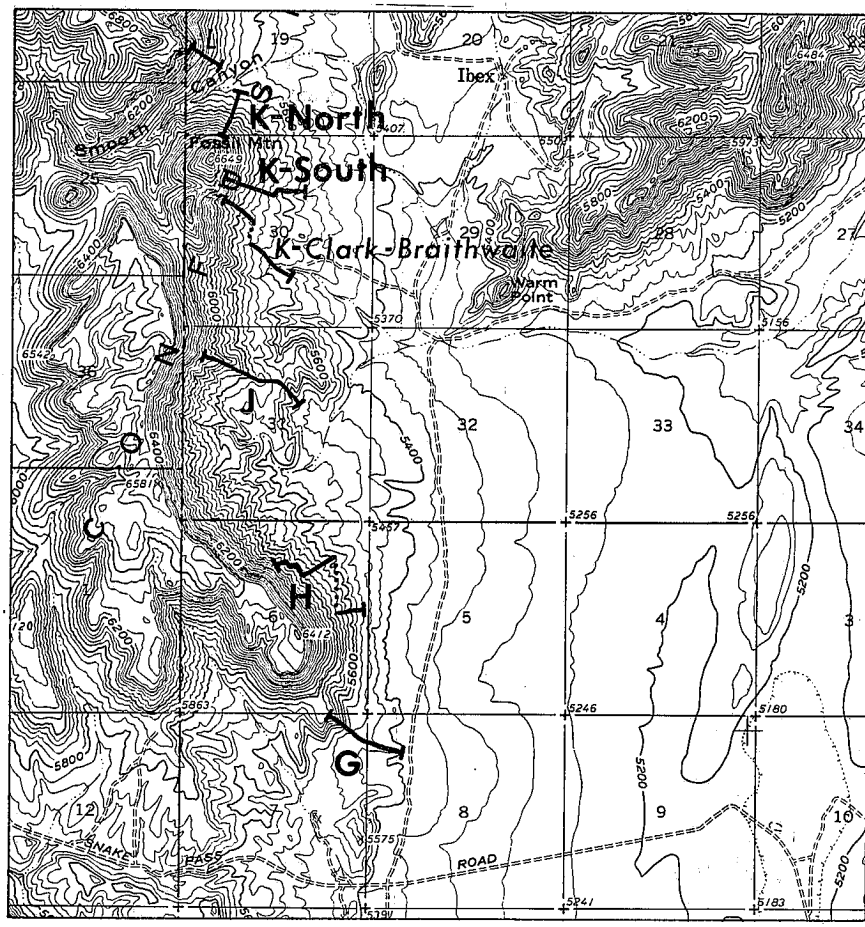
This formation consists of interbeds of calcisiltite, calcilutite, quartzite, dolomitic limestone, and dolomitic sandstone in beds ranging in thickness from a few inches to a few feet thick. Large ostracods are conspicuous on many weathered surfaces. Fossils are not silicified in this formation. The unit commonly forms steep slopes at the base of cliffs of Middle Ordovician quartzite.

Watson Ranch Quartzite

Webb (1956, 1958) established the term "Watson Ranch Tongue of the Swan Peak Quartzite" for the lower of two prominent Middle Ordovician sandstone bodies in the Ibex area. This sandstone is not unequivocally traceable to the type area of the Swan Peak Formation because of the absence of Ordovician sandstones over the Tooele Arch (Webb, 1958, p. 2353). It is therefore recommended that the lower quartzite at Ibex be designated simply as the "Watson Ranch Quartzite." Its type section is the L section (Text-fig. 5) described in detail by Webb (1956, p. 35). The Watson Ranch Quartzite usually weathers to a darker reddish brown than the Eureka Quartzite; it is also less massively bedded and is characterized by fucoidal marks on many bedding surfaces.



TEXT-FIGURE 4.—A portion of The Barn 1:62,500 topographic map showing locations of sections measured along Yersin Ridge between the Lava Dam and Square Top. Abbreviations: ST–Square Top; M–Mesa; C–1965–C; LDN–Lava Dam North.



TEXT-FIGURE 5.—A portion of The Barn 1:62,500 topographic map showing locations of sections measured on the east face of the Heckethorn Hills between Snake Pass road and Smooth Canyon.

Crystal Peak Dolomite

This dolomite weathers light olive gray and occurs in beds not usually more than a foot thick. Occasional thin beds of limestone and quartzite are included in the dolomite sequence. Silicified *Orthambonites perplexus* brachiopods (Jensen, 1967) are found in a thin zone in the lower 6 feet of the formation; *Eofletcheria* corals are found in the upper third of the formation. Topographically this formation usually makes a bench between the more resistant quartzites.

Eureka Quartzite

This formation consists of medium- to fine-grained orthoquartzite and quartz sandstone, vitreous in part, white to light gray, weathering to reddish

brown. Spherical pockmarks, about one-half inch in diameter, are numerous and characteristic of this formation. The upper and lower few feet are gradational dolomitic sandstone. Webb (1956, 1958) discusses this formation in detail.

Ely Springs Dolomite

Budge (1972) has recently completed a regional stratigraphic study of Upper Ordovician dolomites in the eastern Great Basin, and he recommends that these dolomites be included in the Ely Springs Dolomite (a name derived from Pioche, Nevada) rather than in Fish Haven Dolomite (a name applied in northeastern Utah). Budge recognized four members in the Upper Ordovician dolomites of the Ibex area: (1) A lower member, representing beds deposited on the disconformity above the Eureka Quartzite, is characterized by frosted quartz sand grains suspended in a dolomite matrix. This unit is 31 feet thick in the Barn Hills near Ibex. (2) The next overlying member is a dark gray, finely crystalline, generally massive ledge- and cliff-forming unit about 156 feet thick. (3) The next member above is an alternating light and dark gray, thin- to thick-bedded dolomite about 230 feet thick. (4) The uppermost Late Ordovician member is an argillaceous, thin-bedded, laminated dolomite that has been correlated with the Floride Dolomite of the Spor Mountain area of the Thomas Range. In the Barn Hills the upper member is about 130 feet thick. Upper Ordovician dolomites are overlain in western Utah by Silurian dolomites of similar aspect. Budge (1972, p. 70) claims that in some stratigraphic sections in Utah the basal Silurian dolomite contains frosted quartz sand grains or oolites suggestive of a disconformity between the Upper Ordovician and the Silurian. The frosted quartz grains have not been seen in stratigraphic sections in the Ibex area.

MEASURED SECTIONS

Sections measured during the summer of 1965 are described in the following pages. Each section was marked with yellow highway paint at five-foot intervals to ensure accurate location of fossil collections later obtained from the measured sections. Eugene Demeter and my sons, Paul and Wayne Hintze, assisted in the section measurement. All descriptions were made by me.

A Section

This section was remeasured in 1965 but, because the published description (Hintze, 1951) seemed adequate, was not redescribed. Because the Notch Peak quadrangle topographic map did not exist in 1951, it was thought useful to show the location of Section A on Text-figure 3. Section A is the type locality for the House Limestone.

Lava Dam North Section

This section was measured just north of the "Lava Dam" in Section 6, T. 23 S., R. 13 W., as shown on Text-figure 4. The contact of the House and Notch Peak formations is shown here better than in most sections.

Unit No.	Description	Unit Thickness	Cumulative Section Thickness
HOUSE LIMESTONE			
6	Upper massive ledge of House Limestone: calcisiltite, medium gray; some calcarenite, intraformational conglomerate layers; forms ledge. Sheepherder cairn marks top of section.	10	445
5	Calcisiltite; some calcilutite, calcarenite, intra-formational conglomerate; 2 percent chert; medium gray; forms slope and ledge; silicified trilobites common on bedding surfaces. *Syntrophina campbilli* C-zone layer at top.	110	435
4	"Typical" House lithology: calcisiltite; calcilutite; medium gray, weathers medium bluish gray, with 5-10 percent black chert as bedded nodules; forms step ledges; silicified fossils on bedding surfaces; occasionally few intraformational conglomerate beds.	112	325
3	"Brown marker bed": calcisiltite, siliceous to sandstone, calcareous; 10 percent cherty; medium to thick bedded; forms resistant ledge.	38	213
2	Calcisiltite, calcarenite, thin to medium bedded; light gray; weathers light brownish gray; forms ledgy slope; *Symphysurina* in place 65' above base of House Limestone.	135	175
1	Calcisiltite, calcarenite, intraformational conglomerate, interbedded; thin to medium bedded; forms slope; medium gray; weathers brownish gray; siliceous, with 5 percent bedded chert. Conformable contact with Notch Peak Formation.	40	40
NOTCH PEAK FORMATION			
1	Calcisiltite: dark gray, with 10 percent nodular chert, forms cliff. A collection of fossils, including *Eoorthis* and unidentified Upper Cambrian trilobites was obtained from ledges 30 feet above base.	155	155

1965 C-Section

The base of the measured section is located in the south center of Sec. 19, T. 22 S., R. 13 W., as shown on Text-figure 4. The base of the section is prominently marked with "1965" in five-foot-high, yellow painted numbers on the top of the House Limestone ledge. This number can barely be seen from the main grazing service road one-half mile away. The section proceeds almost due eastward up the gully to the top of Member 1, which is capped by brownish-weathering, siliceous, platy limestone with very abundant silicified asaphid trilobites forming a matte.

The 1965 C-Section follows a slightly different course than either the original C-Section, described by Hintze in Utah Survey Bulletin 39, or by "C" sections later collected by Rigby and Clark. The C-Section is located in the area of the best exposures of the basal member of the Fillmore Formation. Members above the basal member were measured and marked with yellow paint in 1965 in the northward offset of the C-Section, which has its base at footage 485 located about at the quarter corner between Section 19 and 20, and proceeds from there northward up the ridge crest to the rock cairn on the hilltop. The 1965 C-Section offset is approximately the same as Hintze's 1951 "D-Section."

Unit No.	Description	Unit Thickness	Cumulative Member Thickness	Cumulative Section Thickness
FILLMORE FORMATION—Light gray ledge-forming member.				
10	Intraformational conglomerate: medium gray; pebbles of calcareous siltstone in matrix of same with few beds with calcarenite matrix; thin to medium bedded; forms ledges capping hilltop. Yellow member "965" is painted on same ledge as "Section D, 575" of Utah Bull. 39. A six-foot rock cairn marks the top of this section.	11	160	965 (=969′ of Hintze, 1951, p. 39)
9	Calcilutite: medium bluish gray; massive, with 5 percent irregular chert stringers; forms ledge.	2	149	954
8	Intraformational conglomerate: medium gray; thin intrabeds of thin beds, brownish gray weathering, calcareous, fine-grained sandstone.	23	147	952
7	Intraformational conglomerate: medium gray; medium bedded, with about 50 percent interbedded calcareous siltstone; forms steep step ledges.	59.5	124	929
6	Calcilutite: medium light gray; ledge forming.	1.5	64.5	869.5
5	Intraformational conglomerate: medium gray; medium bedded; forms step ledges, with about 50 percent interbedded calcareous siltstone, forming slopes.	40	63	868
4	Siltsone: calcareous; light gray; one 4-inch calcarenitic intraformational conglomerate ledge at 824; forms slope.	7	23	828
3	Calcilutite: medium gray; medium bedded; irregular parting; forms ledge.	3	16	821
2	Siltstone: calcareous; light gray; two 6-inch interbeds of intraformational conglomerate; forms slope.	10.5	13	818
1	Intraformational conglomerate: massive, but with irregular partings; forms ledge.	2.5	2.5	807.5
FILLMORE FORMATION—Slope-forming shaly siltstone member.				
5	Silty limestone: same as unit 4, but intraformational conglomerate increases to comprise about 40 percent of unit as medium- to thick-bedded ledges.	98	320	805
4	Silty limestone: light gray; nodular; about 15 percent interbeds of intraformational conglomerate forming ledges less than a foot thick. Unit forms silvery gray slope when not talus covered.	67	222	707
3	Shale: olive gray; fissile; 30 percent interbedded thin beds of calcareous siltstone and intraformational conglomerate; well exposed in gully, but forms slopes on hillside.	52	155	640
2	Siltsone: calcareous; medium to light gray; interbedded intraformational conglomerate comprising 50 percent in lower half and 30 percent in upper half of unit. Intraformational conglomerates form ledges, and calcareous siltstones form talus-covered slopes (*Hintzeia aemula* and *Aulacoparia venta* collected at 588).	92	103	588
1	Siltstone: calcareous; medium gray; weathers yellowish and pinkish gray; thin bedded; platy, fossil-trilobite hash common; forms slope.	11	11	496

FILLMORE FORMATION—Slope-forming shaly siltstone member. (Only lower 30 feet are exposed here; measured section offsets approximately one-half mile and starts again at base of this member.)				
1	Intraformational conglomerate with 50 percent fine sandy calcisiltite with abundant silicified trilobite matte. Forms ledgy slope above steeper ledges below.	30	30	515
FILLMORE FORMATION—Basal ledge-forming limestone member.				
24	Intraformational conglomerate: thin bedded, medium gray; weathers brownish gray; 20 percent intrabeds of thin-bedded calcisiltite and calcarenite. Two one-inch chert beds at 405, and one at 460. Fossiliferous horizon at 485; above, has silicified asaphid trilobites in brownish gray fine sandy limestone. This unit is well exposed as a series of ledges that together form a resistant hill-capping horizon within the Fillmore Limestone.	106	485	485
23	Algal reef: light gray; massive; forms conspicuous rounded ledge; abundant sponges and scarce *Leiostegium formosa.* LFB locality 11217 is 1 foot below sponge reef.	12	379	379
22	Calcisiltite: medium gray; calcareous shale interbeds; two chert beds 1-2 inches thick at 362.	12	367	367
21	Calcisiltite: shaly; yellowish gray; massive algal masses rudely spherical and 3 feet in diameter comprising 10-20 percent of this zone and downbending the shaly bedding beneath them.	6	355	355
20	Calcisiltite: medium gray; quartz silty; thin to medium bedding with 20 percent intraformational conglomerate interbeds; unit capped with one-foot medium gray calcarenite ledge.	21	349	349
19	Calcisiltite and intraformational conglomerate interbedded: thin to thick bedding; forms ledgy outcrops.	31	328	328
18	Calcisiltite: medium gray; weathers to moth-eaten texture; forms ledge.	3	297	297
17	Intraformational conglomerate interbedded with quartz silty calcisiltite: intraformational conglomerate is thin to medium bedded and forms ledges; calcisiltite is thin bedded with thin platy calcareous nodules in a silty-shaly matrix; calcisiltite is not well exposed except in gullies, is masked by intraformational conglomerate on hillsides, and comprises about 50 percent of section from 186 to 240 and about 70 percent above 240. Slope-forming unit.	108	294	294
16	Algal reef: light medium gray; massive; forms ledge; top quite regular, but bottom undulatory; units 15 and 16 together form a ledge; cephalopods common.	3	186	186
15	Calcisiltite: thin bedded, but well cemented; forms ledges, and contains algal-patch reef masses up to a foot high and a few feet in diameter.	13	183	183
14	Calcisiltite: thin bedded; medium to light gray; 20 percent interbeds of intraformational conglomerate, forming thin-bedded ledges. Units 13 and 14 form a slope; unit 14 best exposed as reentrant beneath ledges formed by unit 15.	30	170	170

13	Intraformational conglomerate: thin to medium bedded; medium gray; interbedded with yellowish gray-weathering, thin-bedded calcisiltite; forms slope with about 30 percent exposure. Note: Units 1-12 comprise lower ledgy part of Fillmore Limestone here.	68.5	140	140
12	Calcisiltite: medium gray; thick bedded; 5 percent bedded black chert; forms highest ledge of lower ledgy part of Fillmore.	3.5	71.5	71.5
11	Intraformational conglomerate: medium gray; thin bedded; small calcisiltite pebbles in calcarenite matrix; interbedded thin-bedded calcisiltite; forms covered slope.	8	68	68
10	Interbedded intraformational conglomerate and calcisiltite: medium gray; thin to medium bedded; forms talus slopes. The calcisiltite bears about 5 percent chert, mostly as irregular black stringers about one inch thick.	19	60	60
9	Calcisiltite: medium gray; medium bedded; 5 percent gray chert as irregular bedding masses; forms ledge.	3	41	41
8	Calcisiltite: medium gray; thin bedded; forms slope.	4	38	38
7	Calcisiltite: medium brownish gray; silty; thin to medium bedded; forms prominent ledge.	7	34	34
6	Limestone: thin-bedded interbedded calcarenite, calcisiltite, and intraformational conglomerate; medium and brownish gray; forms slope.	8	27	27
5	Calcarenite: brownish gray; medium bedded; forms ledge.	7	19	19
4	Limestone: silty, thin bedded; reentrant-forming, like Unit 2.	1.5	12	12
3	Intraformational conglomerate: medium dark gray; forms ledge; flat silty limestone pebbles up to 5 inches long and 1/2 inch thick in matrix.	1	10.5	10.5
2	Limestone: thin, wavy bedding; silty; medium light gray; forms reentrant under ledges along stream; talus covered on hillside.	2.5	9.5	9.5
1	Limestone: mostly medium gray; weathers same; flaggy; calcisiltite with 5 percent interbedded calcarenite, medium gray, weathering brownish gray; both calcisiltite and calcarenite somewhat mottled with yellowish brown silty stains; forms step ledges in gully bottom, slopes on hillside. Base of Fillmore Limestone here rests on uppermost massive ledge of House Limestone.	7	7	7

Mesa Section

Base of section in Sec. 18, T. 22 S., R. 13 W., as shown on Text-figure 4. Section proceeds northeastward to near quarter corner between Sections 17 and 18 where the section offsets, at footage 1152 to Sec. 17, and proceeds from there northward to Mesa triangulation station.

Base of section taken at the top of Fillmore Limestone Basal Member (footage 485), which was traced northward from the C-Section. Footages painted in yellow on outcrops.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Member Thickness*	*Cumulative Section Thickness*
FILLMORE FORMATION—Calcarenite member.				
1	Calcisiltite: medium gray; weathering medium to brownish gray; interbeds of intraformational conglomerate in lower third and of calcisiltite in upper part. Forms top of hill with MESA triangulation station at top of section.	49.5	49.5	1350
FILLMORE FORMATION—Brown slope and ledge member.				
11	Calcilutite: medium gray; irregular silty parting; thick-bedded ledge.	3.5	323.5	1300.5
10	Intraformational conglomerate: brownish gray; silty; slope forming.	55	320	1297
9	Calcilutite: medium gray; medium bedded; irregular parting; ledge.	2	265	1242
8	Intraformational conglomerate: brownish gray; silty; about 10 percent interbeds of wavy-bedded siltstone.	55	263	1240
7	Intraformational conglomerate: brownish gray; both pebbles and matrix very siliceous and silty; about 20 percent siltstone, platy, light gray, in 3- to 5-foot beds.	33	208	1185
6	Calcilutite: medium gray; basal third weathers brownish gray, and remainder, medium gray. *Forms the most conspicuous and prominent ledge in this part of section.* Correlates with "Marker ledge 4" of the G-Section. Mesa Section offsets northwest 0.2 miles following this ledge.	5	175	1152
5	Intraformational conglomerate: medium gray; weathers brownish gray; medium bedded; 30 percent interbeds of platy calcareous siltstone; forming step ledges and slopes. "Marker ledge 3" not recognized here.	47	170	1147
4	Calcilutite: siliceous; brownish gray; weathers light brown; conchoidal fracture; massive. "Marker ledge 2."	1.5	123	1100
3	Intraformational conglomerate: medium gray; weathers brownish gray; medium to thick bedded; forming reentrants.	47	121.5	1098.5
2	Calcilutite: medium bluish gray; massive; 5 percent chert nodules. "Marker ledge 1."	1.5	74.5	1051.5
1	Intraformational conglomerate: medium gray; medium bedded; weathers rusty brownish gray; 40 percent interbedded calcareous siltstone; platy; forming slopes.	73	73	1050
FILLMORE FORMATION—Light gray ledge-forming member.				
13	Calcilutite: silty; medium gray; irregular parting. Note: Small fault, 8-foot displacement, crosses here at footage 977-85.	2	180	977
12	Siltstone: medium gray; thin bedded; 30 percent interbedded intraformational conglomerate, thin to medium bedded, forming step ledges. Ripple-marked, fine sandy beds near top; also 2-inch bluish chert layer.	90	178	975
11	Calcilutite: medium gray; silty; thick bedded, with nodular partings.	2	88	885

10	Siltstone: light gray; thin bedded; 20 percent intraformational conglomerate; forms slope.	11	86	883
9	Calcilutite: medium gray; thick bedded; nodular partings; forms ledge.	4	75	872
8	Siltstone: calcareous; medium gray; except for upper one foot, which is a fine sandy siltstone stained pale red.	8	71	868
7	Limestone: mostly calcilutite; thin zones of calcarenite and intraformational conglomerate; forms ledge.	5	63	860
6	Siltstone: calcareous; thin bedded; forms slope.	8	58	855
5	Calcilutite: medium gray; medium bedded; forms ledge.	2	50	847
4	Siltstone: calcareous; thin bedded; 10 percent interbedded intraformational conglomerate.	13	48	845
3	Calcilutite: medium gray; thin bedded; silty; forms ledge.	3	35	832
2	Siltstone: calcareous; 40 percent interbedded intraformational conglomerate; few thin calcarenite interbeds; forms steep step ledges.	29	32	829
1	Calcilutite: medium gray; forms ledge.	3	3	800

FILLMORE FORMATION—Slope-forming shaly siltstone member.

9	Siltstone: shaly, calcareous; thin bedded; 15 percent interbedded intraformational conglomerate; forms step ledges.	23	312	797
8	Shales: olive gray; fissile; few graptolites, lingulid brachiopods, and asaphid trilobite impressions.	13	289	774
7	Siltstone: calcareous; thin bedded; some nodular; others platy; 10 percent interbedded thin beds of intraformational conglomerate ledges. The whole unit forms a regular silvery gray slope. Note: A fault having a displacement of a few feet follows the gully up which the section is marked. Section described from north of fault.	51	276	761
6	Silty limestone: nodular; light gray; 20 percent interbeds of thin bedded intraformational conglomerate. Unit 6 forms slightly steeper slopes than above and below.	38	225	710
5	Shale: greenish gray; fissile; slope forming.	7	187	672
4	Siltstone and intraformational conglomerate interbedded: similar to unit 3, but forming base of steeper slope.	25	180	665
3	Siltstone: shaly; calcareous; medium gray; weathers yellowish gray to rusty buff; interbeds of thin bedded intraformational conglomerate forming ledges. Shaly siltstone exposed only in gullies, masked by intraformational conglomerate talus on most slopes. This unit forms rather poorly exposed slope at base of better-exposed ledgy Fillmore above.	50	155	640
2	Siltstone: calcareous; medium to light gray; interbedded intraformational conglomerate comprising 50 percent in lower half and 30 percent in upper half of unit. Intraformational conglomerate forms ledges and siltstone forms slopes, whole unit forming step ledges.	94	105	590
1	Siltstone: calcareous; medium gray; weathering yel-	11	11	496

lowish gray; thin bedded; platy; few thin beds of coarse cobbled intraformational conglomerate; asaphid trilobite matte common.

FILLMORE FORMATION—The top Member 1 is well exposed here but was not measured. Measurements begin at 485 feet above the base of the Fillmore Formation.

Square Top Section

Base of section in wash southwest of square-topped butte as shown on Text-figure 4. Lower part of section concealed by sandy alluvium.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Section Thickness*
	WAHWAH LIMESTONE—Not measured here, the Basal Wahwah Limestone forms a medium gray, 2-foot-thick calcisiltite ledge, the most prominent ledge in this vicinity, capping the measured section on the small conical hill just south of square top.		
	FILLMORE FORMATION—*Calathium* calcisiltite member.		
3	Interbedded intraformational conglomerate and calcarenite: medium gray; weathers brownish gray; forms ledges; 30 percent interbeds of nodular calcisiltite, light gray, forming reentrants.	100	418
2	Calcisiltite: nodular; light gray; beautifully preserved trilobite parts; 20 percent light olive gray shale interbeds; forms a talus slope.	53	318
1	*Calathium* reef: calcarenite, light gray, friable, forms slope; large asaphid trilobite fragments.	5	265
	FILLMORE FORMATION—Calcarenite member.		
6	Calcarenite: medium gray; weathers brownish gray; forms ledges.	25	260
5	Calcarenite: nodular; silty; forms slope.	31	235
4	Calcarenite: light gray; weathering medium gray; silty interbeds; thin bedded; forms slopes and low ledge.	64	204
3	Calcisiltite: calcarenite, intraformational conglomerate, interformational conglomerate interbedded; thin nodular bedding; 20 percent shale interbeds; medium gray; weathers same to yellowish gray.	80	140
2	Calcarenite and intraformational conglomerate interbedded; silty; calcareous siltstone partings and about 10 percent light olive shale interbeds; forms low ledges along dry creek bed. Medium gray, weathering same to orangish gray.	30	60
1	Intraformational conglomerate: medium to light gray; thin bedded; interbedded calcarenite and calcisiltite and 30 percent light yellowish gray silty shale interbeds. Silicified trilobite fragments very abundant. *Trigonocerca,* harpid trilobite at 10 feet.	30	30

Skull Rock Pass Section

Road cuts along U.S. Highway 50-6 expose interbedded thin-bedded limestones and shales of portions of the lower three members of the Fillmore Formation. Graptolites have been obtained from most of these road cuts by L. F. Braithwaite (1969). The roadcuts are numbered on Text-figure 3 from east

to west. The approximate footage above the base of the Fillmore Formation, and the faunal zones represented in the road cuts, are tabulated below.

Roadcut	Footage above base of Fillmore Formation	Fillmore Member	Trilobite Zone	Graptolites found
6	935–945	Light gray ledge-forming	G–2	Phyllograptus Clonograptus Adelograptus
5	745	Slope-forming shaly siltstone	G–2	Dictyonema Clonograptus Adelograptus
4	585	Slope-forming shaly siltstone	G-1	Dictyonema Adelograptus Clonograptus Desmograptus Cactograptus
3	465	Basal ledge-forming limestone	F	Adelograptus
2	440	Basal ledge-forming limestone	F	Adelograptus
1-west end	410	Basal ledge-forming limestone	?	Adelograptus Dictyonema
1-east end	360	Basal ledge-forming limestone	E	none

All collections belong to Braithwaite's *Adelograptus* zone except roadcut 6, which Braithwaite has assigned to the *Phyllograptus-Clonograptus* zone.

G Section

Remeasurement of the G-Section described in Hintze, 1951. The base of this section is located in Sec. 8, T. 23 S., R. 14 W., in the southern end of the Confusion Range, Utah, as shown on Text-figure 5. The base of the section is at the lowest outcrop of a small bedrock spur just east of a sheepherder truck trail, as shown on The Barn U.S.G.S. quadrangle map. Numbers indicating the cumulative measured section thickness were painted with yellow highway-marking paint on the outcrops in 1965.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Member Thickness* (Utah Geol. Survey Bull. 39 comparable footages in parentheses)	*Cumulative Section Thickness*
FILLMORE FORMATION—Brown slope and ledge member.				
13	Intraformational conglomerate: calcarenitic; forms ledge capping highest exposure of "G" section.	7	199	963 (864)
12	Calcisiltite: medium gray; thin wavy bedding; ledge.	2	192	956
11	Intraformational conglomerate, calcisiltite, and calcarenite interbedded: thin bedded; forms slope.	13	190	954
10	Calcilutite: medium gray; wavy bedding; "Marker ledge 4."	1.5	177	941

9	Intraformational conglomerate, calcisiltite, and calcarenite interbedded: forms slope.	16	175.5	139.4
8	Calcilutite: medium gray; thick bedded; "Marker ledge 3."	3.5	159.5	923.5
7	Intraformational conglomerate: medium gray; weathers brownish gray; calcarenitic; thin to medium bedded; step ledges.	19	156	920
6	Calcilutite: medium gray; massive; "Marker ledge 2."	3	137	901 (814)
5	Intraformational conglomerate: medium gray; calcerenitic; weathers rusty brown on some surfaces; 50 percent interbeds of silicious calcisiltite, thin bedded; few thin beds of fine-grained calcareous quartz sandstone; forms ledges.	53.5	134	898
4	Calcilutite: medium gray; massive; Marker ledge 1."	4.5	80.5	844.5 (766)
3	Intraformational conglomerate: 50 percent interbeds of siliceous, calcareous siltstone and fine sandstone; sandstone carries ripple marks.	22	76	840
2	Calcilutite: medium gray; ledge.	2	54	818
1	Intraformational conglomerate: medium gray; weathers brownish gray; 50 percent interbedded siliceous, calcareous, siltstone; forms step ledges. (812 of 1965 equals 738 feet of Hintze, 1951).	52	52	816
	FILLMORE FORMATION—Light gray ledge-forming member.			
12	Siltstone: calcareous; shaly in part; thin platy bedded; weathers to light yellowish gray; few interbeds of greenish gray shale and about 30 percent interbeds of ledge-forming intraformational conglomerate; forms ledges and slope.	49	194	764
11	Siltstone: calcareous; platy to nodular; medium light gray; 15 percent intraformational conglomerate interbeds; forms slope.	41	145	715 (659)
10	Siltstone: calcareous; 30 percent interbedded ledge-forming intraformational conglomerate.	12	104	674
9	Calcilutite: silty; medium gray; ledge.	2	92	662
8	Calcisiltite: silty; thin nodular bedding; two thin interbeds of intraformational conglomerate; forms slope.	13	90	660
7	Calcilutite: medium gray; thin to thick bedded; wavy partings; forms ledge.	6	77	647 (603)
6	Intraformational conglomerate and calcareous siltstone interbedded; forms slope.	9	71	641
5	Calcilutite: medium gray; thick bedded; wavy partings; ledge.	3	62	632
4	Siltstone: calcareous; light yellowish gray; nodular to platy; 20 percent interbeds of thin intraformational conglomerate beds.	10	59	629 (585)
3	Cilcilutite: medium gray; lower half forms ledge; upper half thin wavy bedding.	2	47	619
2	Siltstone: calcareous; nodular to platy; 40 percent interbeds of intraformational conglomerate, thin to medium bedded, forming ledges.	43	47	617 (574)
1	Calcilutite: medium gray; thick bedded; wavy partings; lower part algal.	4	4	574

FILLMORE FORMATION—Slope-forming shaly siltstone member.				
4	Siltstone: calcareous; light gray; 30 percent interbeds of intraformational conglomerate in lower half and 50 percent intraformational conglomerate in upper half. Unit forms series of intraformational conglomerate ledges and siltstone reentrants.	60	309	570 (524)
3	Mostly talus covered; about 10 percent exposure of thin intraformational conglomerate ledges; most of interval is probably calcareous siltstone. Note: Beds are very well exposed from 510 upwards, best section for this part of Fillmore Limestone.	138	249	410 (473.8)
2	Intraformational conglomerate: medium gray; weathers same with brown siliceous patches; forms low ledges at bottom of hill; 50 percent exposed; concealed portion probably platy calcareous siltstone.	30	111	372
1	Covered; calcisiltite and igneous talus float.	81	81	342 (300)
FILLMORE FORMATION—Basal ledge-forming limestone member.				
5	Intraformational conglomerate: medium gray; weathers brownish gray; interbedded calcisiltite and calcarenite; medium bedded; forming back slope of hill. Asaphid "marker" horizon from 230-250.	44	261	261
4	Intraformational conglomerate: medium gray; weathers brownish gray with much siliceous, almost cherty debris on some bedding surfaces; resistant; forms good exposures along hill top.	55	217	217
3	Intraformational conglomerate: medium gray; thin to medium bedded; weathers brownish gray; forms step ledges to top of first hill; about 6 percent exposed; some intraformational conglomerate and calcisiltite beds; calcareous siltstone beds in float.	63	162	162 (129.4)
2	Algal reef: medium light gray; siliceous debris weathering brownish in patches on surface. *Leiostegium formosa* collected here at 97'.	2	99	99
1	Intraformational conglomerate: medium gray; medium-bedded pebbles to cobble-sized conglomerate in silty to calcarenitic matrix; about 20 percent exposed; talus slopes probably concealing thin-bedded intraformational conglomerate and thin-bedded platy calcareous siltstone.	97	97 (21' of 1965 = 16.2 of Bull. 39)	97

H Section

Remeasurement of the H-section described by Hintze, 1951. The base of this section is located in Sec. 6, T. 23 S., R. 14 W., as shown on Text-figure 5. Rainstorms in 1964 cleaned out the gully and have exposed twenty or more feet beneath "H-zero" of 1951. These new exposures were not included in the remeasurement but are noted in the description of the base of the section. Correlation with measurement section G is corrected from that of Bull. 39 by use of marker ledges in the newly established members of the Fillmore Limestone. Numbers indicating the cumulative measured section thickness were painted with yellow highway-marking paint on the outcrops in 1965.

Beds at the top of H Section cannot be traced directly northward to the continuous Wahwah Limestone ledges because volcanic talus in a 50' gully conceals the Ordovician strata. Basal Wahwah ledge as exposed north of this gully consists of basal 18" calcisiltite ledge, then 18" of shaly parted calcisiltite capped by 4½ feet of ledge-forming silty calcisiltite. The uppermost

Fillmore silty calcisiltite beneath is somewhat similar here but forms less-conspicuous ledges and contains nodular calcareous siltstone beds in its uppermost part.

(Utah Geol. Survey Bull. 39 comparable footages shown in parentheses.)

Unit No.	*Description*	*Unit Thickness*	*Cumulative Member Thickness*	*Cumulative Section Thickness*
FILLMORE FORMATION—*Calathium* calcisiltite member.				
9	Calcisiltite: silty; medium gray; weathers grayish orange; thin nodular bedding; fossiliferous; forms slope; contains thin shaly interbeds, and near top contains siltstone.	49	170	915 (725)
8	Calcisiltite: silty, ledge.	1	121	866 (677.8)
7	Siltstone: calcareous; nodular; weathers light yellowish gray; few interbeds of silty calcisiltite weathering brownish; about 30 percent interbedded thin beds of silty shale; forms slope.	32.5	120	865
6	Calcisiltite: silty; fossiliferous; wavy parting; massive.	4.5	87.5	832.5 (646.8)
5	Shale: greenish gray; 30 percent interbedded, thin bedded nodular gray calcareous siltstone; forms slope.	18	83	828
4	Intraformational conglomerate: thin bedded; silty; calcarenitic; 50 percent interbeds of calcareous siltstone; thin beds of fissile, greenish gray shale.	25	65	810
3	Calcisiltite: quartz; silty; ledge.	3	40	785
2	Siltstone: calcareous; calcisiltite and thin shale interbeds; forms slope.	27	37	782
1	*Calathium* sponge reef from 745-750; silty in patches and calcarenitic along most of exposure; sponge algal-patch reefs 3' in diameter occur intermittently along upper half; ledge forming. Section offsets northward on this unit.	10	10	755 (573)
FILLMORE FORMATION—Calcarenite member.				
7	Intraformational conglomerate: calcarenitic; silty; medium to thick bedded; slope forming.	35	310	745
6	Calcarenite: medium gray; *Calathium* common; abundant trilobite hash; forms ledge.	5	275	710
5	Intraformational conglomerate: calcarenitic; weathers brownish gray; thin bedded; abundant silicified trilobite fragments; 50 percent thin interbeds of nodular calcareous mudstone. No major ledge-forming beds.	155	270	705 (532.6)
4	Intraformational conglomerate: brownish weathering; silicified trilobite fragments common; interbedded with 50 percent platy calcareous siltstone; forms slope at base of spur.	40	115	550 (535 of 1965 = 389.2 of Bull. 39)
3	Algal reef: medium gray; forms knobby outcrops.	2	75	510 (368.6)
2	Siltstone: calcareous; platy; 30 percent interbedded intraformational conglomerate forming ledges.	32	73	508
1	Calcarenite: fossil hash with interbedded intraformational conglomerate and siliceous, almost cherty,	41	41	476

	calcisiltite; weathers brownish gray; forms step ledges.			
FILLMORE FORMATION—Brown slope and ledge member.				
14	Intraformational conglomerate: calcarenitic; medium gray; weathers brownish gray; 20 percent interbedded calcareous mudstone. Silicified trilobite fragmental hash common in intraformational conglomerate; forms step ledges. sponge bryozoan (?) at 438.	85	370 (412 of 1965 = 293.9 of Bull. 39)	435
13	Mudstone: calcareous; medium gray; weathers very light yellowish gray; 40 percent interbeds of intraformational conglomerate-forming ledges; mudstone exposed only in gullies.	83.5	285 (285 of 1965 = 191.6 of Bull. 39)	350
12	Calcarenitic intraformational conglomerate in lower half; silty calcisiltite in upper half; medium gray; "Marker ledge 4."	2.5	201.5	266.5
11	Siltstone: calcareous; platy; 30 percent interbedded intraformational conglomerate ledges; forms covered slope area except in gullies.	14	199	264
10	Calcilutite: medium dark gray, "Marker ledge 3." Note: Measured section H is offset by tracing this bed one quarter mile northward to SW, NE, NE, Sec. 6 for upper part of Fillmore.	3	185	250 (166.6)
9	Siltstone: calcareous to fine sandy; platy; 40 percent interbedded intraformational conglomerate; medium to thick bedded; forming step ledges.	18.5	182	247
8	Calcilutite: medium dark gray; wavy silty partings. "Marker ledge 2."	3.5	163.5	228.5
7	Siltstone: calcareous; platy; some beds fine; ripple marked sand; 30 percent intraformational conglomerate interbeds; medium gray; weathering yellowish to brownish gray.	51	160	225 (148.0)
6	Calcilutite: medium gray; wavy partings. "Marker ledge 1."	3.5	109	175 (109.5)
5	Siltstone and shale: poorly exposed; reentrant.	4	105.5	170.5
4	Calcilutite: medium gray; silty; ledge.	1.5	101.5	166.5
3	Siltstone and intraformational conglomerate interbedded: poorly exposed; 2' ledge of intraformational conglomerate at top.	9	100	165
2	Calcilutite: medium gray; ledge.	2	91	156 (92.0)
1	Siltstone: calcareous; platy to nodular; few shaly interbeds; medium gray; weathers yellowish gray; 30 percent interbeds of intraformational conglomerate; medium gray; silty; forming step ledges. This interval about 70 percent exposed in gully, partially masked by slopewash.	89	89	154
FILLMORE FORMATION—Light gray ledge-forming member.				
2	Calcilutite: medium gray; silty; wavy partings; ledges.	2	65	65
1	Siltstone: calcareous; shaly in part; nodular; medium gray; weathers yellowish gray; 20 percent interbeds of intraformational conglomerate in 3- to 6-inch ledges. H-O at base of Unit 1.	63	63	63 (31)
0	Intraformational conglomerate interbedded with 50 percent thin-bedded shaly calcareous siltstone ex-		approx. 20	(–20)

posed only in gully bottoms below "H-O" marker. Lee F. Braithwaite identified *Adelograptus* from shale interbeds 4 feet below H-O.

J Section

This section was remeasured in the same place described by Hintze, 1951. The location is shown on Text-figure 5.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Section Thickness*
	KANOSH SHALE—A complete section of Kanosh Shale is not present at the top of the J Section because the Eureka Quartzite and Fish Haven Dolomite comprise an overthrust mass that cuts out the upper part of the Kanosh Shale. The measured section terminated at the base of the fissile shale slope some distance beneath the overthrust because exposures of the Kanosh above here were incomplete.		
7	Shale: olive; fissile; forms talus slope.		not measured
6	Calcisiltite: calcarenite; 40 percent interbeds of olive weathering shale. Limestones contain abundant fossil debris: ostracods, brachiopods, some trilobites, cephalopods, cystid fragments. Some intraformational conglomerate pebbles. Limestones weather brownish gray, but from a distance the weathered slope is silvery.	148	330
5	Calcisiltite: thin bedded; nodular; shaly partings and thin interbeds of shale and calcarenite. Forms steeper slope than beds below; looks silvery gray at a distance.	45	182
4	Shale: olive gray like unit 3 but with 50 percent interbedded thin-bedded calcarenite.	20	137
3	Shale: light olive gray; 30 percent interbeds of thin-bedded, nodular, fossiliferous calcarenite containing orthid brachiopods and ostracods chiefly and some trilobites and cystid material. Note: Base of this unit is marked with a painted "O"; top is marked "80." A fault perpendicular to the line of traverse has eliminated units 1 and 2 from the line of section, and one must go right or left of the numbered section and drop down to see units 1 and 2.	80	117
2	Calcarenite: dark gray; weathers brownish gray; fossiliferous.	2	37
1	Shale: olive gray; fissile; forms slope; weathers brownish gray; fossiliferous.	35	35
	JUAB LIMESTONE		
11	Calcisiltite: medium gray; weathers brownish gray; forms one- to two-foot ledge at top of Juab Limestone.	2	157
10	Calcisiltite: light to medium gray; some brownish weathering layers; forms low ledges and slope.	30	155
9	Calcisiltite: light gray; nodular bedding with few intraformational conglomerate beds; forms one-foot ledges and slopes.	21	125
8	Calcisiltite: light gray; silty; forms step ledges.	11	104
7	Shale and thin-bedded calcisiltite. Braithwaite graptolite collecting pits.	5	93
6	Calcisiltite: silty; ledges. Braithwaite graptolite pits above and below this ledge.	2	88
5	Calcisiltite with interbedded shale. Braithwaite graptolite horizon at top.	8	86

4	Calcisiltite: medium gray; forms ledge; orthid brachiopods common.	4	78
3	Calcisiltite: silty; light gray; forms step ledges and slopes, uneven bedding; weathers to nodular talus.	39	74
2	Calcisiltite: medium gray; forms prominent ledge.	9	35
1	Calcisiltite: light gray; forms step ledges.	26	26
WAHWAH LIMESTONE			
23	Calcisiltite: medium dark gray; medium bedded; forms less resistant step ledges above upper Wahwah 230-237 ledge.	21	258
22	Calcisiltite: medium dark gray; forms upper Wahwah ledge.	7	237
21	Calcisiltite: medium dark gray; thin to medium bedded; forms step ledges.	13	230
20	*Hesperonomiella minor* coquina ledge.	2	217
19	Shale: light olive gray; 60 percent interbeds of thin bedded calcisiltite, calcarenite, intraformational conglomerate; silty; forms ledge.	32	215
18	Silty calcisiltite: thin to medium bedded; olive shale interbedded; forms step ledge.	8	183
17	Calcisiltite: medium gray; weathers brownish gray; forms ledge.	5	175
16	Interbedded calcisiltite, calcarenite, and shale; medium gray; forms step ledge; thin to medium bedded. Sponge-algal patch reefs in upper 10 feet.	25	170
15	Calcisiltite: silty; medium gray; forms ledge. Braithwaite graptolite pit at base of 143 ledge and near old footage 108 but on other side of fault from old number.	2	145
14	Interbedded silty calcisiltite, calcarenite, shale: forms slope.	7	143
13	Calcisiltite: silty; muddy; medium gray; forms ledge.	11	136
12	Interbedded silty calcisiltite, calcarenite, and shale: forms low ledges; medium gray; weathers brownish gray.	30	125
11	Sponge-algal reef mass: light gray calcisiltite; variable thickness along strike; forms ledge.	3	95
10	Interbedded shale, thin-bedded calcarenite, and calcisiltite; forms ledge.	31	92
9	Calcisiltite ledge.	1	61
8	Covered, thin-bedded limestone and shale.	6	60
7	Calcisiltite; medium gray; weathers brownish gray; calcarenite layers; forms prominent ledge.	5	54
6	Interbedded shale, thin-bedded calcarenite, and calcisiltite: forms slope.	14	49
5	Calcarenite and calcisiltite: medium gray; medium bedded; silty; abundant fossil debris; forms step ledges.	10	35
4	Shale: light olive gray; thin interbeds of nodular calcisiltite and calcarenite. Braithwaite graptolite pits at 20 feet.	13	25
3	Calcisiltite: medium gray; ledge; sponges common in silty reefoid limestone. Lowest ledge.	2	12
2	Intraformational conglomerate: silty and shaly; calcarenite and calcisiltite matrix; medium bedded; forms low ledges at base of unit 3.	4	10

1	Shale: light olive gray; 30 percent thin interbeds of nodular shaly calcarenite; fossil trilobite hash abundant; forms slope.	6	6

K-South Section

This section is located on the southeast flank of Fossil Mountain as shown on Text-figure 5. A complete thickness of Kanosh Shale is exposed here. Base of section is at top of Juab Limestone, here marked by a 2-foot orangish gray-weathering calcisiltite ledge.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Section Thickness*
LEHMAN FORMATION			
7	Dolomitic limestone: weathers olive brown; mostly concealed by talus from quartzite cliffs above. Overlying quartz apparently conformable on Lehman.	15	205
6	Sandstone: light brownish gray; fine to medium grained; small-scale cross-bedding; forms ledge.	21	190
5	Dolomitic limestone: weathers olive brown; medium bedded; forms ledges.	16	169
4	Calcisiltite: dark bluish gray; weathers light bluish gray; silty; talus-covered slope.	37	153
3	Quartzite: light brownish gray; medium bedded.	2	116
2	Calcisiltite: dark bluish gray; weathers medium bluish gray; silty; thin bedded; some calcarenite; ostracods and gastropods common to abundant; some trilobites, bivalves, and brachiopods; few other fossils.	103	114
1	Sandstone: calcareous at base; quartzitic toward top; light brownish gray; weathers orangish gray; cross-bedding a few inches high is common; forms conspicuous ledge; one foot calcareous interval two feet below top. Basal ledge conformable, almost gradational into underlying Kanosh, silty calcisiltite.	11	11
KANOSH SHALE—Calcisiltite member.			
1	Calcisiltite: silty to fine sandy; thin bedded; nodular; light gray; weathers light brownish gray; 5 percent fissile shale; forms steep slope.	141	564
KANOSH SHALE—Sandstone and shale member.			
5	Sandstone: calcareous; medium gray; weathers orangish gray; medium bedded; 20 percent shale interbeds; forms series of ledges, orange from distance.	14	423
4	Shale: olive gray; fissile; 40 percent interbeds of calcarenite; coquinoid; silty to fine sandy; rubbly talus slopes.	54	409
3	Sandstone: fine grained; calcareous; medium gray; weathers orange gray; one foot of shale four feet above base; few orthid brachiopods in sandstone; forms ledge.	8	355
2	Shale: olive gray; fissile; 30 percent interbedded calcarenite; dark gray; weathering orangish gray; slope forming; *Illaenus* at 315 feet.	54	347
1	Sandstone: calcareous; light gray; weathering orangish gray; fine grained; forms ledge; parted in middle with 8-inch layer of olive fissile shale. Brachiopods present in sandstone.	7	293

KANOSH SHALE—Upper olive shale and calcarenite member.			
3	Calcarenite as below, but with 40 percent shale interbeds.	51	286
2	Calcarenite: silty; dark gray; weathering dark brownish gray; orthid brachiopod coquinas in many layers; forms steep slope; good outcrops; 20 percent olive shale interbeds.	15	235
1	Shale: olive gray; 20 percent interbeds of calcisiltite, dark gray weathering, dark brownish gray; slope has brownish color. Large endoceroids and receptaculitids at 150' in float.	75	220
KANOSH SHALE—Silty limestone member.			
1	Limestone: muddy; silty; medium gray; thin-bedded calcisiltite and calcarenite; some intraformational conglomerate with 30 percent interbeds of calcareous shale; forms steep slope covered with thin platy limestone talus. Slope has a light gray color from distance. Ostracods abundant in limestone beds. Section offsets southward at 105.	40	145
KANOSH SHALE—Lower olive shale and calcarenite member.			
4	Shale: dark olive gray; 50 percent interbeds of calcarenite, calcisiltite, and intraformational conglomerate; thin bedded; silty; dark gray; weathering dark brownish gray; forms talus-covered slopes slightly steeper than beds below.	20	105
3	Shale: olive gray; 30 percent interbeds of calcarenite and calcisiltite; silty; thin bedded; dark gray; weathers dark brownish gray; forms small chips of talus covering shale slope. Brachiopods, ostracods, and trilobites common in limestone.	61	85
2	Calcisiltite: silty; dark gray; weathers brownish gray; brachiopod fragments common; forms ledge.	1	24
1	Shale: olive gray; fissile; forms slope.	23	23

K-North Section

Located on the north flank of Fossil Mountain as shown on Text-figure 5. Base of section in wash along south side of Smooth Canyon drainage 50 feet west of largest (10-foot diameter) Ordovician quartzite boulder just above level of wash. Measured section thicknesses were painted on outcrops in 1965. Base of section starts within lower part of Kanosh Shale, about 70 feet above its contact with the Juab Limestone.

Unit No.	*Description*	*Unit Thickness*	*Cumulative Section Thickness*
WATSON RANCH QUARTZITE—Forms cliffs, not measured.			
LEHMAN FORMATION			
14	Sandstone: dolomitic; medium bedded; forms slope.	15	212
13	Quartzite: light yellowish gray; weathers orangish gray; ledge.	9	197
12	Dolomite: sandy; weathers brownish gray; slope.	4	188
11	Quartzite: medium grained; yellowish gray; worm tubes and cross laminations. These quartzites in the upper part of the Lehman Formation indicate its gradational contact with the quartzite formation above.	10	184

	Thin carbonate interbeds continue upwards; but upwards from here, the Lehman is mostly quartzite.		
10	Dolomitic limestone: dark gray; weathers light yellowish brown; sandy; thick bedded; ledges.	15	174
9	Calcisiltite: medium gray; weathers medium bluish gray; silty; lower half concealed by talus; upper half forms low ledges below overlying cliffs.	38	159
8	Quartzite: medium grained; yellowish gray; wavy bedding; forms ledge.	3	121
7	Siltstone: calcareous; thin bedded; fossiliferous; shaly; slope forming.	17	118
6	Quartzite: fine grained; yellowish gray; thin bedded; forms ledge.	2	101
5	Calcisiltite: silty; medium gray; weathers grayish orange; nodular; rubbly; fossiliferous; forms slope.	34	99
4	Calcilutite: medium gray; weathers light bluish gray with yellowish gray silt partings; thin to thick bedded; fossils, mostly ostracods, show in bedding surfaces commonly; forms ledges.	25	65
3	Limestone: interbedded with calcisiltite, calcarenite, and calcilutite; thin to medium bedded; silty; forms slope; weathers light bluish gray.	28	40
2	Calcisiltite: dark medium gray; interbedded siliceous debris; ledge.	4	12
1	Quartzite: yellowish gray; weathers grayish orange; cross-bedding 3 to 6 inches high; forms most conspicuous ledge.	8	8

KANOSH SHALE—Top of Kanosh here is placed at base of massive quartzite ledge at base of the Lehman Formation.

16	Calcarenite: medium gray; abundant orthid brachiopods and ostracods; 50 percent interbedded silty, nodular, calcisiltite; forms step ledges.	59	494
15	Limestone: silty; thin bedded; nodular; 20 percent shale interbeds and 20 percent platy siltstone; forms slope weathering yellowish gray. Note: Kanosh Shale has brownish color below unit 15 and grayish color above.	70	435
14	Shale: olive gray; 50 percent thin-bedded calcareous siltstone interbedded; forms slope.	16	365
13	Siltstone: calcareous; weathers orangish gray; ledge.	3	349
12	Shale: olive gray; fissile; slope.	4	346
11	Fine-grained sandstone: calcareous; weathers orangish gray; fucoidal markings; ledge.	3	342
10	Shale: olive gray; fissile; 20 percent interbeds of thin-bedded nodular calcarenite and platy calcisiltite; weathering orangish gray.	56	339
9	Siltstone: calcareous; orangish gray; thin bedded; ledge.	3	283
8	Shale: olive gray; fissile.	3	280
7	Siltstone: calcareous; weathers orangish gray; several olive shale breaks in lower half; thick bedded; ledge.	4	277
6	Shale: olive gray; weathering brownish gray; fissile; 20 percent interbeds of fossiliferous silty limestone with abundant brachiopod, ostracod, and echinoderm hash; forms brownish slope.	58	273

5	Shale: same as unit 4, but interbedded with 40 percent shaly limestone orthid brachiopod coquina.	20	215
4	Shale: olive gray; weathering brownish gray; fissile; 15 percent interbedded platy calcareous siltstone and calcarenite, weathering dark yellowish brown; forms slope.	85	195
3	Shale: olive gray; fissile; 30 percent interbeds of silty, thin-bedded fossiliferous calcarenite which weathers dark yellowish brown; 3-foot resistant zone at top contains 50 percent calcarenite beds.	20	110
2	Calcarenite: shaly and silty; fossiliferous; thin wavy bedding; weathers dark yellowish brown; 20 percent interbeds of fissile olive gray shale.	15	90
1	Shale: olive gray; fissile; 30 percent interbeds of very fossiliferous shaly limestone which weathers dark yellowish brown to grayish orange. Limestone is thin and unevenly bedded and forms rubbly talus. The unit is poorly exposed.	75	75

L Section

This section was remeasured in 1965 but was not redescribed because the original description (Hintze, 1951) seemed adequate. Location of the section is shown on Text-figure 5. The thickness of the Lehman Formation obtained here in 1965, as shown in Table 1, exceeds the original measurement by 24 feet but may have included some of the Watson Ranch Quartzite since the contact is somewhat gradational.

Camp Section

This section was measured and collected by Hinds (1970). Its location is shown on Text-figure 4. This is the most easily accessible of any complete section of the Lehman Formation in the Ibex area.

Crystal Peak Section

Location of this remeasured section is shown on Text-figure 6. Only the Kanosh and Lehman formations were remeasured; the description of the overlying quartzites and Crystal Peak Dolomite may be found in Webb (1956).

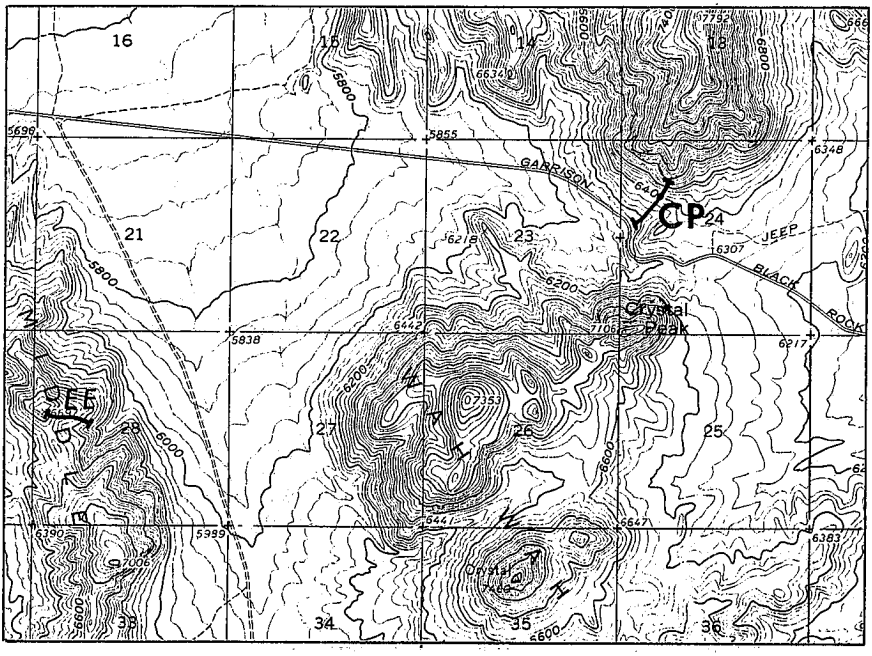
Unit No.	*Description*	*Unit Thickness*	*Cumulative Section Thickness*
	WATSON RANCH QUARTZITE—Not remeasured. At this locality this formation includes several limestone interbeds resembling those in the Lehman Formation and bearing ostracods and trilobites of Lehman aspect. The Lehman-Watson Ranch contact is thus somewhat arbitrary here, reflecting the regional diminution of lower Middle Ordovician sand tongues towards the west. Both in 1951 and 1965, the Lehman-Watson Ranch contact was placed at the base of a prominent brown-weathering quartzite ledge.		
	LEHMAN FORMATION		
3	Calcisiltite: silty; dark gray; weathers medium bluish gray; typical Lehman lithology; mottled silty partings; forms ledges.	52.5	167.5
2	Calcisiltite: dark gray; weathers dark gray to medium bluish gray; thin bedded; talus slope.	45	115
1	Calcisiltite: silty; blue gray with yellowish gray mottled partings; forms ledges; gastropods and ostra-	70	70

	cods abundant on weathered surfaces; trilobites and brachiopods less so; clams abundant in a few thin layers. "Base Lehman Fm" painted on basal ledges here.		

Note: The measured section offsets here to east 50 yards across a minor fault. There is some difference of topographic expression (cliffs vs. slope for base of Lehman) but the section is believed to be essentially continuous.

KANOSH SHALE

12	Calcisiltite: silty; shaly; yellowish gray, with 30 percent yellowish gray shaly interbeds. *Modiolopsis,* cephalopods, and brachiopods common (old "50" = 320).	25	320
11	Shale: light yellowish gray; 50 percent fossiliferous calcarenite interbeds; nodular rubble; *Cybelopsis; Leperditia; Lytoceras.*	70	295
10	Sandstone: very fine grained; calcareous; weathers orangish gray; 40 percent shale interbeds; forms steep slope. All beds below 225 have brown color; above, grayish.	35	225
9	Shale: olive; 20 percent interbeds of silty calcarenite and thin-bedded calcareous sandstone; forms slope.	46	190
8	Sandstone: like unit 6.	1	144
7	Shale: dark olive gray; forms slope.	7	143



TEXT-FIGURE 6.—A portion of the Crystal Peak 1:62,500 topographic map showing locations of sections measured in the vicinity of Crystal Peak. EE shows location of lowest 425 feet of Fillmore Formation collected by Terrell (1973); CP indicates Crystal Peak section described herein.

6	Sandstone: very fine grained; calcareous; forms ledge; orangish gray weathering.	1	136
5	Shale: dark olive gray; forms slope.	5	135
4	Sandstone: very fine grained; calcareous; brownish gray; weathers reddish brown; forms ledge (old painted "20" on ledge).	2	130
3	Shale: dark olive gray; fissile; 20 percent interbeds of calcarenite; slope forming.	23	128
2	Calcarenite: thin to medium bedded; very fossiliferous; mostly orthid brachiopods and ostracods; 40 percent olive shale interbeds; forms steep slope and low ledges.	36	105
1	Shale: olive; fissile; 10 percent interbeds of *Orthambonites Anomalorthis* coquina in a silty calcarenite; forms slope.	69	69

Note: All Kanosh beds in this section weather to a brown color up to footage 225. Above this the general color is gray.

Desert Range Experiment Station Sections

Measurements from this area, shown on Table 1, are from two localities about a mile apart, as shown on Text-figure 2. Hintze (1951) and Webb (1956) described the section plotted as DRES-North. Hinds (1970) collected from the section shown as DRES-South. The southern section was measured, but it was not described because it is neither as complete nor as well exposed as the section to the north.

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