Linn County

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THE SNOW PEAK GLACIER

Viewed from the Willamette Valley, Snow Peak appears to exhibit a different weathering pattern than the surrounding mountains. The most noticeable difference is the serrated appearance of its summit. For the most part, detailed geologic studies have stopped short of explaining the difference and the studies themselves have not penetrated beyond the western slopes of Snow Peak, thus leaving a gap in the geology of the Western Cascades.

In a humid region such as the Pacific Northwest, one would assume that weathering of like materials would proceed at a homogeneous rate. When it does not, other factors must be considered to explain the reason why. It is therefore hypothesized that Snow Peak has undergone extensive glaciation which explains its appearance.

This paper is a combination of research and proposed methodology to support the glaciation hypothesis. It is proposed that a final paper will emerge from this research that will be a detailed study of the Snow Peak Glacier. That final paper will then be submitted as a partial fulfillment of the requirements for the degree of Master of Science.

MATERIALS SECURED FOR RESEARCH

Before entering the field it is important that the proper maps are secured. For this study five (5) maps are available: The U.S. Geological Survey 15 minute series of the Snow Peak Quadrangle in three scales: 1:62,500, 1:50,000, and 1:37,500, a geology map at a scale of 1:62,500 developed for Bulletin 84 Environmental Geology of Western Linn County, Oregon by J.D. Beauliew, and a road map prepared by the Linn Fire Patrol Association showing logging roads. Air Photos are also available, however, good stereo coverage has not been secured at this time.

Map and Air Photo Interpretation

By using the maps it was possible to identify those areas most likely effected by glaciation. The type of features most easily identifiable on the U.S.G.S. maps were semicircular in nature. Six (6) such features are present on Snow Peak (FIGURE 1.0) All six lie above the 3,000' contour level and seem to be clustered on the east half of the mountain. The open side of four (4) of the semicircular features is toward the north and northeast. The remaining two (2) open toward the northwest and southeast respectively.

The geology map was too general to be of major assistance and was incomplete in the area where the semicircular features are present. Probably the most beneficial aspect of the geology map was the indentification of Quaternary gravels. These gravels will be discussed in detail in the Literature Review section

Air Photo coverage, especially at a scale of 1:62,500, is most helpful in distinguishing the semicircular features. Other features which may be present do not appear even at this scale. Stereo coverage at a scale of 1:62,500 may show such features as moraines, however it is not known that coverage like this exists.

FIELD OBSERVATIONS

Observations made in the field can be divided into two(2) types: A) close observation- one where observations are made while traversing as much of a site as possible, B) distant observation- one where observations are made without traversing the site, usually from a vantage point above the site.

Close observations were made at four (4) semicircular features and two (2) non-semicircular features. Distant observations were made at two (2) semicircular features.

Semicircular Feature-I

Semicircular Feature-I (SCF-I) (Figure 1.1) is probably the most dramatic of all features on Snow Peak. Situated in the center of Snow Peak, SCF-I can best be described as a canyon within a mountain. The head of the canyon is located at the juxtaposition with the summit of Snow Peak. Vertical relief from the summit (4,298') to the first level of the canyon floor (3,200') is approximately 1,098'. The second level of the canyon floor lies at an elevation of 3,060. From here the canyon slopes away to the northwest at a low angle. A waterfall at an elevation of approximately 2,800' ends the low angle floor of the canyon.

From the head of the canyon to the waterfall is a distance of approximately one and a half miles. A cross profile at the widest spot covers a distance of approximately one half to eight tenths of a mile. The canyon has a cross profile resembling a steepsided U (Figure ~~III~~ 1.1). The floor of the canyon is poorly drained and is occupied by a marsh with several areas of open water.

On the western canyon side is a relatively small semicircular depression. The depression has a shallow slope on its floor and opens towards the northeast. Quantities of small angular, subangular and rounded rocks are found within the canyon, however, no clear till deposits were observed. In the vicinity of the waterfall several large (2-3' diameter) well rounded boulders were observed. These boulders are situated on the east canyon wall and are visible in a road cut. Whether these boulders constitute a morainal deposit is questionable as the area has visible rock falls and has been well worked during the construction of logging roads.

Downstream of the waterfall, the canyon assumes a V shaped cross profile. Both sides of the canyon exhibit what appears to be stone stripes. On closer examination it was observed that the stripes were rather broad and consisted of angular rock fragments 2-3' across. The source of these rocks is not clearly visible, however they may be weathering out of the canyon side rather than falling in place from higher elevations. It is also possible that the rock fragments are remnants of a lateral moraine which moved down the canyon side after the glacier subsided.

Summary and Conclusions of SCF-I

The cross profile of the canyon upstream of the waterfall exhibits a classic glaciated form (U-shaped). Existance of a flat canyon floor occupied by a poorly drained marsh also points to glaciation. Absence of till or morainal deposits can not discredit the glacial hypothesis as material of this nature could easily be washed away over time in such a confined drainage basin. This canyon would appear to have been formed by glacial activity and for all intent and purpose was occupied by a valley glacier which may have extended downstream beyond the waterfall.

Semicircular Feature-II

Semicircular Feature-II(SCF-II) (Figure ~~II~~ I.2) is located on the northeast slope on Snow Peak. The open end of the semicircle is toward the northeast. The floor is occupied by a lake (tarn) at an elevation of 3,000' identified on maps an Indian Prairie Lake. This lake has a depth of 20-50' and is deeper on the west side than the east as related by fishermen who have fished the lake for many years. A logging road now crosses the eastern shore of the lake which drains through a culvert under the road. Before the road was built the lake drained naturally, carving its way through two(2) ridges which lie to the east. The ridges are curved and slope in towards the stream which drains the lake. The top ot the ridge closest to the lake lies over 50' above the present lake level. The second ridge is removed from the first by a distance of 30-60' depending on which side of the creek one is on, the south side being farther removed. The ridges are composed of subangular to well rounded boulders ranging in size from a few inches to 3' in diameter. The boulders are arranged in a light brown to dark brown matrix of fine soil and appear to be stratified to some degree. Though all boulders show signs of weathering, mostly exfoliation, the boulders in the second ridge seem to be in an advanced stage of weathering. The ridges seem to be wrapped half way around Indian Prairie Lake. On the western shore of the lake a vertical headwall rises approximately 200' above the surface of the lake.

Summary and Conclusion of SCF-II

Indian Prairie Lake is without a doubt the result of a cirque glacier. Evidence to support this statement is manifested in the two ridges which border the lake to the northeast. Because two ridges are present and the fact that one ridge is weathered to a greater degree than the other, the indication would be that two separate glacial stages deposited them. If the ridges which are morainal were of a single glacial stage than both would show the same degree of weathering. Other factors which support the glacial hypothesis are the presence of a headwall and the aspect of the features. The tarn is also a supporting feature.

Semicircular Feature-III

Semicircular Feature-III (SCF-III) (Figure 13) is identified on the U.S.G.S. map as Indian Prairie. This feature is probably the most complex of all features on Snow Peak. Situated on the east slope of Snow Peak, Indian prairie is a large semicircular depression approximately one third to one half mile in diameter. The floor of Indian Prairie is relatively flat and marshy, draining almost due north through a large opening. Near this opening bare rock is exposed on the floor. The rock has a polished appearance with several deep striations (FIGURE 1.4) trending in a northerly direction. (Figure IV)

Within the semicircular feature of Indian Prairie at least three smaller features are present. All three are semicircular in appearance and are located above the floor of Indian Prairie. ~~(Figure V)~~ At least one lies in association with well rounded boulders. The smaller features within Indian Prairie should be examined in greater detail.

Above the western rim of Indian Prairie is located yet another semicircular feature. This feature is bordered on the west by a vertical headwall and on the east by a narrow ridge approximately 30' high and 50' wide. The ridge trends off in a northwesterly direction and has been bisected apparently by a small stream. A logging road traverses the area east of the ridge forming the western rim of Indian Prairie. The ridge appears to be composed of well rounded and subangular boulders averaging about 8-10" in diameter and are most visible on that portion of the ridge south of the stream.

The stream that bisects the ridge flows north and drops abruptly into the semicircular depression of Indian Prairie. Water which is not ponded on the floor of Indian Prairie continues flowing in a northerly direction where it drops in a falls for a distance of approximately 100' or more. At the base of the falls the stream is again ponded on the floor of another semicircular feature smaller than Indian Prairie yet substantially larger than the feature above Indian Prairie.

The floor of the feature below Indian Prairie is broad and virtually flat sloping only enough to accomodate drainage. This is not to say the floor is well drained as it is also marshy. The point at which the stream entered is over a vertical headwall. Where the stream flows out of the feature, the area is littered with well rounded boulders. This feature also opens towards the north as does Indian Prairie, however the true semicircular shape is disrupted to the south where it opens at a less steeper slope than does the majority of the feature.

Extensive timber harvesting in Indian Prairie and the area around it makes observations much easier than in unharvested areas. Although timber harvesting causes disruption of the ground surface it can not cause the type of disruption that could be confused for glacial landscape. ~~One~~ AN EXCEPTION would be striation on rock surfaces. Cables and logs which are dragged over rocks will create pseudo-stria (Thayer, 1936, p. 22). Stria observed on rocks in Indian Prairie does not appear to have been created during logging.

Summary and Conclusion of SCF-III

Indian Prairie is a complex and rather large semicircular depression on the east slope of Snow Peak. The presence of similar features both above and below THE FLOOR OF Indian Prairie would indicate a possible cascading glacier or flight.(Flint, 1971, p. 137) Stria and polished rock on the floor of Indian Prairie would tend to support the moving glacier hypothesis.

The presence of smaller features within Indian Prairie point to a second or possibly third period of glaciation younger than that which carved Indian Prairie. The overall appearance of the landscape in the immediate area of Indian Prairie could be explained by the presence of a large glacier which overrode the Indian Prairie depression and moved into the surrounding area.

Semicircular Feature-IV

Semicircular Feature-IV (SCF-IV) (Figure 1.5) is located south of Indian Prairie and is also on the east slope of Snow Peak. SCF-IV, which is drained by Ella Creek is a semicircular depression opening to the north east. A vertical headwall is present on the west rising approximately 200' or more above the floor. Unlike the headwalls of the previous features This headwall appears to be terraced.

Several ridges are present which cross the floor of the SCF-IV, mostly in a southeast to northwest direction. The ridges are composed of subangular to well rounded boulders ranging in size from a few inches to several feet in diameter. Many show signs of exfoliation. The ridge which is most extensive lies farther west than the others and rises approximately 80' above the eastern floor. This ridge is joined by an area of large angular rock fragments many in excess of 10' across. From a distance these rocks appear to be a lava flow, however, on close examination they are individual rock fragments randomly laid on top of one another, creating numerous crevices and small caves.

Summary and Conclusion of SCF-IV

The presence of several ridges on the floor of SCF-IV could indicate fluctuation within a single glacial stage. They could also point towards multiple glacial stages. It is very likely that two and possibly three separate glacial stages created some of the ridges which are undoubtedly recessional and end moraines. These ridges have not been studied to determine relative age.

The large rock fragments located in connection with the ridge farthest to the west are a mystery as to how they fit into the system, although they could have been on top of the last glacier and were subsequently laid down as the ice melted as a protalus rampart.

Other Features

Several other features are present on Snow Peak which support the glaciation hypothesis. The most visible is the serrated mountain top of Snow Peak (Figure 1.0) On close examination, the serration which makes up the narrow ridges above SCF-I and SCF-III appear to be a massive intrusive bodies composed of a fine grained gray rock probably andesite. These massive bodies are much more resistant to weathering than the large grained rock (probably tuffs) which surrounds them. The location of these massive bodies at the extreme upper slopes of many of the headwalls, leads one to believe that their shape is in part due to headward errosion by glaciation. Two of the most prominent serrations have been named Snow Peak and Thomas Cairn.

Summary and Conclusion of the Serrated Appearance of the Top of Snow Peak

The location, shape and composition of the serrated top of Snow Peak make this feature a likely candidate to have been modified by glaciation. The glacial terms which best fit the features on the top of Snow Peak are: 1) Horn- Thomas Cairn is the best example of a horn. It lies directly above and between SCF-I and SCF-III (Indian Prairie) and SCF-V on the south which has not been discussed. The shape of Thomas Cairn is also that of a horn. 2) Arete- The best example of an arete on Snow Peak is the ridge that radiates away from Thomas Cairn to the northwest. This ridge is flanked on the east by SCF-III (Indian Prairie) and on the west by SCF-I. 3) Col- Two locations on the ridge top of Snow Peak could be explained as cols. One is located between Thomas Cairn and the summit of Snow Peak. It is a visible depression in the ridge line. This col can best be viewed when looking south from the floor of SCF-I. The second possible col is located on the ridge east of Thomas Cairn. This too is a depression in the ridge line between SCF-III and SCF-V.

The shape of the summit and ridge line of Snow Peak also support the glaciation hypothesis. Clearly visible are a horn, an arete and at least two cols. All these features are synonomous with the glacial landscape created by alpine glaciation.

The East Slope

Another feature is located on the east slope of Snow Peak. It is a relatively low level slope (FIGURE 1.0) dropping approximately 500' per mile, which can be considered low level for slopes on Snow Peak. The slope has been extensively cut over by a logging operation which has removed most of the timber. To extract the logs, many logging roads were built, leaving several road cuts. The streams which drain SCF-II, SCF-III and SCF-IV all cross this slope and have down cut deep into it. The surface of the slope is littered with well rounded boulders. Similar boulders are also visible in both stream cuts and road cuts. The boulders range in size from a few inches to several feet in diameter. Many show signs of exfoliation, even those within stream banks and road cuts. In several road cuts it would appear that the boulders have been laid down in layers.

Summary and Conclusion

The slope which is located directly below SCF-II, SCF-III and SCF-IV has been dissected by the streams which drain those features and is covered with well rounded boulders of various sizes. It would appear that if indeed SCF-II, SCF-III and SCF-IV were created by glaciation than this slope is covered with the glacial outwash debris from that glacier(s).

SCF-V and SCF-VI

There are two other semicircular features on the slopes of Snow Peak. (FIGURE 1.0)

Both lie above the 3,000' level. Neither SCF-V or SCF-VI have received much attention. The only observations made were from a distance with the exception of SCF-V (FigureI)

Semicircular Feature-V

Semicircular Feature-V (SCF-V) (Figure 1.6) is very large, approximately one and a half miles across. The opening of the semicircular feature is to the south east. SCF-V can be divided into a north and a south half. The north half drops to a lower elevation than the south half, however both are above 3,000'. The north half appears to be an independent depression which could explain its lower elevation. Much of the timber has been removed from the north half making observations less difficult than in the south half. Water draining from both halves of SCF-V flows into Crabtree Creek. SCF-V is the only feature on Snow Peak which drains into Crabtree Creek. A vertical headwall is present on the northern border of SCF-V. Recent slides have removed parts of the Snow Peak-Mill City trail which traversed the head wall.

Semicircular Feature-VI

Semicircular Feature -VI (SCF-VI) (Figure 1.7) is the smaller of the two features. It is bordered by an almost vertical headwall on the west. The floor of SCF-VI contains a marsh similar to those found in the SCF-I, SCF-III and SCF-IV.

SCF-VI opens to the northeast and there appears to be two separate ridges which parallel each other crossing the floor in a northwest-southeast direction.

Summary and Conclusion of SCF-V and SCF-VI

In appearance, both SCF-V and SCF-VI resemble SCF-I, SCF-III, and SCF-IV. SCF-VI probably has morainal deposits still intact as evidenced by the two ridges on its floor. The morainal deposits most likely were able to avoid errosion because the drainage area created by SCF-VI is small. The large size of SCF-V may in part be due to glacial ice which entered from SCF-I and SCF-III, during an extremely active period of glaciation. The southern exposure may have been a limiting factor for the continuation of glacial activity within all of SCF-V. Conditions may have been more favorable in the north half of SCF-V and if a vertical headwall is present on the west side of this smaller depression, direct rays of the sun would have been avoided. Both SCF-V and SCF- VI should receive more study.

LITERATURE REVIEW

Several studies have been written which address the subject of glaciation in the area of Snow Peak. Although no one study deals specifically with glaciation on Snow Peak, all studies which will be reviewed will be used to support the glacial hypothesis on Snow Peak.

Crandell, Dwight R.

Dwight R. Crandell wrote The Glacial History Of Western Washington And Oregon. In this paper Crandell makes the statement: "Glaciers in the Western Cascades consisted of two main types: tongues from the summit ice fields of the high Cascades that extended westward along major valleys and local cirque and small valley glaciers on the higher ridges and peaks." Along with this paper, Crandell also published a map (Figure 1.8) which shows several glaciers "too small to show at true scale." The area indicated on the map is undoubetedly Snow Peak. Crandall also points out that "evidence of multiple glaciation in the Cascade Range has been reported at only a few places." Although Crandell does not elaborate on the glaciation which he identified on Snow Peak, he does provide documentation of glaciation in the vicinity.

Thayer, Thomas P.

Probably the most extensive study of glaciation in the vicinity of Snow Peak, is Thomas P. Thayer's 1939 paper entitled: Geology of The Salem Hills and the North Santiam River Basin, Oregon. In this study Thayer states "Three stages of glaciation appear to be represented by deposits in the North Santiam River Valley." These stages were named for localities near where the deposits were found. The first stage was named the Mill City Glaciation. This stage of glaciation was believed to be a valley glacier which had its source in the snow fields of the high Cascades.

Thayer established the age of the Mill City Glacier with the Sherwin stage of glaciation, identified in the Sierra Nevadas. Thayer bases the age on the depth of the deposits and the amount of down cutting (by the north Santiam River) which has taken place since the deposits were laid down.

The second stage is identified as the Detroit Glaciation. Although no age was given to this stage it was believed by Thayer to be an intermediate stage between the Sherwin and Late Wisconsin Glaciations.

The third stage of glaciation identified by Thayer is the Tunnel Creek GLACIATION, which corresponds with Late Wisconsin Time. This stage is most evident by well preserved moraines located in the upper drainage of the North Santiam River. Lateral, recessional and terminal moraines at elevations from 4,400' to 2,000' have all been contributed to the Tunnel Creek Stage.

Allison, Ira S.

A classic paper entitled Pleistocene Alluvial Stages In Northwest Oregon was written by Ira S. Allison in 1936. In this paper Allison documents the presence of Pleistocene gravels in the Willamette Valley. "The oldest of the well-defined Pleistocene stages is represented by high gravel terraces along valleys in the Cascade Mountains and by perched remnants along the margins of the Willamette Valley lowland." "These terraces slope down from elevations of 1,000 to 1,500 feet or more above sea level in the mountain valleys to about 300 feet above sea level on the borders of the Willamette Valley lowland."

Allison identified gravels from three independent glacial stages. The oldest being Kansan, next Illinoian and the third, Wisconsin. All are considered subdivisions of the Pleistocene. In correlating the age of the gravels identified as Kansan in age, Allison referred to the dissection which makes the landscape somewhat rolling, oxidization of the gravels to a depth of 20 to 30 feet and pebbles of basalt and andesite which have been softened to clayey consistency.

The age of the Illinoian gravels were also determined in much the same way as those of Kansan Age. However, the presence of a claypan two (2) to three (3) feet thick resembling that found in glacial drift (of Illinoian age) in southcentral Illinois, was the basis for assigning these gravels to the Illinoian Age. Wisconsin Age gravels were distinguished by the presence of comparatively fresh feldspathic erratics within the zone of weathering.

The formula used by Allison in all cases to correlate the age of the gravels is as follows: Topographic position, degree of weathering and amount of subsequent erosion.

Felts, Wayne M.

Wayne M. Felts wrote the Geology of the Lebanon Quadrangle, Oregon in 1936. In this paper felts identifies two (2) gravels at the mouth of Crabtree Creek. The oldest which Felts called the Lacomb gravels were given an age of early Pleistocene (Nebraskan). The second were identified as being Kansan in age and called the Sand Ridge gravels. Although the Sand Ridge gravels are found in other locations they are present with the Lacomb gravels in an alluvial fan the origin of which is the canyon of Crabtree Creek. The methods of determining age were: Topographic position and degree of weathering.

Smith, Raymond Ives

Raymond Ives Smith wrote the Geology of the Northwest Part of the Snow Peak Quadrangle, Oregon in 1958. In this paper Smith identified three (3) gravels of Pleistocene Age. They were Lacomb gravels, early Pleistocene in age, Leffier gravels (FIGURE 1.9) middle Pleistocene in age and Linn gravels, Wisconsin in age. All three (3) gravels were present in the Crabtree CREEK drainage and the Thomas Creek Drainage.

Summary and Conclusion of Literature Review

The fact that Crandell identified glacial activity on what appears to be Snow Peak is the strongest documented support of the glacial hypothesis. This provides a basis on which to begin. It would appear that researchers have identified multiple stages of glaciation in the Western Cascades which range in age from early Pleistocene to late Pleistocene. Three (3) definite stages were identified by Thayer, ~~Felts~~, and Smith and Allison mentioned that there were four stages of glaciation which deposited gravels in the Willamette Valley.

Allison was also responsible for developing a method by which to place relative dates on the glacial deposits he encountered. By using Allison's method of dating and the documentation of multiple stages of glaciation within the Pleistocene, it will be possible to determine if multiple glaciation occured on Snow Peak. This can be accomplished by studying the degree of weathering within morainal deposits and by using the relationship of these deposits to one another. Judging by the number of morainal deposits observed on Snow Peak, it is very possible that Snow Peak was host for multiple stages of glaciation.

GLACIAL FORM AND MORPHOLOGY

Glaciation has been and is currently the subject of much research. As a result of this research many glacial features have been described by various authors. A review of some of these descriptions is necessary in order to properly describe the features on Snow Peak. It has been mentioned that the glacial activity in the Western Cascades was of two types: 1) tongues from summit ice fields and 2) local cirques and small valley glaciers (Crandell, 1965 p. 148). This review should then concentrate on cirque and small valley glaciers.

Cirques

Several descriptive terms are used to describe the appearance of a cirque. Flint (1971, p. 133) refers to cirques as deep, steepsided recesses roughly semicircular in plan. Andrews (1975, p. 136) explains cirques as amphitheaters or cauldrons cut into a mountain. Other terms such as half bowl or scallop also describe a cirque. Trenhaile (1976, p. 451) aids in the identification of cirques by stating: 1) cirgues generally occur within a rather narrow altitudinal zone and 2) cirques in the mid-latitudes of the northern hemisphere are most numerous on the north and northeastern sides of mountains. Flint (1971, p. 136-137) states that three factors which control aspects of cirques are 1) protection from insulation, especially in summer, 2) distribution of snowfall and 3) wind drifting of cold and dry snow.

Valley Glaciers

For the most part it can be assumed that when conditions are right, a cirque glacier will expand downslope. As long as the cirque is located in the zone of accumulation, potential is present to feed a valley glacier A valley glacier and a cirque can be viewed as parts of the same system. However, the valley glacier has an elongated profile and may reach below the zone of accumulation into the zone of ablation.

Valley glaciers will tend to occupy existing valleys in mountainous areas. Here, because of cold air temperatures and heavy orographic precipitation, development and expansion of valley glaciers is favorable. (Strahler, 1975, p. 523)

Other Terms Applied to Alpine Glaciation

The following is a list of terms developed in Strahler(1975, p. 526-527), Garner (1974, p. 471-496) and Flint (1971, p. 137) et al, which define those features related to alpine glacial morphology.

Arete: A narrow jagged knifelike ridge formed at the intersection of two opposing cirques.

Basin: The somewhat flat floor of a cirque.

Col: A pass, depression or notch created by intensive weathering of an arete by two opposing cirques.

Drift: Rock transported and deposited by glacial ice or its melt water.

Flight: A vertical sequence of two to five cirques which have their basins (floors) separated by a vertical distance. Also called glacial steps.

Hanging Valley: A valley which has been shaped by glacial ice and then truncated by another glacier usually moving perpendicular to it. The intersecting valley floor is left stranded above the main valley floor.

Headwall: A vertical to moderately steep rock wall which is created by headward erosion of a cirque glacier.

Horn: A sharp pointed peak formed at the intersection of three or more opposing cirques.

Moraine: Unsorted masses of glacial detritus dumped directly from the ice to form ridge-like configurations.

Lateral Moraine: Morainal material deposited on the side of a glacier.

Medial Moraine: Morainal material deposited by two glaciers which join along each others lateral edge.

Ground Moraine: Morainal material usually that of a Lateral Moraine which is deposited from the outside in as the glacier recedes.

Recessional Moraine: Morainal material deposited by a retreating glacier at the front of the glacier.

Terminal (END) Moraine: Morainal material marking the line of maximum glacial advance.

Nunatak: A high ground or mountain peak which surmounts an ice mass.

Protalus Rampart: Rock fragments freed by mass wasting that slide down and over glacial ice and collect at the front forming a ridge.

Tarn: An ovate lake on the basin (floor) of an empty cirque.

Threshold: A lip on the basin of a cirque which separates the cirque from the area downslope.

Till: Unsorted and unstratified material deposited by glacial ice or melt water. Very similar to drift.

U-Shaped Valley: A glaciated valley with a cross profile conforming to that of a steep sided U. Created by glacial movement and erosion.

V-Shaped Valley: A valley with a cross profile conforming to that of a V. Created by stream downcutting.

Summary and Conclusion of Glacial Form and Morphology

The features and forms which have been described herein are, for the most part, present on Snow Peak. In an effort to support the glacial hypothesis, those features which are clearly glacial must be identified and mapped.

SNOW LINE

Mention is made in the literature to snow line. Flint (1971, p. 133) refers to cirques as part of the system of "mechanical weathering and mass wasting, localized at topographical favorable places near the lower limit of the perennial snow." In an unpublished paper, Mc Ewan (1977, p. 4) explains the differences in snow line terminology. He states that the snow line marks the point below which glaciers can not form and presents four ~~different~~ TYPES OF snow line~~s~~.

The first snow line is the annual snow line usually found on glaciers. It is the lowest elevation which snow will remain through the summer melting season. Second is the orographic snow line which is traced on the land surface between glaciers, roughly the same as the annual snow line. Both are said to demonstrate considerable difference in elevation within the same region. The third is climatic snow line which is theoretically the lower limit of snow exposed of a flat surface. Fourth is the regional snow line which can be postulated as the trend of both the annual and orographic snow lines throughout a region.

Trenhaile (1975, p. 451) points out that cirques form at or slightly below the orographic snow line. The cirque then becomes an instrument by which one could determine the relative elevation of the snow line during the time when glaciation was active. By inferring snow line from cirque floor elevations,it would be possible to set a limit for the regional snow line during the last glacial stage which effected Snow Peak. However,it must be understood that the limited number of cirques on Snow Peak would not constitute a valid sample. The information could, however, be used by others who are studying snow line.

Summary and Conclusion of Snow Line

It has been mentioned that cirque floors are at or slightly below the orographic snow line. All cirque floors on Snow Peak are at or above 3,000 feet which would indicate that the orographic snow line during creation of these cirques was also at or slightly below 3,000 feet above sea level. It should be pointed out that sea level was also subject to change during the Pleistocene, which makes determination of snow line difficult.

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