MT HOOD'S ELIOT GLACIER:

THE STUDY OF A RECEDING ICE MASS AND ITS SURROUNDING ENVIRONMENT

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FINAL PROJECT - ENVIRONMENTAL STUDIES 102

PROF. ART, DETHIER, AND KEGLEY

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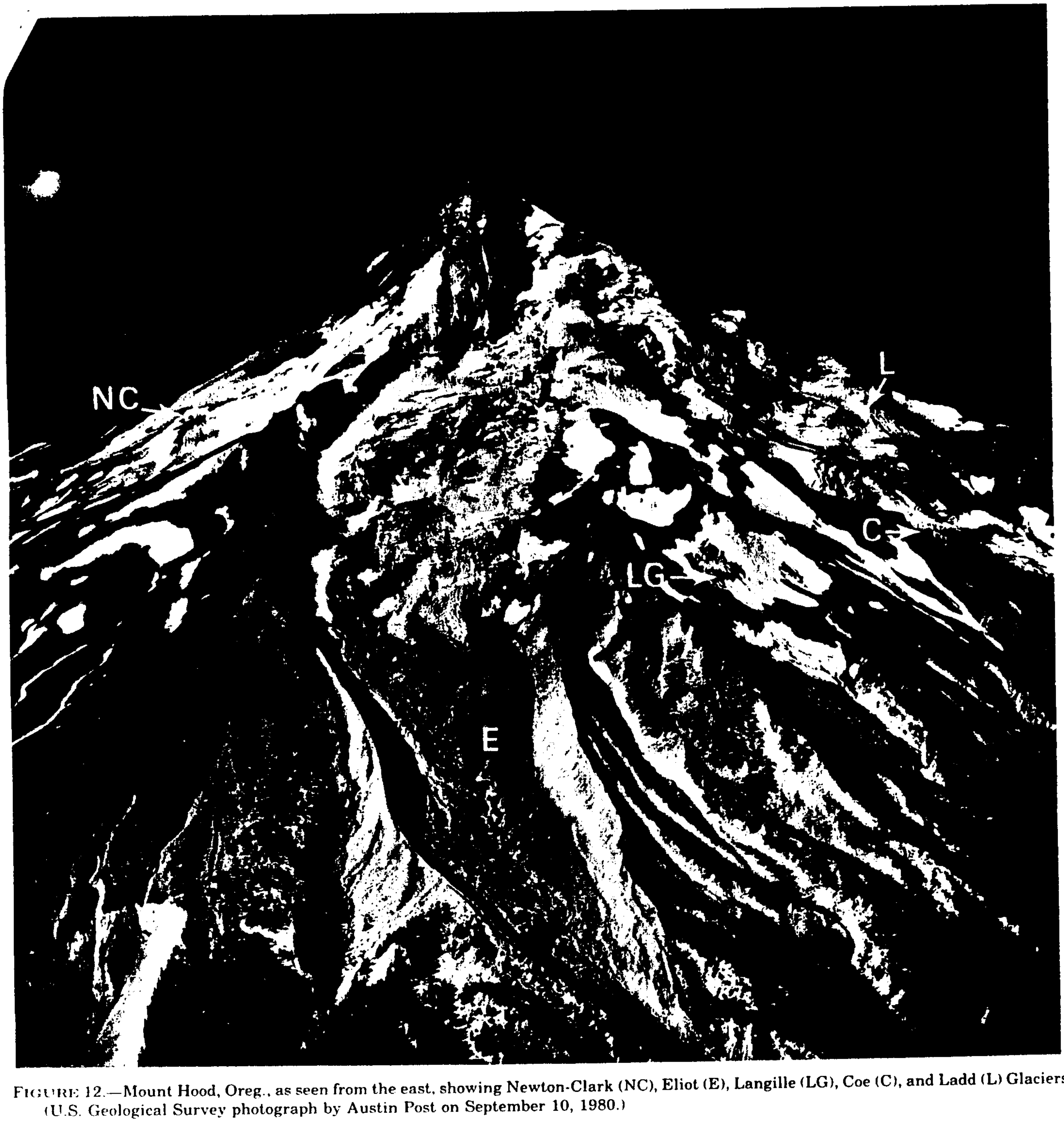

FIGURE 12.—Mount Hood, Oreg., as seen from the east, showing Newton-Clark (NC), Eliot (E), Langille (LG), Coe (C), and Ladd (L) Glaciers. (U.S. Geological Survey photograph by Austin Post on September 10, 1980.)

FOREWORD

how - not in your first line ?

what happened to this margin ?

It is evident that the research data compiled for this report is immense. Therefore it is logical and reasonable to separate these materials from the actual report. Therefore, I am not referencing my information to specific research materials in the packets. I will not refer to these sources in the paper because doing so would be time-consuming and perhaps tedious to the reader, who would be forced to thumb through numerous pages in the documents to find the desired data. Instead, any references made are focused upon either maps or entire packets. In the compiled datas, there are extensive graphs, tables, charts, and maps which will be available to the reader, even though they are not referenced. The data ~~will~~ are, however, ~~be~~ organized so that the most used materials, the ones most relevant to the glacier study, will be the most accessible following the actual paper.

but how will reader know which one to look at

Although there are other articles included in the data sheets, the primary research materials have been provided by the following government organizations:

The U.S. Department of Agriculture

- The Soil Conservation Service;

The U.S. Department of the Interior

- The Geologic Survey.

title here - this must be an introduction

Eliot Glacier is located on the north face of Mt. Hood. Mt. Hood, the tallest and most northern member of the Oregon Cascades, ~~has~~ supports sixteen glaciers. Of these sixteen glaciers, Eliot is the largest in terms of overall size and volume. Since the glacier was first studied, more than one hundred years ago, a great deal of ~~receding~~ recession has taken place. In this measured time period, the elevation of the lowest exposed part of the glacier, the terminal ~~moraine~~ area, has risen from the 6200 foot level to the present day 7100 feet. The rate of melting has been recorded as horizontal sixteen feet a year on the average. This change, on the recorded time scale and a geologic time scale, has had profound impacts upon the geology and the biology of the region. The important questions which need to be answered are: what has happened to this environment in the past? what is the situation today? and what can be predicted in the future?

so what horizontal distance, up total?

Brief stated, a glacier is a large mass of snow and ice on land which has persisted for numerous years. An adequate definition of glaciers is difficult, because they range in size and shape from small ice patches to the Antarctic ice sheet. Mountain glaciers also come in various shapes and sizes. Some what are carved out of mountain sides by ice erosion (cirque (i.e. - cirque glaciers flow from depressions cut in the mtn glaciers). Ice masses on exposed slopes are slope glaciers. Others formed in the lee of ridges where snow is deposited are drift glaciers. Large mountain glaciers that flow down valleys are aptly named valley glaciers. Although there are many types of glaciers on Mt. Hood, Eliot is a valley glacier. Glaciers are incredibly useful to both nature and mankind because: three-fourths of the world's fresh water supply is stored as glacial ice; in the North American continent, the volume of water stored in glaciers is many times greater than the volume stored in all of the lakes,

glaciers must flow

new thought?

there is only because of Alaska, right?
rivers, watersheds, and ponds combined; in many regions, glacial run-off is a principal source of dry season water and helps to balance the year-round stream flows.

A glacier never physically 'recedes' (as in withdrawing up a mountainside). A glacier is always pushing its ice mass down a mountain side. Therefore, the receding is actually a melting of the new growth of the glacier - in essence, erasing the glacial progression. The existence of a glacier depends upon the relation between melt / run-off and precipitation. When there is more snowfall, there is less summer exposure and run-off; the glacier is then likely to extend down the mountain. When there is inadequate precipitation, run-off is greater and the lower part of the glacier melts, and the glacier appears to recede (the term 'recede' will be used for convenience).

say that ice flows!

FIELD STUDIES -

The primary concerns of the field research were to observe and analyze the geological and biological aspects of the glacial environment. Of geological value are the visible glacial attributes, the drainage system, the physical make-up, and the direction of geological change. Of biological value are the wildlife and the vegetation, along with the trends that are evolving in the forests.

The studies were taken at the end of March - the 25th to the 29th, during Spring Vacation. It had been an excellent snow year, with deep snow depths at the timberline and higher elevation. Gauged by maps and an altimeter, the timberline on the northeast face of Mt. Hood is at approximately 6500 feet. Measured with depth prods, the snow depths around timberline were between twelve and eighteen feet, with an average depth of fourteen feet. The variance is due largely in part to wind-created *drifts. The mountain had received a large amount of snow in the week*

not Williamstown

prior to the studies (about four fresh feet). The field studies were taked during a period of settling and calm between snow storms. Due to the abundance of snow, the field studies were conducted while on backcountry mountaineering skiis and skins; this equipment provided great mobility in
(actually snowfield, right!.)
the glacial environment that would have otherwise been unattainable.

Eliot Glacier, being the largest permanent ice mass on Mt. Hood, dominates the northeast side. It has been measured recently (in research) as being 13,100 feet in length, originating close to the summit and extending down towards the Hood River Valley. All of the elevations in the field studies have been measured by an altimeter and comparisons to maps.
do you think it is stagnant?
Whereas the visible moraine ends at 7100 feet, glacial ice covered by till and wind-driven sediments exists down to the 6400 foot level. The glacial valley, of course, is substantially longer than the actual glacier, extending through and across the Cooper Spur and Tilly Jane regions, bordered on the east by Ghost Ridge and on the west by Stranahan Ridge (see the main map - "Mt. Hood and Vicinity"). There are two main bowls which constitute the exposed glacial valley. There is a small bowl from 5400 feet to 6200 feet, and a much larger bowl from 6200 feet up the mountain to the 10,000 foot level. The region from the summit down to 10,000 feet is a steep, open slope which gradually splits into two parts - Eliot Glacier on the east and Coe Glacier to the west.

The upper bowl (6200 and up) is a vast, wide region. The glacial walls are about 300 feet in height. The width ranges from 600 to 1500 feet across. The pitches of the valley in this bowl range from a shallow lower area (5 to 20 degrees) to the steeper middle area around the terminal moraine (20 - 30 degrees) to a very precipitous upper area (30 - 60 degrees). The walls of the valley ranged in pitches from 25 degrees in the lower part of the bowl, to 60 degrees along the middle and upper sections of the bowl. The snow depths in the basin were around fourteen feet deep.

The depths on the walls, on the contrary, ranged from twelve feet down to bare patches of till; this is the result of the steep ridges and the high wind exposure.

The smaller, lower bowl, which extends down to the 5400 foot level in fragment
an exposed basin below the surrounding timberline. This bowl, open at the top, is gradually encroached upon by the surrounding forests as the elevation drops. This bowl is much narrower than the one above it. The ridges bordering the bowl are about as high as the bowl is wide (100 - 300 feet, gradually becoming smaller with elevation drop), creating the appearance of a channel rather than a valley. avalanches here? The weather exposure in the lower bowl is much less than the larger, upper bowl, enabling it to support limited amounts of vegetation (which will be described later). Due to less how much?
wind, the walls of the lower bowl had more snow and fewer exposed areas.

The composition of the exposed valley is glacial till. The till ranges from fine sand to huge boulders forty feet across. The upper bowl has the could you see this.
more coarse sediments, due to the more active erosion that was taking place. The lower bowl had finer material because in recent history, it has only been a run-off region for the glacier above. Because the upper bowl flattens out at the 6400 foot level, much of the larger materials settle there. The walls of the upper bowl are experiencing incredibly high rates of erosion, due to steep slopes and intense wind and precipitation. how high? how can you tell? The glacial valley would be getting deeper, except that erosion from the surrounding walls collects in the flatter part of the valley, keeping the depth relatively constant. The changes in the topography of the lower bowl are being minimized by encroaching vegetation. Conversely, if the upper bowl isn't getting deeper, it is getting wider, expanding to the east and west as weather erodes the ridges.

The run-off from Eliot Glacier forms a stream known as the Eliot Branch. This stream eventually becomes the East Fork of the Hood River, which then flows north to the Columbia River. The Eliot Branch constitutes most of the water flow in the East Fork, as other water sources are minor regional tributaries. Eliot Glacier therefore supplies much of the Hood River Valley with water during the dry summer months. Although the glacier appears certain to withstand total elimination for hundreds of years more (discounting volcanic eruptions and similar situations), the diminishing (if it continues to decrease in size) glacier may provide fewer available dry season water resources to the agricultural valley in a nearer future.

Can you supply some figures here, please

Eliot Glacier supports little in the way of wildlife, but the area in the forested region below is full of animals. Most of the animals have migrated away from the upper elevations during winter. I therefore didn't see any animals other than birds during my studies. Since I am not an ornithologist, I had a difficult time identifying the birds. However, I certainly did see jays and crows. Other common birds were in the region but I hadn't the time or knowledge to make educated guesses as to their names (bluebirds, sparrows possibly). The other animals that are active in the region during more temperate months are a variety of creatures ? ranging from rodents, rabbits, and squirrels to larger animals such as deer, elk, and bears. With the exception of the Cloud Cap area (see map), the region is lucky enough to be without serious human impacts.

— I knew this!

The true timberline on the north side of Mt. Hood, excluding the glacial bowls, is around 6500 feet. At that elevation, with 20 % cover, the trees are struggling against the weather. They are contorted and battered by the constant, powerful winds; most trees here have branches on only one side of the trunk - limbs that face away from the wind. At the timberline of the Cooper Spur region (note map), there was only 5 % cover at 6600 feet and none beyond that point. At 6000 feet on Cooper Spur, the cover reached a stable forestation, with a varying cover from 60 to 120 %. — different layers? trees + shrubs?

Many tree species exist in this region. In the forested areas at timberline and below, the most common trees are: Mountain Hemlock, Douglas Fir, Silver Fir, Western White Pine, Mountain Larch, Western Cedar, and Lodgepole Pine. The trees that predominate throughout the region are the Mountain Hemlock and the Silver Fir. The Douglas Fir is generally found at the lower elevations, though stands of this species do exist in the area. The Western White Pine is interesting and hearty tree which is noteworthy because it only exists at elevations 5000 feet or higher in the Northwest.

The forests at the timberline around the glacial valley are undergoing a period of change. As the glacier recedes, the treeline in the bowl is rising. The Eliot Glacier valley is in stark contrast with the treeline of the rest of the mountain, by having a timberline beginning around 5400 feet. The difference has been created by the glacier, which of course once extended much lower, and by the actions of the glacier - run-off, floods, erosion. The treeline changes affect the lower bowl, which has its highest point at around 6400 feet (close to actual treeline in the areas nearby). The difference in treeline does not affect the upper bowl, as the land above 6500 feet has weather that is far too inclement for vegetation to exist, regardless of glacial proximity. Even though the lower bowl is barren, trees appear all along the tops of the bordering ridges, up to the top of the bowl. As the bowl drops in elevation, the trees from the surrounding hillsides gradually encroach upon the basin. As the top of the bowl was 300 feet wide (at 6400 feet), the trees from opposing ridges were 300 feet apart. The trees close in upon the bowl much more rapidly than the topography does. At 6000 feet, the trees are separated by 200 feet. At 5800 feet, although the bowl is still pretty wide, the trees are separated by not much more than 100 feet. At 5600 feet, the trees are coming closer together, only about forty feet apart. As the elevation drops, the trees gradually come together (see sketches in field journals). ↑ you should include them here as illustrations!

It is worth noting that the trees on the edge of the bowl, that are coming together, are younger than the trees of the more established forest. The forest appears to be steadily working to fill the bowl with vegetation. Along the steep walls are some unidentified alpine shrubs, which are ideally suited for clinging to walls in partially exposed areas. Spaced in clusters along the exposed walls of the basin are very young trees, quickly growing to eventually fill the basin with forests. Due to the deep snow (twelve feet or more). I could not get an adequate idea of how much cover and abundancy these young trees had in the bowl. Measuring the trees at breast height to figure diameter, age, and cover was also rather unfeasible (I wasn't going to dig - esp. not that much!). Even without exact field measurements, one can still conclude that the trees from the surrounding hillsides are rapidly invading the lower bowl. Though the forests will eventually fill most of the bowl, the direct channel of the bowl will remain cleared due to the actions and flooding of the glacial run-off. The forestation of lower bowl, aided by wind cover and an array of richer soils, will continue to slow the erosion of the area, hence creating a larger topographic change in the valley. The larger bowl will become forced to deposit more of their sediments on the flats around 6500 feet rather than have the deposits flow down into the lower regions, making the differences between the two bowls more pronounced.

- it'd be good to know what they were?

RESEARCH -

The research undertaken is primarily concerned with two things: weather / precipitation history and patterns; and comparisons of Eliot Glacier to other glaciers on Mt. Hood and other mountains in the Cascades. Concerning weather and precipitation, there are many historical records compiled from snow courses and testing sites on Mt. Hood. Comparisons to other glaciers are focused upon the activities of glaciers on Hood, Mt.

Rainier, Mt. Shasta, and The Three Sisters. The amount of data provided is extensive. I will only draw out the inforn[illegible]n which I feel is pertinent to the glacier study.

Trying to find trends in the weather actions and precipitation is valid, in order to find out whether or not changes in these two subjects have had impacts on the recession of the glacier. The years between 1900 and 1945 have been a period in which most all glaciers in North America receded. The exact figures for Mt. Hood during this time were not available over Spring Break. I would therefore conclude why? that Mt. Hood followed the path of other glaciers of the region in a pattern of gradual recession during this time period. I do have data on snow courses on Mt. Hood at two valid sites, the 'Mt. Hood Test Site' and the Tilly Jane test site.

needs help for this

that wasn't it this the key to your study?

need a graph of this here for the reader!

The 'Mt. Hood Test Site' (MHTS) has materials recorded from 1961 to the present. The site is located at 5400 feet on the southeast side of the mountain. This site coincides with the Eliot Glacier region because both get a similar amount of snowfall - less snow falls on the east side of Hood, regardless of whether it's on the northeast or southeast side. Nonetheless, a lot of snow does fall. The 1987 total precipitation was (converted into liquid) 81.4 inches. This figure was a decline from 1986, when total precipitation was 105.7 inches. These two figures represent the basic range of precipitation at the MHTS - mild year-to-year fluctuations with an overall mean in the high 90s.

Plot this

Though similar to the MHTS, the Tilly Jane site is more applicable to the Eliot Glacier situation. It is at 5600 feet in elevation, close to Cloud Cap and located on the Cooper Spur, adjacent to the glacial valley. Recordings were taken at the Tilly Jane site from 1931 to 1983. Unfortunately, I only have the data from 1946 onwards. The tables show that up until the 60s, the snowfall was very stable, with depths April 1st averaging around 110 inches. The 60s to the 80s was a more eratic time,

this would make a fine plot!

in which great fluctuations occurred in snow fall from a high of 158 inches down to a low of 26. I can't believe that the greenhouse effect would have had an impact in 1963. I must therefore assume that weather patterns go in cycles - between times of little glacial change and times of great melting. Years with solid snowfall would not appear to greatly harm the glacier, though perhaps allow it to recede a small amount. Years of little snowfall would indicate great depletions of the glacier. It is logical from looking at the snow testing sites, then, to deduce that weather patterns and changes have produced a direct impact upon the size and length of Eliot Glacier.

you're talking about snow right now!

why wouldn't the glacier advance?

Water Supply Outlooks can imply expected changes in the glacier's size. If a year is a bad snow year, the winter's precipitation is melted and drained away too fast. So that when there is no other sources of water in the valley and the glacier is exposed to the heat of summer too soon, much glacial melt will take place. Stream flow throughout dry summers is meager because the winter's precipitation is gone and the only thing that is flowing is glacial run-off. Good snow years allow the glacier to remain intact, with less ablation heat exposure and an opportunity to expand. The late 1970s were bad snow years on Mt. Hood (refer to 'Water Supply Outlook For Oregon' packets). As a result, the glaciers were exposed to summer heat too soon. The glaciers receded at nearly record paces during these time periods. The yearly precipitation does therefore have a significant impact upon the rate of glacial recession.

how fast... when was the response?

show it. Graph ppt vs. recession rate !?

this belongs earlier

Compared with other glaciers on Mt. Hood, Eliot is the largest in volume, depth, and length. It is 13,100 feet long and 361 feet deep at its thickest point. Its ice and snow volume is 3.2 billion cubic feet. The total ice and snow volume on Mt. Hood is 12.3 billion cubic feet. Therefore, Eliot represents a large portion of the mountain. In contrast, the second largest glacier, Coe, has 1.9 billion cubic feet - still a huge number, but much

citation!

how is depth known?

smaller than Eliot. Surprisingly, Eliot doesn't have the largest surface area. Of the 145.1 million square feet of permanent snow on the mountain, only 18.1 is on Eliot Glacier. If you discount ice patches, Eliot is third largest in surface area, behind the Coe-Ladd and Newton-Clark glaciers. What this all implies is that Eliot is a huge, deep glacier compared with the thinner, often more spread out glaciers on other parts of the mountain.

seemingly pairs of glaciers

The glaciers on the other mountains, Rainier, Shasta, and The Three Sisters, are much different than the ones on Mt. Hood (see mountain comparison packets). Rainier, to the north, is a glacial wonderland - 990.9 million square feet of surface area and 156.2 billion cubic feet of volume. There are 23 glaciers on Rainier. Thirteen of these are larger than Eliot, often many times larger. Whereas Rainier was substantially larger glacially than Hood, The Three Sisters' glaciers are quite smaller - 89.3 million square feet on the surface and 5.6 billion cubic feet in volume. To make The Three Sisters appear even smaller, one must note that these glaciers are all a part of a three mountain chain rather than one single mountain. There are no glaciers on The Three Sisters that can compare in size to Eliot - the largest has one-fifth the volume. Mt. Shasta, the southern-most mountain studied, has even fewer glaciers than The Three Sisters. The total surface area on Shasta is 73.8 million square feet and the volume is 4.7 billion cubic feet. Of the glaciers on Shasta, none remotely compare to Eliot in size. In the studies of the different mountain glacial systems, one can see obvious differences due to latitude. However, most, if not all, of these glaciers have receded in the past one hundred years. It is therefore worthwhile to take into account the situations on other mountains as cross comparisons, when looking at the situation on Mt. Hood.

why is this info. here?

don't make reader sift info — put tables, graphs here

but where is the largest glacier? the largest?

why not due to snowfall

Eliot Glacier, the largest ice mass on Mt. Hood, has been receding at a rapid rate. As the ice has receded up the mountainside, the walls of the how fast?

glacial valley have been more exposed. The resulting erosion has placed materials on a flat area around the 6500 foot level. This continual depositing of sediments and rocks has created two separate bowls - a large upper one which contains the actual glacier, and a small lower bowl which is beginning to integrate with the surrounding environment at that elevation. So as the glacier rises, the upper bowl erodes, widens, and fills. Conversely, the lower bowl, without the erosion above, is beginning natural forestation. The problem with the entire situation is that a naturally and economically important ice mass is rapidly diminishing. If Nature doesn't allow this trend to stop, the water supplies and drought buffer that the glacier gives the Hood River Valley could be depleted, resulting in a much more unstable environment that may become dependent upon other sources of liquid during the dry seasons - sources that may prove to be unreliable.

you noted this before

Gordon - you needed to present this data for the reader to see... digest your information and then present it. Where is your bibliography - where is this information from. Since you did that interesting fieldwork, where are some summaries of the information you gathered?