Bard, Carr, & Wright

Golden Trout '72

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Addendum

Due to the fact that the computer was not functioning properly, we were unable to compile a master chronology. Although this would have been a very interesting addition to the conclusion of this report, C'est la vie!

Introduction & Purpose

Since the beginning of recorded history and probably since his first sunrise, the human animal has exhibited a strong innate curiosity, a curiosity that has pulled him through the stone age to the present, a yearning for knowledge that can so obsess him as to make him spend his entire life on this earth in a wild search for a single answer. Each man has his own dreams, his own quest, his own unanswered question, but through the years two schools of thought developed both aimed at the ultimate end — an answer for that private question. In some, the drive for knowledge was too strong to be satisfied by earthly wonders, so they raised their eyes to the sky and beheld the moon, and the sun, and the stars, and they knew that all the knowledge of the universe was there, waiting for them. Once they knew where their answers lay, they soon developed the means with which to root them out, and these men with their instruments and their will discovered the unknown, proved the unbelievable and created a whole new way of life for themselves and the entire world.

But not all turned their eyes to the heavens. Some went with eyes toward the ground. They delved into deep places, looked under rocks, among the blades of grass, and discovered worlds within worlds beneath their very feet. They too, spurred on by visions of fantastic solutions to previously unanswerable questions developed their own instruments. Then these men with their technology and their will, harnessed the powers of nature, broke them to be their servants, and created whole new ways of life for themselves and the world. To them, the majesty of a snowcapped mountain was beyond compare, the silent, learned brooding of a tree filled them with the awe and wonder which is natures due. As followers of this group is it any wonder that we were drawn to a place where natures beauty is laid bare, a place where the stamp of man has not yet been affixed? It is, in all, a place of primeval grandeur, this high sierra; of granite crags striated by avalanche gullies; of trees tortured and dwarfed at timberline but superbly tall in the forests below; of scores of booming cascades and nearly 2,000 mountain lakes and ponds, each resting inits cup of granite or flower-speckled meadow grass. This is the world which we hoped would show us, if not an answer, at least the means to aid in its eventual discovery. We desired knowledge of nature in general, but to channel our search we picked the silent watcher of the sierra forests, the stately pine.

The coniferous evergreen was merely one medium among thousands which would have aided in our aquiring the knowledge which we sought. Our purpose was to gain experience in the study of an area. Contained within any area of appreciable size in the sierra are countless objects of interest. One could observe and study any single one of these for a lifetime, and still not know all, or even half of the secrets held within them. We do not exactly know why we chose to study trees, but in any case, the choice seems to us to have been a good one. The knowledge and experience which we have gained in this pursuit presents itself in this report, but the information contained here does not represent the end of the project. We have barely scratched the surface of a great wealth of knowledge that is anyone's for the taking.

Collecting Data

For the most part, our research was conducted in the main and eastern valleys in the immediate area of the Golden Trout cabins in the greater cottonwood basin, above Lone Pine. Of the many different species of pines in existence today, only five have claimed this area for their own. Since our project was one concerning Dendrochronology, "the study of the chronological sequence of annual growth rings in trees,"[1] and since annual growth rings could conceivably differ from species to species we familiarized ourselves with our five local species as a pre-requisite to our actually begining work.

The common appelations given these pines are as follows: Foxtail, Jeffrey, Limber, Lodgepole, and Whitebark. The criteria used in differentiating berween these trees are simple and, for the most part, fairly obvious. Limber and Whitebark pines seem at a glance to be very simillar while Foxtail, Jeffrey, and Lodgepole are easily set apart. One key leading to the classification of these trees is to be found in the needles. Foxtail, Limber, and Whitebark all have five needles in the vassele; Lodgepole has two, and Jeffrey has three. For Lodgepole and Jeffrey pines, there is no other necessary criterion in this area, but for those trees with five needles, one must turn to their coresponding pine cones and a closer inspection of the needles and bark to tell them apart. The Foxtail needles grow like a bottle brush and

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[1] C. W. Ferguson, Concepts and Techniques of Dendrochronology, in Scientific Methods in Medieval Archaeology, (Berkeley, Los Angeles, London: 1970), pg. 183.

this allows the species to be easily distingushed from Whitebark and Limber. The adult Whitebark cone should measure from one to three inches in length, and the Limber's from three to five and a half. The length of the cones can be deceiving, however, in a young tree whose cones are bound to be small regardless of species, so in this case there is another means of differentiating between the two. The end of the scale of a Whitebark's cone is "thickened" while the Limber's is only "slightly thickened."

It would take years for a group of three to study every standing tree in the great cottonwood basin, and perhaps a lifetime or two to process the data obtained. We, therefore, had to come across a way of collecting data from a limited number of trees which could be expanded scientifically to provide findings valid throughout the area. There are several ways of accomplishing this, but the most simple and least time consuming is the transect method. A transect is an imaginary straight line laid along a compass bearing to provide a cross section of a given area. By plotting and marking three parallel transects across the main valley; and by collecting data only from trees along these lines we were able to collect fairly accurate information, representative of the entire valley.

By hiking to the summit of one valley wall, exploring and obtaining a view of the entire area to be studied, we could select the starting points of each transect so as to provide the greatest possible coverage of the valley. After selecting and marking these points we decided on a compass bearing which would place the transects in a position most nearly straight to the top of the opposite valley wall. Having done this we merely followed each bearing across the valley and up the other wall, marking each tree that fell within its bounds. These first three transects were constructed prior to the collection of data along them, but due to the time involved in the collecting of data, we later found it more expedient to examine each tree as the transect came to it, as opposed to walking along each line a second time to obtain this information. Our studies in the eastern valley were made by this method and subsequently took much less time to complete.

The aforementioned data obtained from each tree along the transects is in the form of a small core, about 3/16 of an inch in diameter which makes visible a horizontal cross section of a tree trunk. A core of a single tree should show the annual growth rings of that tree from center to bark. In order to obtain these samples, a precision instrument called a Swedish increment borer was used. (Plate I, a &b) The increment borer in in the form of a hollow steel tube the tip of which "has a razor-sharp cutting edge with external screw threads that draws the borer into the tree as the handle is turned."[2] When the borer is in use, the boring tube and handle form a T which facilitates easy penetration, much like turning the steering wheel of a car. When not in use, the handle serves yet another purpose, that of a protective sheath for the coring cylinder, which must remain sharp for effective use.

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[2] Ibid pg. 184-185

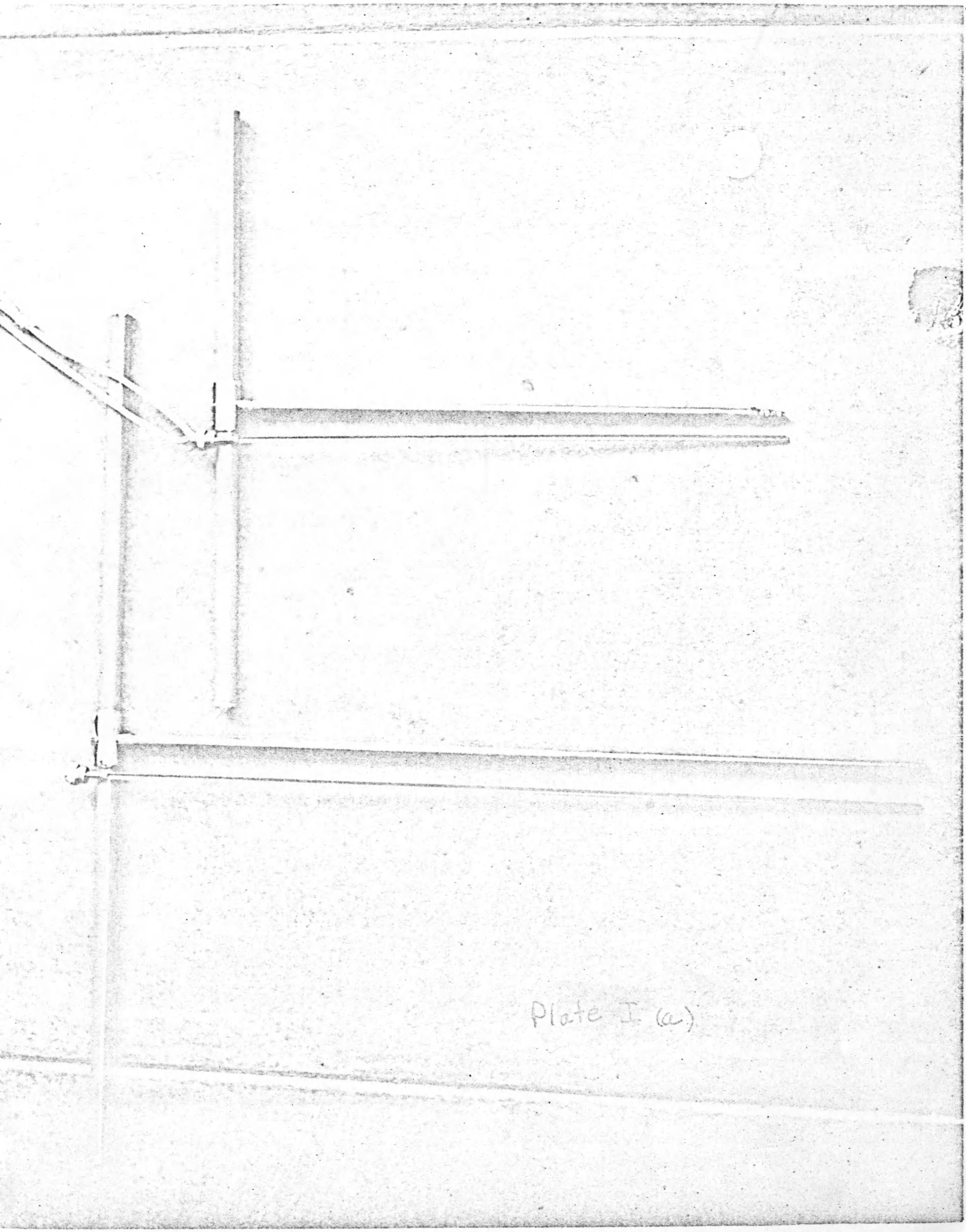


Plate I. (a)

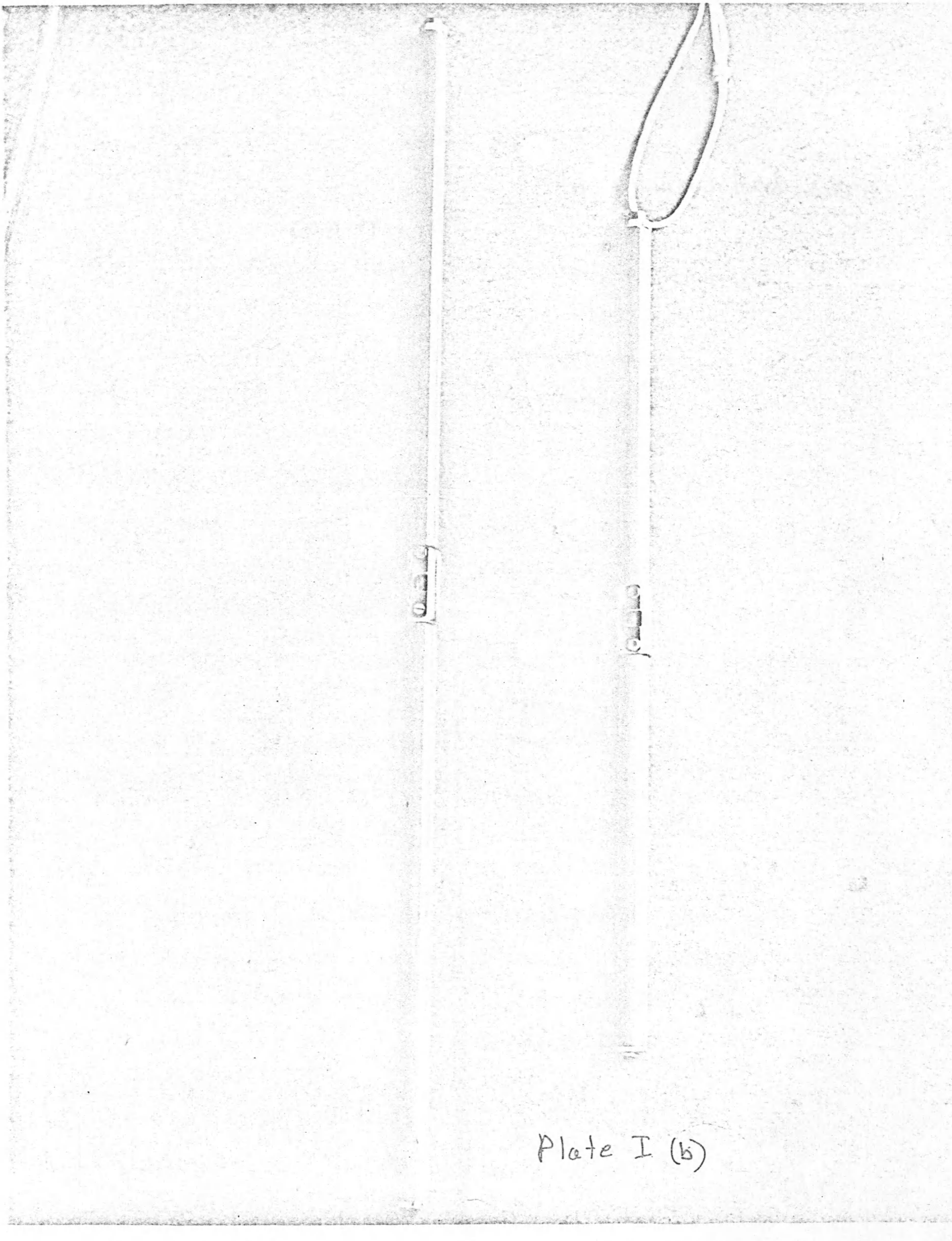


Plate I (b)

An unmounted core.

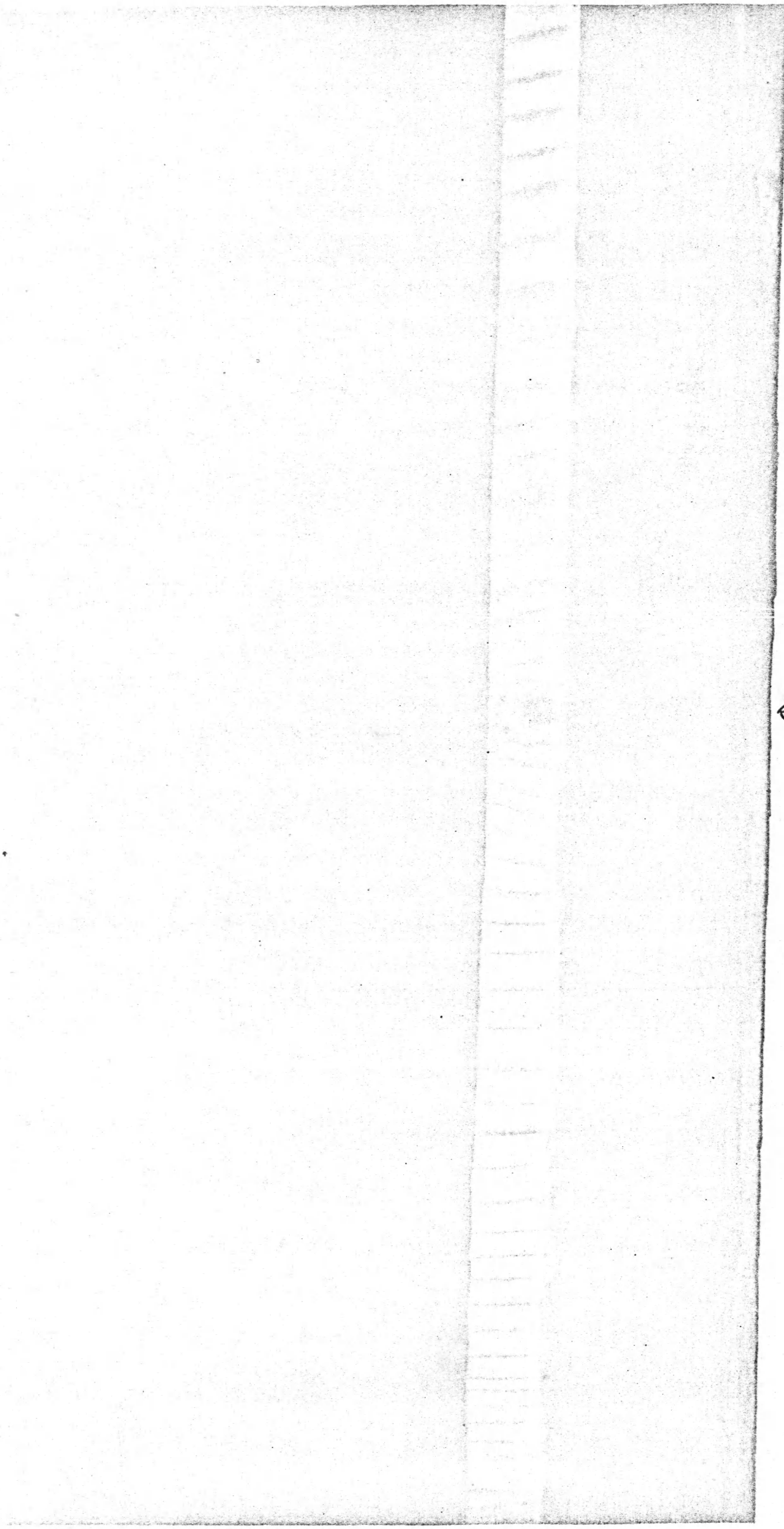
center

bark

Plate II

For information towards the aquisition of this fairly expensive piece of equipment, we first wrote Mr. Earnest DeGraff, the acting District Ranger in the Mt. Whitney Ranger District. Mr. DeGraff in turn, directed us to the Labroratory of Tree-ring Research, University of Arizona. To this party we sent another letter explaining our project in which we brought up the possibility of our borrowing an increment borer from them. Mr. Bryant Bannister, director of the Laborotory of Tree-ring Research, replied that he was enthusiastic toward the project, but was not permitted to loan us any instruments. He was very helpful instead in sending us several reprints and publications concerning Dendrochronology and informing us of The Ben Meadows Company in Atlanta where we could purchase a borer. A bit discouraged by our failure to procure a borer without actually buying it, we contacted the company and explained our situation. To our surprise, they offered(after another letter and a phone call) to send us an 18 inch borer, free of charge! (See appendix on correspondence for more information.)

Being a fairly delicate instrument, the increment borer must be used carefully and properly. As with any other precision instrument, one must perform frequent maintence procedures to keep it operating smoothly and to avoid deterioration. One major difficulty presented in taking a core sample, is hitting the pith. This can only be accomplished by carefully aiming the borer toward what the operator judges to be the center of the tree. Before actually turning the corer into the tree, several



a core that hit center.

Plate III

drops of oil should be applied to the threads. This helps cut down friction between the threads and the wood avoiding overheating which could damage the fine steel constituting the boring shaft, and dull the borer. Then, steadying the cylinder with one hand, and turning the handle clockwise with the other, slight pressure must be applied in the direction of the tree in order to enable the threads to obtain a grip in the wood. To avoid mangling the sample the corer must be kept very sharp. (See appendix on Sharpening.) The corer, at this point, should be at right angles with the tree trunk. Now, the corer can be turned to the center of the tree. Since a sample of only a radius of the reunk is needed, it is unnecessary to core past the center of the tree. In order to determine whether or not the core has reached the center, the handle (which is almost the same length as the corer) can be removed and held alongside the tree. This will show to what point within the tree, the corer has progressed.

The extractor spoon can now be inserted into the small aperture in the end of the boring shaft. This long metal spoon, when pushed completely into the shaft, passes underneath the core, between wood and shaft, and secures the end of the core with small metal teeth. The borer should then be turned one full revolution counter clockwise in order to break off the sample at the center which can then be removed by pulling out the extractor spoon. When pulling out the corer, one should follow the same procedure for turning it in, only turning counter clockwise with slight pressure away from the tree(slowly, again to avoid overheating.)

One must be careful when turning in the borer to notice any change in the amount of force needed to turn the handle. If the borer suddenly moves much more easily and ceases to move into the tree, it has hit rotten wood, and no meaningful data can probably be taken from such a core. It should then be removed and taken to the next tree. A similiar procedure should followed if the force needed to turn the handle suddenly increases. This means that the corer has hit a sap pocket or knot and should be removed immediately, for the force needed to drive the corer through such an obstacle creates too much heat and gums up the borer. If a corer's only source of resistance is a knot, then the borer can be inserted immedietely inserted by another path, to the center. If the shaft has encountered a sap pocket, however, the sticky pitch must be removed with a kerosene soaked rag before it can be used again. Hitting a knot or a sap pocket does not render the tree useless for data, it merely necessitates boring from another side. When carrying the borer any appreciable distance, it should be inserted into the protective handle in case it is dropped.

Before a core is removed from the extractor spoon, it should be numbered to avoid any question as to its origin. For this purpose, we designed an arbitrary identification system which would give all relevant information of a tree on a single 3X5 index card. On the top line of the card is written; first, the letters G.T., standing for Golden Trout; followed by a number representing the valley or area from which the core was taken;

then the transect number for that area; position on the slope; and, finally, the number of that tree. The "area" numbers 1, 2, 3, represent the main valley, the eastern valley, and the cottonwood lakes area, respectively. Number 7, however, indicates quite different. In travelling actoss the valley, several times we ran across a tree, not on a transect, which had some remarkable feature about it. Some were notably ancient; some appeared to be wierd, twisted statues. Very few actually yielded a suitable core, but those we did obtain were labled "special interest" and were not connected with the project's goal.

Next appear the numbers 1, 2, or 3 representing the number of the transect in the particular area. We divided a cross section of the valley into three parts; valley floor, middle slope and upper slope, represented on the card by X, Y, or Z respectively. Finally appears the number of the particular tree in question. If a double tree is cored, the two core samples are differentiated by a ".0" and a ".5" after the tree number, while if two cores are taken from the same tree, they are labeled A and B and are regarded as two cores but only one tree. On the upper right hand corner of the card is marked the letter representing the direction from which the borer entered the tree.(either N, S, E, or W) Other information designating tree species, or, when no core can be obtained, the words "too small," "dead," or "rotten" appears on the center of the card. If there are any peculiarities about a tree that might conceivably alter growth rings or tree structure, a description appears in this same space.

After a sample has been catalogued, it should be wrapped in wax paper and marked with a peice of tape bearing its identification numbers and letters, as seen on its card. These wrapped and labeled cores should then be placed in cardboard tubes so that they may be safely transported, as they are fairly fragile and give the best data when whole.

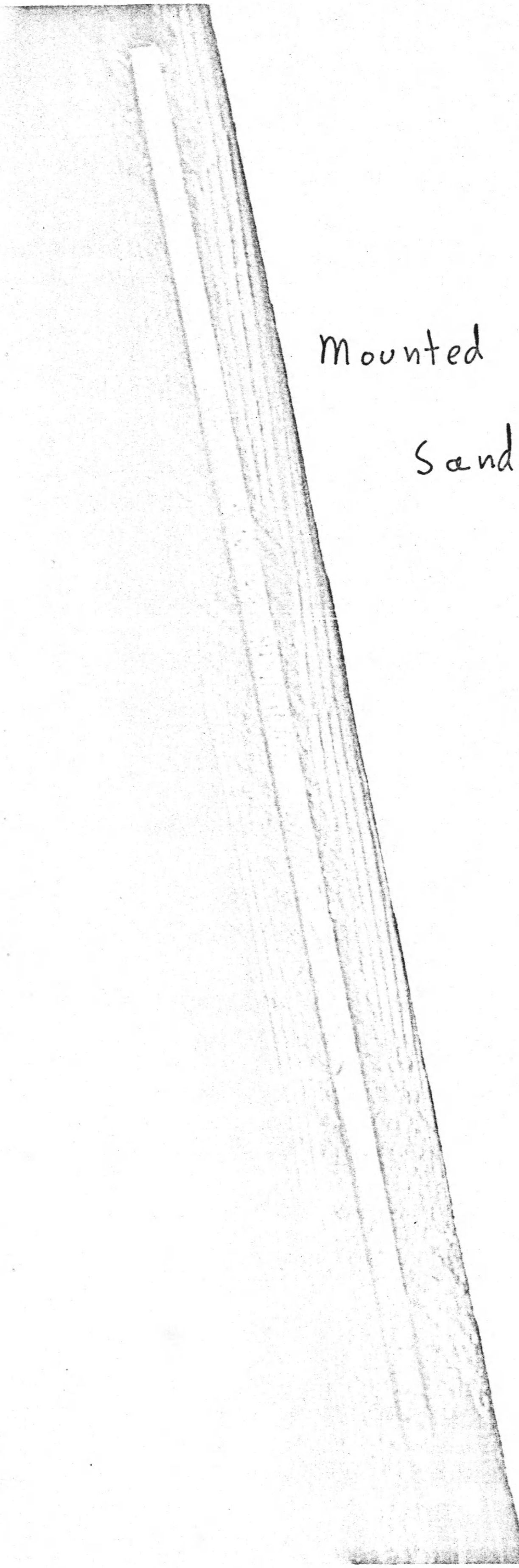
Preparing Data

Once the cores are in the laboratory they can be prepared for measurement of the rings under a dissection scope. "Cores are mounted in a grooved stick to facilitate handling and storage. The mount, specially milled from a piece of clear wood, is [for our purposes approximately,] 3/8 inch wide by 1/2 inch high, and of sufficient length to accommodate the core. One of the narrow sides is grooved to hold half of the core, and the shoulders are sloped. Cores should be air-dried prior to mounting so that they will not shrink and crack after they are glued in place. When cores break in the field, sequential numbering of fragments will aid in reconstructing the core for mounting.

"The specimen number and such notes as the species, site, and collection date are written on the mount in pencil....

"A thin stream of permanent glue (a plastic glue is preferred because it will not crystallize) is spread evenly in the groove, and the core is inserted with the bark end to the observer's right. The original verticle cell structure is placed in the groove tilted toward the observer at an angle of 30° to 45° above the horizontal. The cell alignment can be detected by examining the cell structure at either end and by the sheen on the sides of the core caused by the shearing action of the borer. The core is pressed firmly into the groove and wrapped tightly and evenly with string to hold the core firm while the glue is drying.

"A surface may be prepared by either a microtome or a sanding technique. A razor blade, preferably a larger-than-average size,



Mounted and

Sanded core.

Plate IV

used in a sliding, drawing action will provide a smooth cut. A blade holder, especially one that will allow a little flexibility in the outer portion of the blade, will facilitate the operation."[3] We used the method using a razor blade.

To actually measure the annual growth rings, the mounted core must be placed under a dissection microscope with the bark end at the observer's right. The rings themselves are measured in from the bark to the center and can be measured fairly easily with a metric slide. The width of each ring should then be recorded next to each ring number. In the event of a core not containing the actual center of the tree, it is safe to estimate the number of missing rings, and include the approximation on the data sheet.

If a prepared core, when observed under a microscope, has marred or otherwise unmeasurable rings near the bark, the rings can be counted from the center outward at least 120 rings. By making these measurements and comparing them to the compiled measurements of other trees in the area certain ring patterns can usually be discerned which are apparent in both. When these patterns are aligned, the year on the master chronology with which the center of the damaged core is matched can be considered the "birth year" of that specimen. With this knowledge one can easily determine the age of the sample.

These ring patterns can be most easily noted and compared with other samples when expressed in the form of annual growth ring indices.. "An exponential curve is fitted to each series of ring-width values, and measured ring widths are divided by yearly values of the fitted curve. This transforms the ring-width values to

[3] Ibid pg. 186-187.

tree-ring indices which exhibit a mean of 1.00 and a variance that is independent of tree age, position within the trunk, and mean growth of the tree."[4] (A copy of the computer program we used to perform this exponential fit appears in the appendix under the heading "Computer Program.")

[4] Ibid pg. 191.

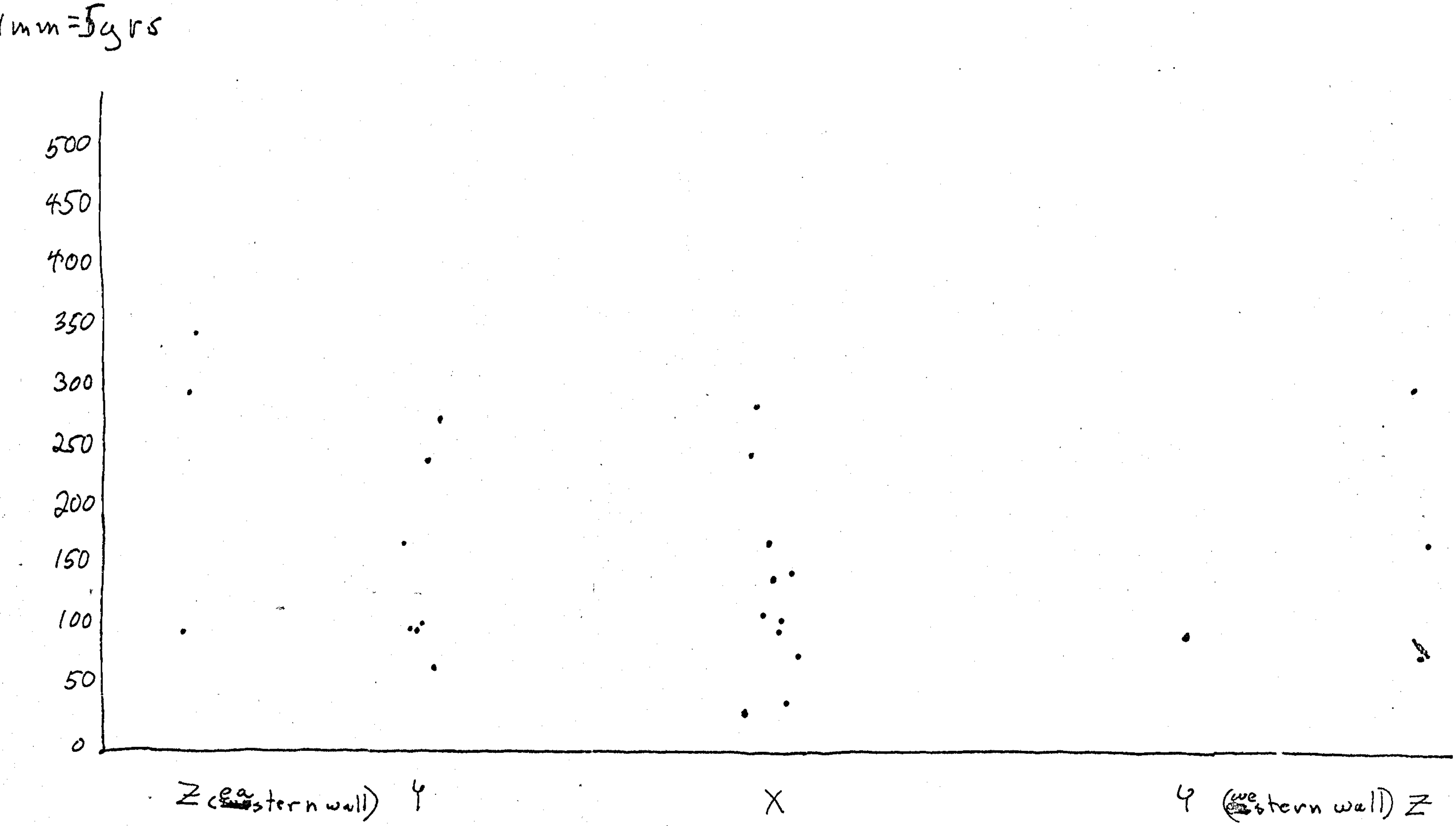
Conclusions

Graphs and Charts on Age

In the following graphs, those representing age versus transect should dip, while, those representing age versus section should not. The former can be explained by the theory that the trees in the X section are younger than those of the other sections. The latter should be true due to the hypothesis that the trees in a given section should not very much in age from transect to transect.

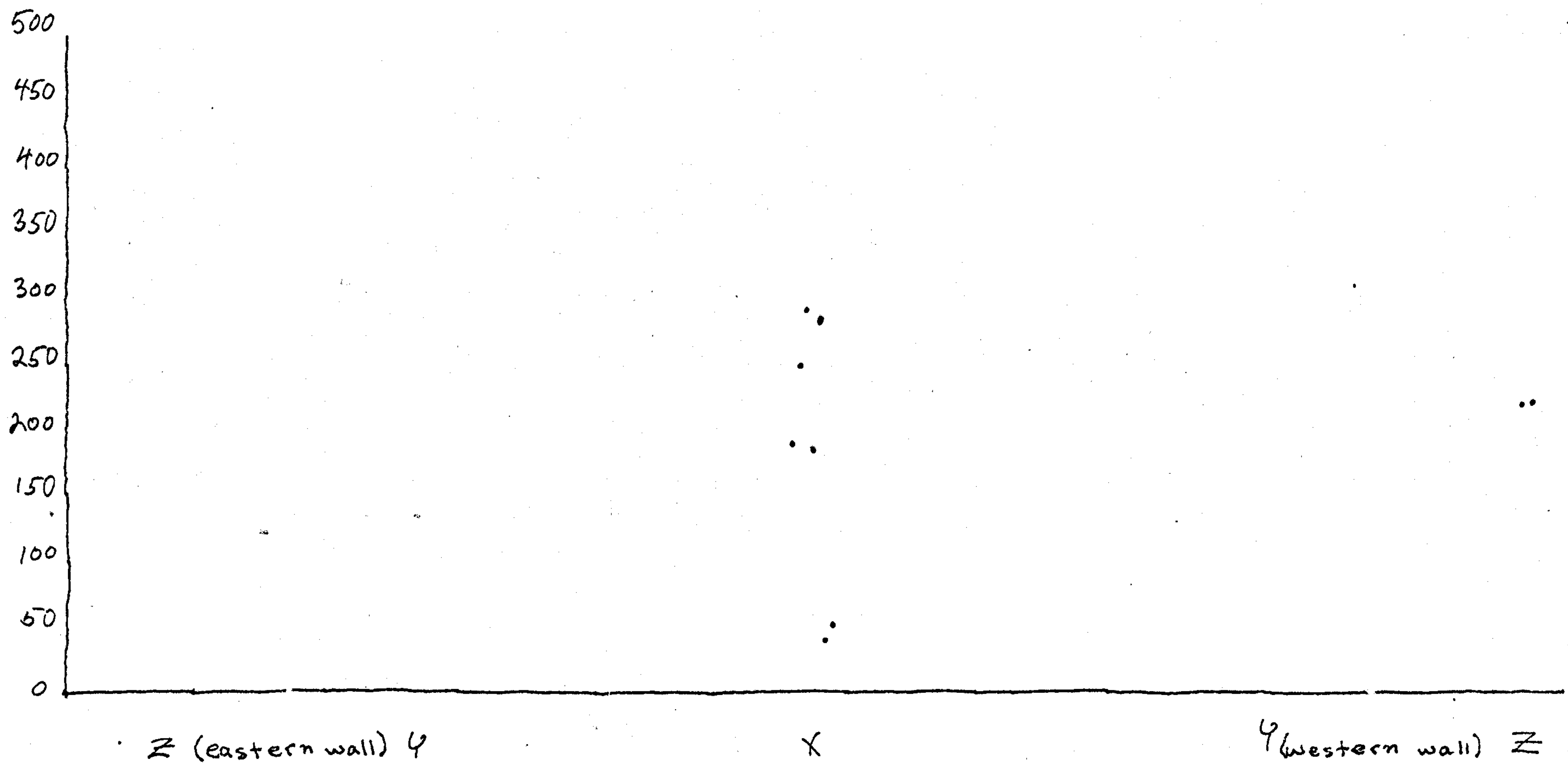
The age versus transect graph for transect two, and the age versus section graphs for the Eastern Z, Eastern Y, and Western Y sections are inconclusive. This is due to an insufficient number of points caused by very small Y sections and the presence of several trees whose cores were marred and had to be measured 120 rings from the center. The graph representing the age versus the Z sections is inconclusive due to the fact that no trees were present in the Z section of the third transect on its western wall.

The age versus transect graphs for transects one and three, and the age versus section graph of the valley floor, could possibly give relavent information. These are not conclusive but hint that the trees in the X sections are the youngest. In order to check this data more thoroughly and to make possible conclusive findings evident, a table was compiled. This table lists the number of each class of tree (Rotten, Dead, Too Small, Cored, and Total) in each section of each transect. The numbers of rotten and dead trees were included so that other possible relations could be seen. The numbers of trees which were too small to core, along with those which were, in fact, cored, appear on the chart to make more valid relations possible. The number of small trees, obviously younger than those cored, is suffucuently large in the X sections and sufficiently small in the Y's and Z's, to influence the age distribution along the transects, although no actual data could be obtained. The fact that the small trees did not give data which could be graphed, explains why the graphs are relatively poor indications of the theory that trees are younger in the valley floor aner, but a simple inspection of the chart does prove this to be true.

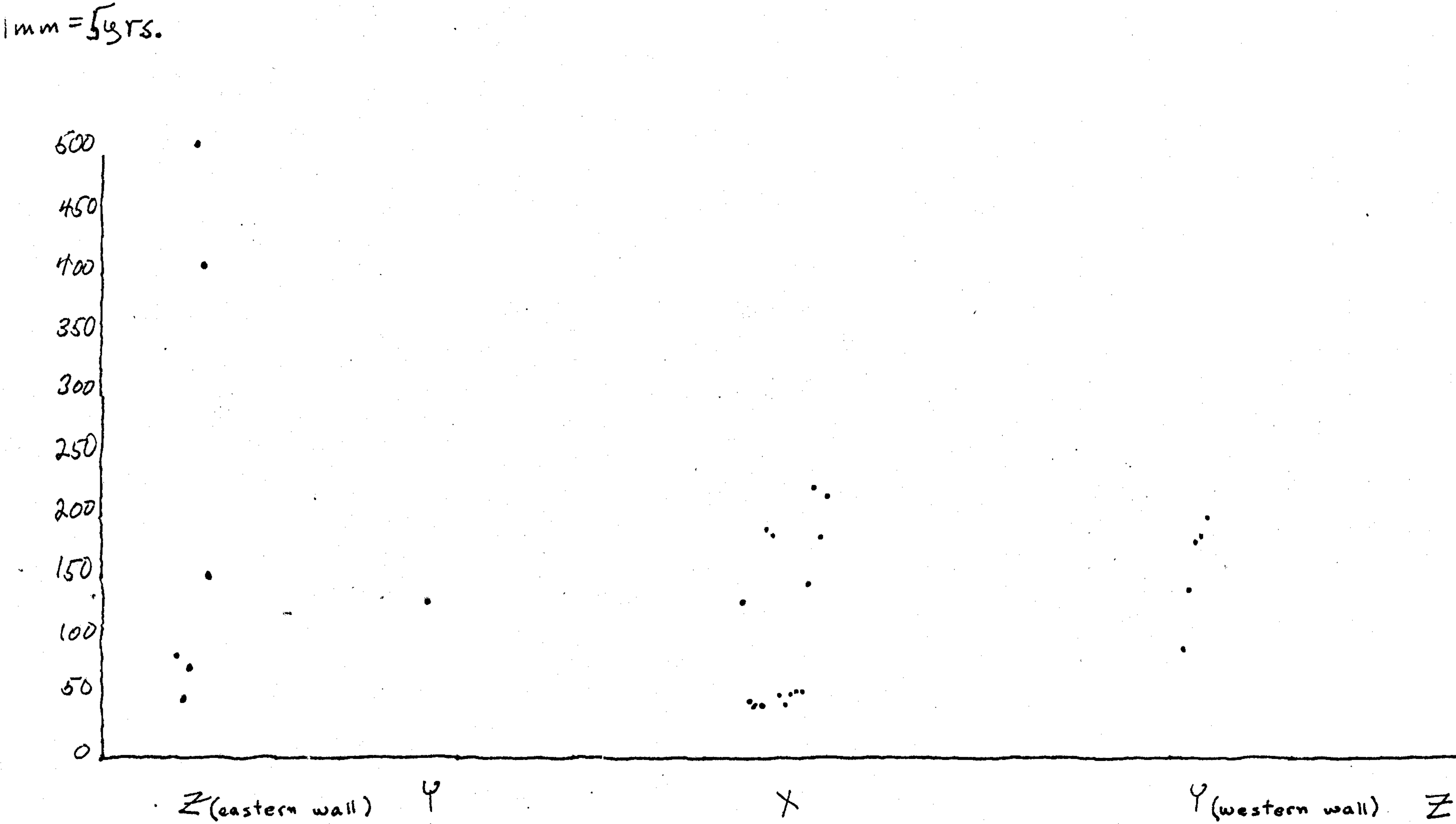


Main Valley. Transect One.
Age vs. Transect

1 mm = 5 yrs.

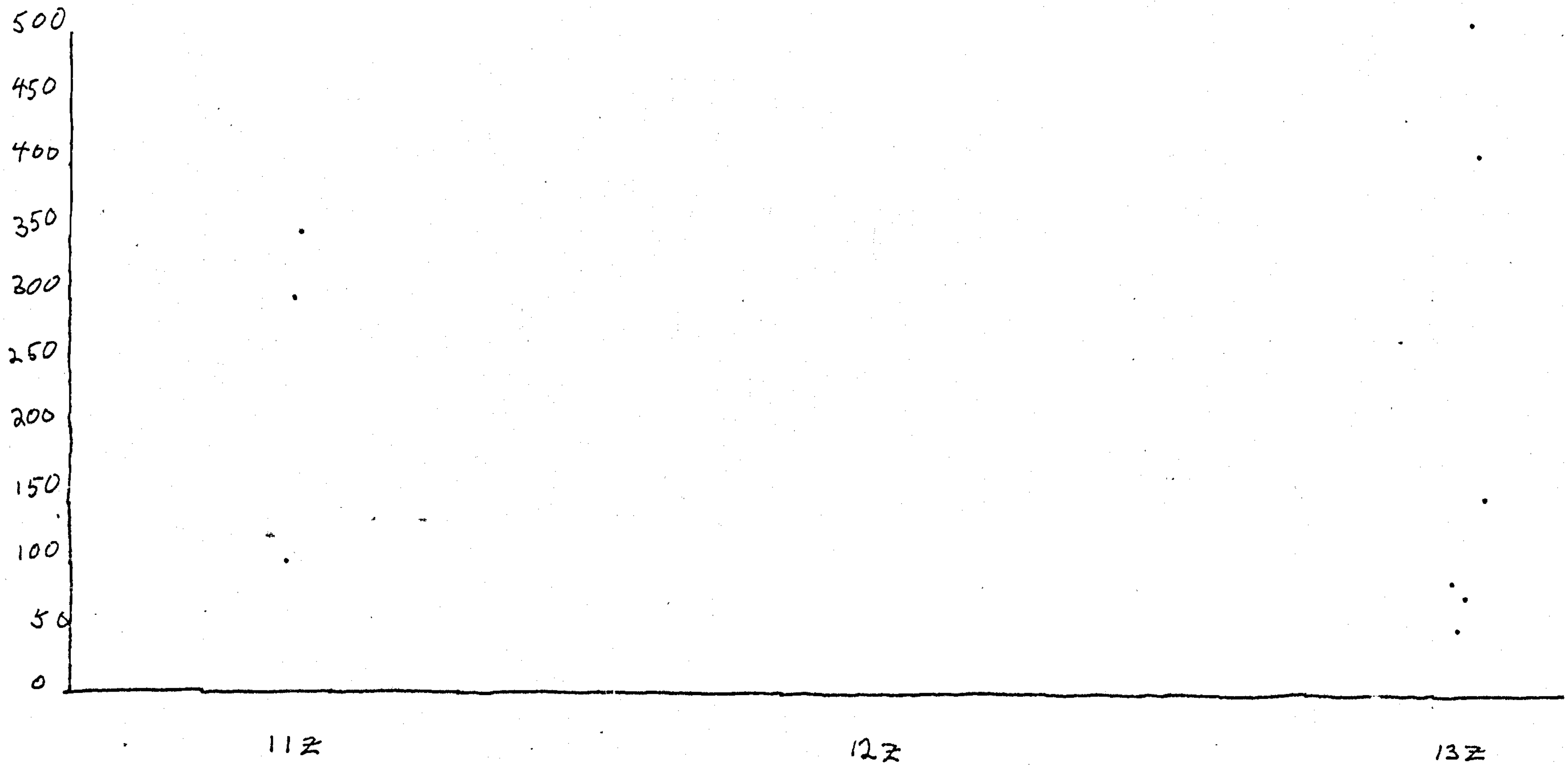


Main Valley. Transect Two.
Age vs. Transect

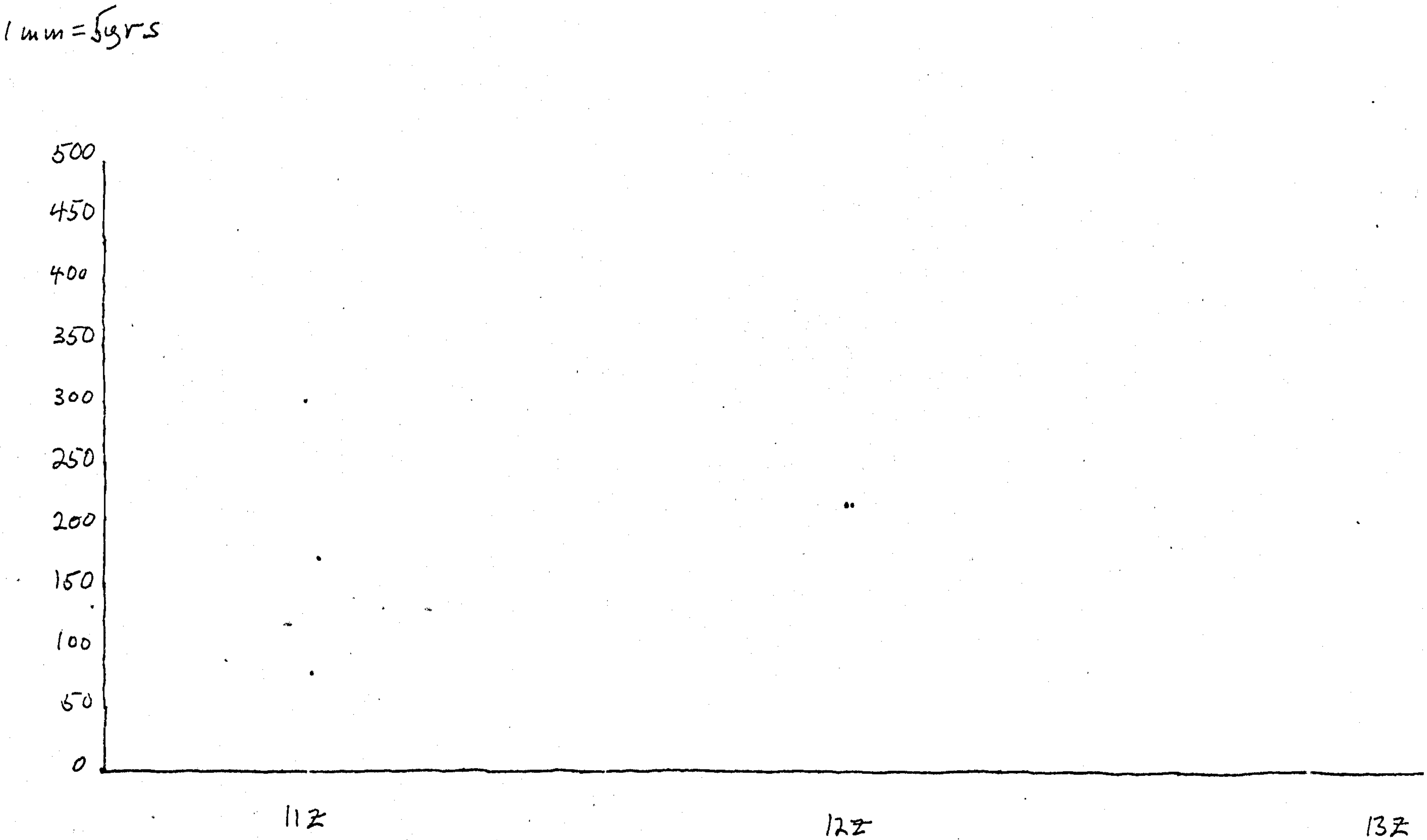


Main Valley. Transect Three.
Age vs. Transect

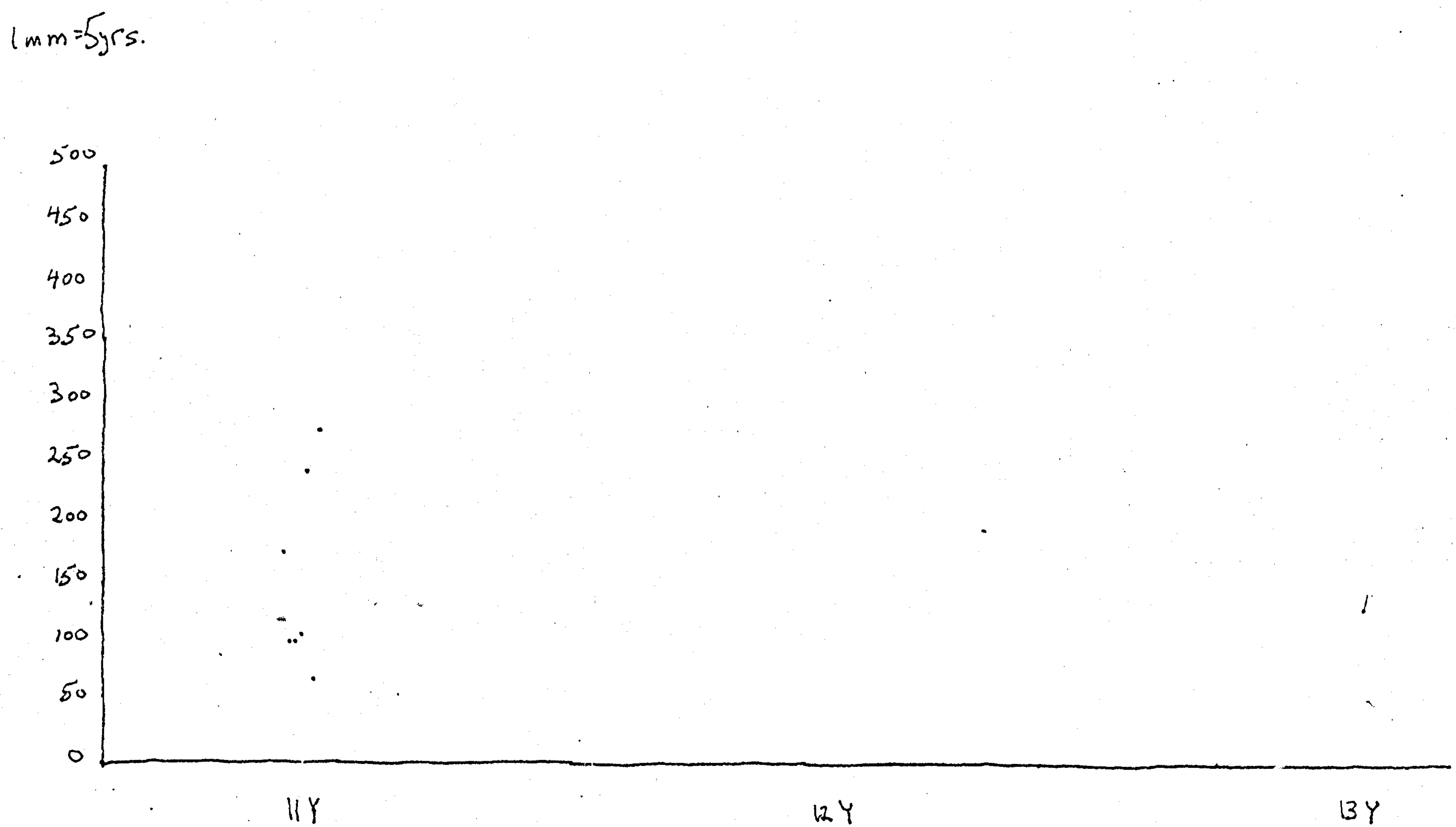
1 mm=5yrs



Main Valley. Eastern Wall. Z sections.
Age vs. Section

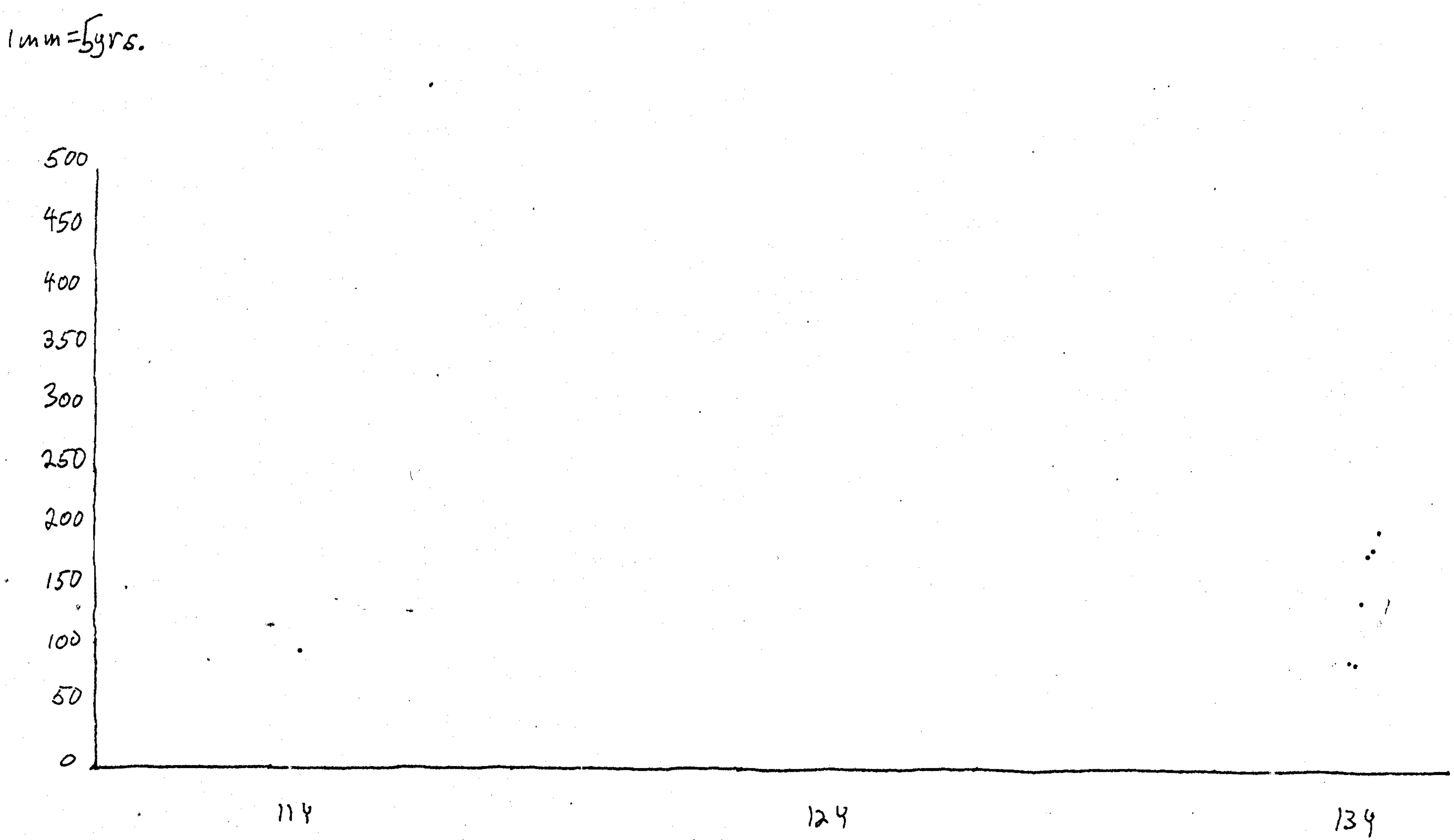


Main Valley. Western Wall. Z Sections.
Age vs. Section



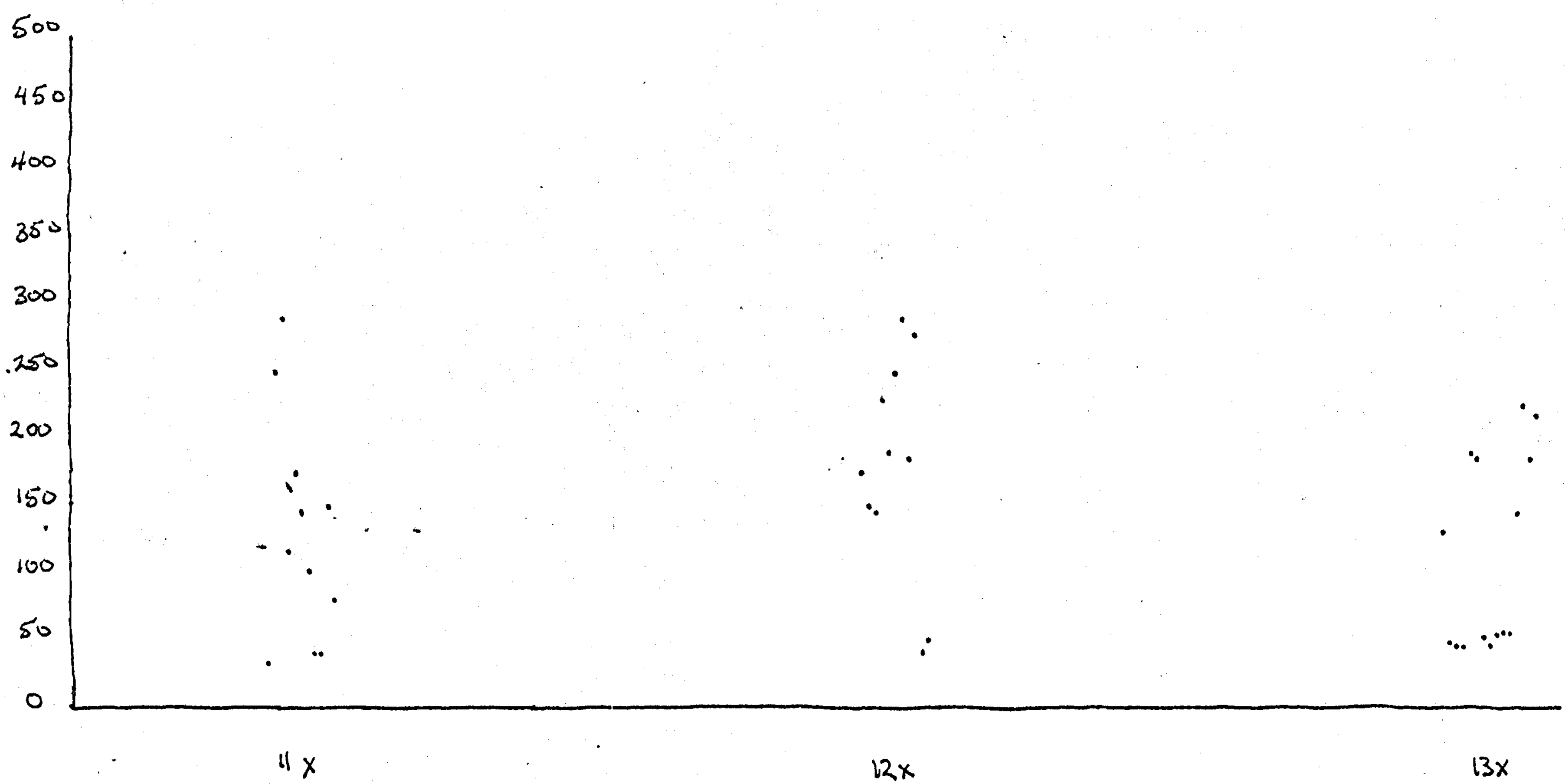
Main Valley Eastern Wall Y Sections

Age vs. Section



Main Valley. Western Wall. Y Sections
Age vs. Section

1 mm= 5yrs.



Main Valley Valley Floor X Sections

Age vs. Section

Chart on Condition of Trees

Transect One

Section,	Altitude.	Rotten,	Dead,	Too Small,	Cored,	Total.
Z(E)	10,560 10,480	4	2	0	3	9
Y	10,480 10,320	3	4	1	9	17
X	10,320 10,100 10,240	4	1	36	16	57
Y	10,240 10,480	1	1	0	1	3
Z(W)	10,480	5	2	2	8	17

Chart on Condition of Trees

Transect Two

Section,	Altitude.	Rotten,	Dead,	Too Small,	Cored,	Total.
Z(E)	10,640 10,500	3	2	2	3	9*
Y	10,500 10,320	1	1	0	2	4
X	10,320 10,100 10,350	1	5	8	17	31
Y	10,350 10,750	0	0	2	1	3
Z(W)	10,750 12,000	3	2	0	2	7

*There appears to be a mistake in addition due to the fact that one tree in this area had two cores taken, but it counts as only one tree in the total.

Chart on Condition of Trees

Transect Three

Section,	Altitude.	Rotten,	Dead,	Too Small,	Cored,	Total.
Z(E)	10,880 10,560	3	2	1	9	15
Y	10,560 10,300	2	2	1	5	10
X	10,300 10,100 10,450	2	1	24	32	59
Y	10,450 10,800	3	2	1	7	13
Z(W)	10,800 12,000	[no trees due to rock wall]				

Table on Species

While coring the transects, we developed the hypothesis that there were a greater number of Lodgepole pines in the valley floor area than on the walls. The following table proves this beyond all doubt.

Table on Species

Transect & Section	Species: Lodgepole,	Foxtail,	Limber,	Whitebark.
11Z(Eastern)	0	8	0	0
11Y	3	11	0	0
11X	56	0	0	0
11Y	1	0	1	0
11Z(Western)	2	9	0	1
12Z(E)	0	6	0	0
12Y	0	3	0	0
12X	24	2	0	0
12Y	1	2	0	0
12Z(W)	0	5	0	0
13Z(E)	1	8	2	2
13Y	6	3	0	0
13X	57	1	0	0
13Y	5	3	0	0
13Z(W)	[no trees due to rock wall]			

Graphs of Ring Widths

The following graphs are of ring widths versus age. As a tree gets older it grows less each year. For this reason the Exponential Fit is used to allow easier comparison of a series of years. (See "Preparing Data")

Trees located in harsh climatic conditions yield a large variance of annual ring index values, which allows good comparisons to be made. An overly sensitive tree, or one subjected to exceptionally harsh conditions, shows annual ring widths of such great span, that an exponential curve cannot be conclusively fitted to its graph. Complacent rings, that is, rings that do not vary significantly, also are difficult to fit. Because a tree grows less each year, the values of its ring widths have an initial high point at the center of the tree and slope smoothly downward toward the bark, as seen in the following graphs.

The age axis of each graph was devised so as to make the season of '71-'72, year 1, and, for example, the number 10, to be 10 years ago. In theory, this would imply that the annual ring index for a particular year (ie. 10) would be the same for all other trees for that particular year.

Since most of these graphs represent "A tree ring sequence exibiting extreme sensitivity, having almost the appearance of erratic growth, [they] may contain less than 90 percent of the annual rings along a single radius and thus be too difficult to use initially in chronology building, but ultimately...may provide an excellent climatic record."[5]

(It should be noted that a core of a tree does not contain rings for the period of its life prior to the time it reached the height at which it was drilled. One method was suggested which would enable us to determine the number of rings missing for this reason; however, within a given section, trees of the same height varied in age, as much as ten years, which, due to the small age of the trees, is a considerable source of error. Because of this discrepancy, we did not attempt to make any adjustment for any ring loss due to the height at which the trees were cored.)

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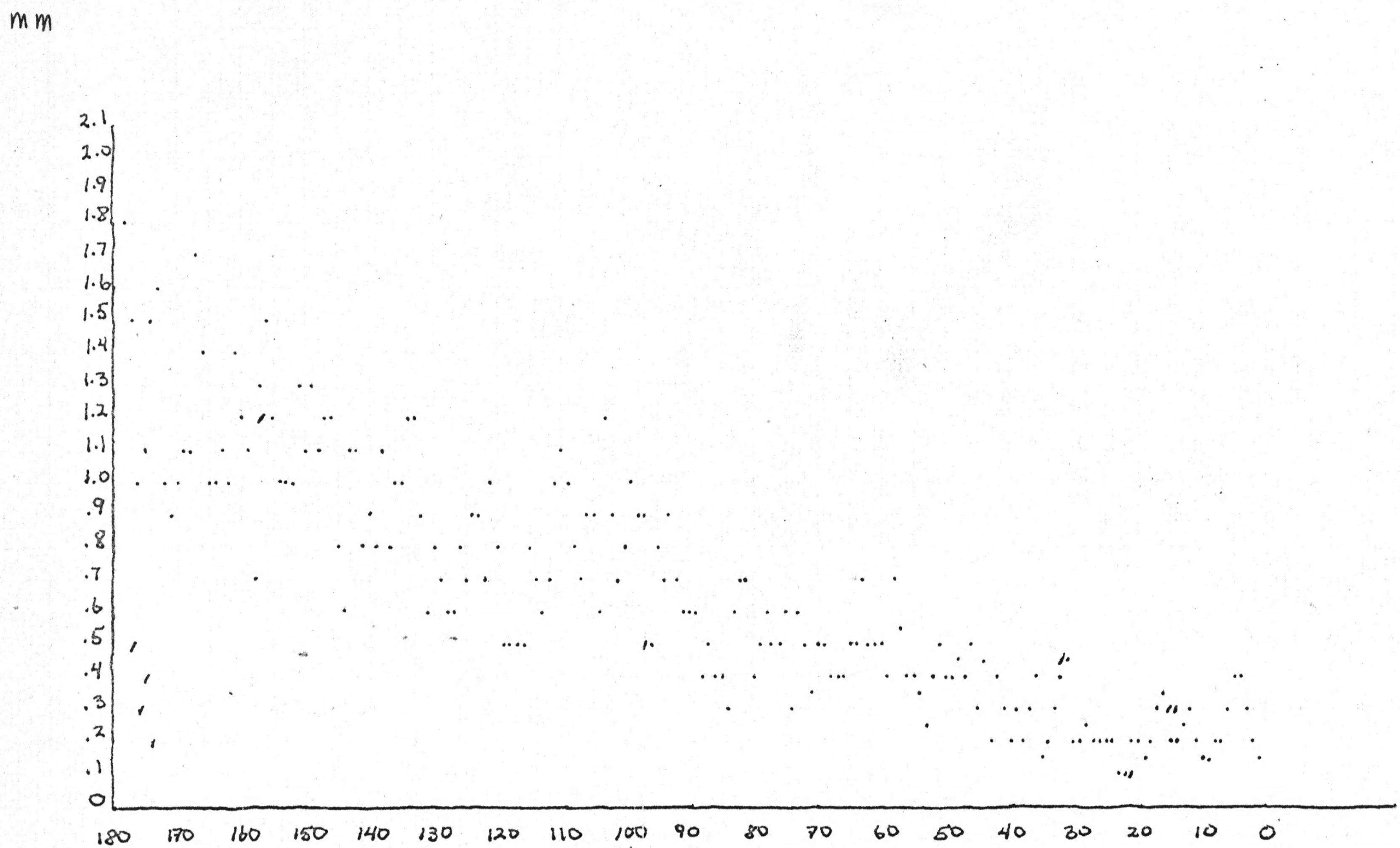
[5] Ibid pg. 192

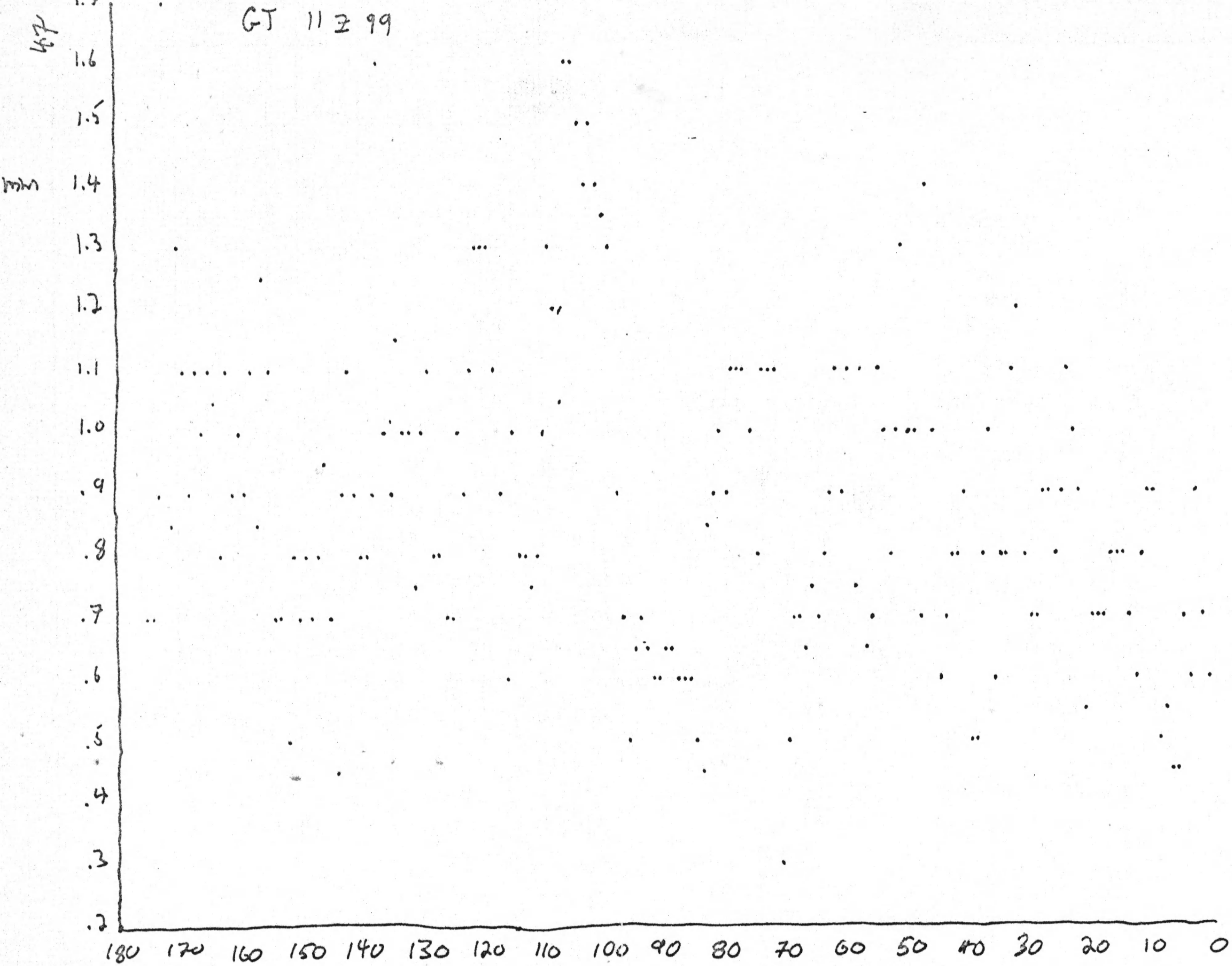
GT 11 Y 10



Foxtail

1 mm = 1 yr.

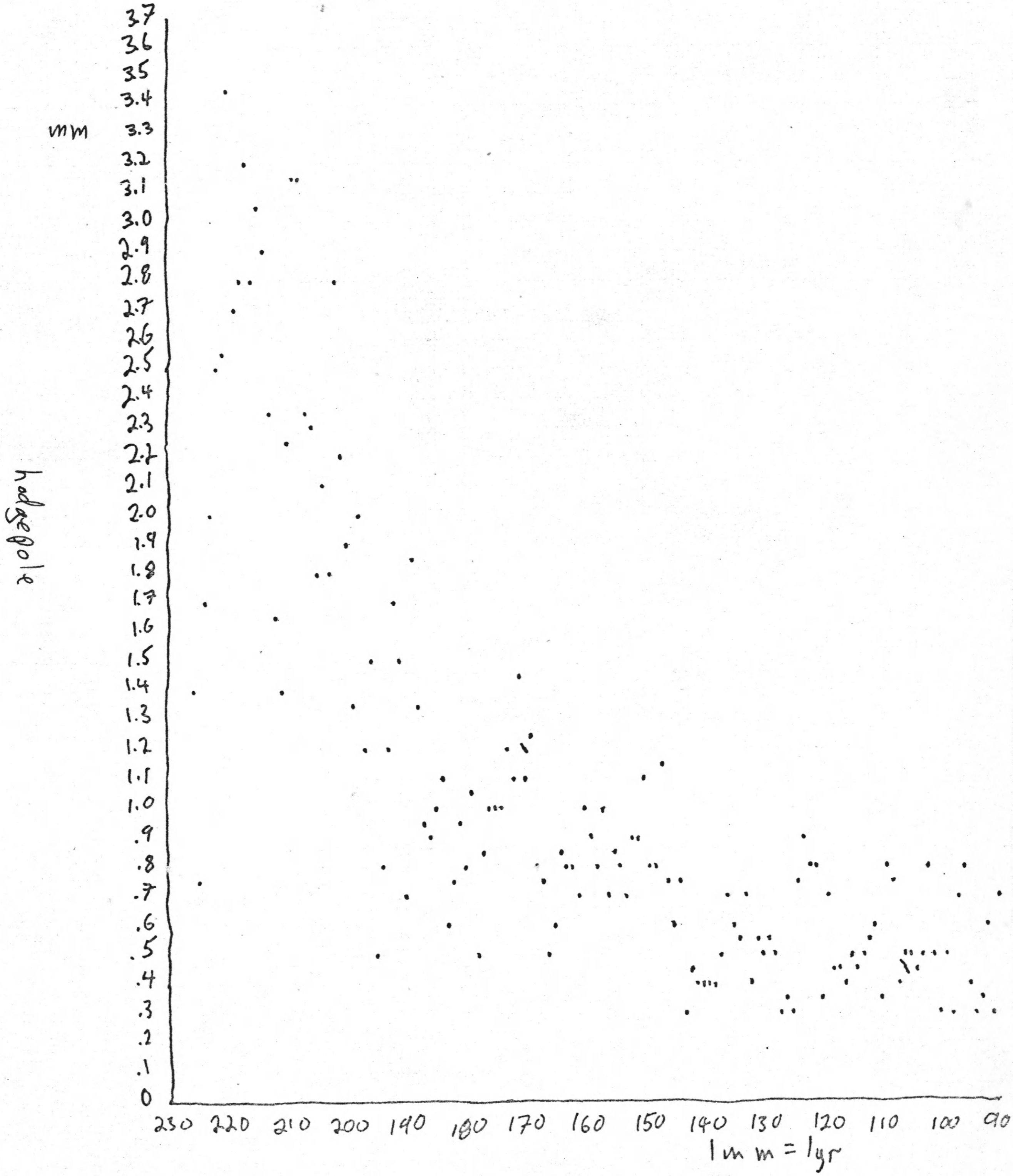
GT 11 Z 99



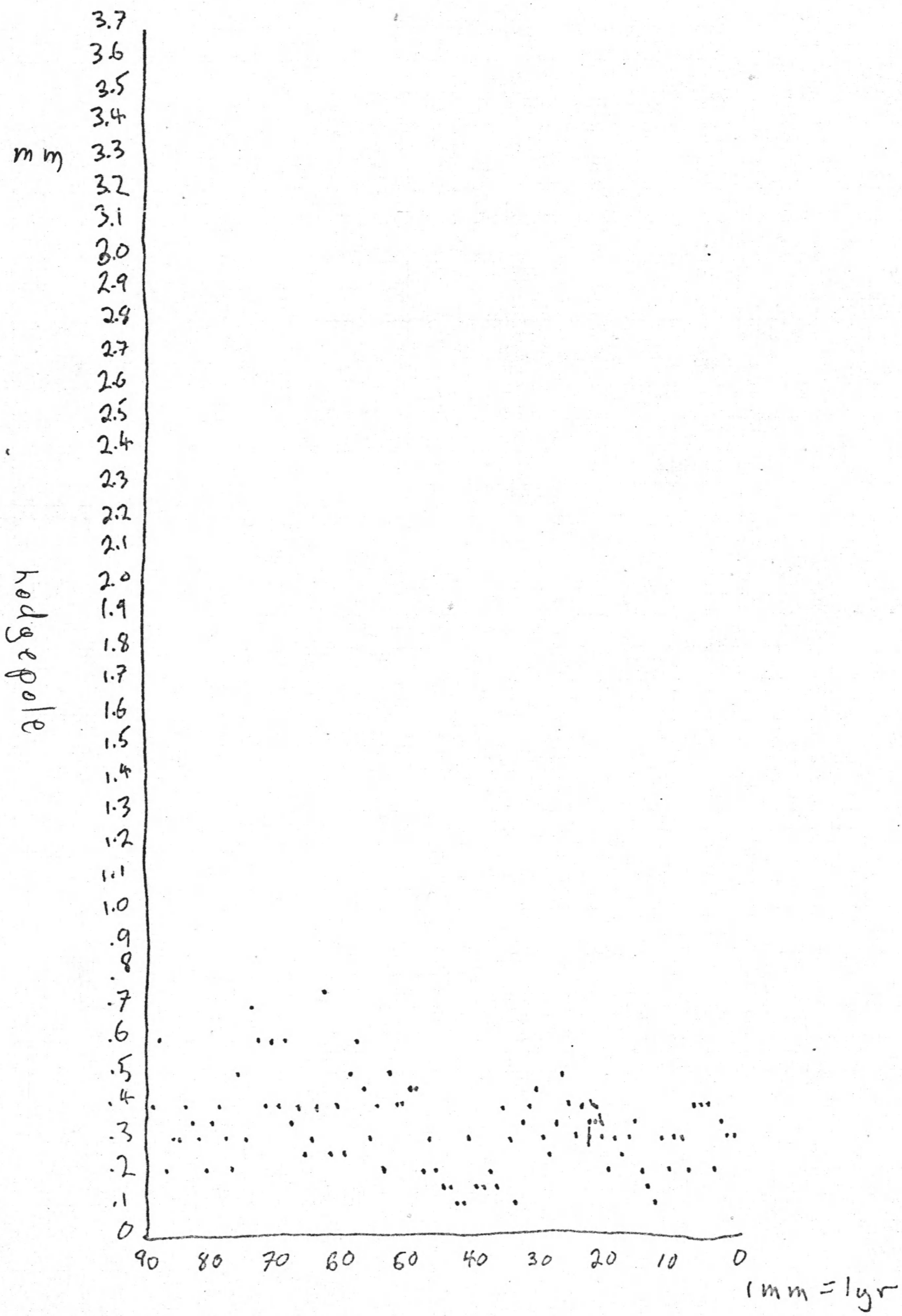
Foxtail

1mm = 1yr.

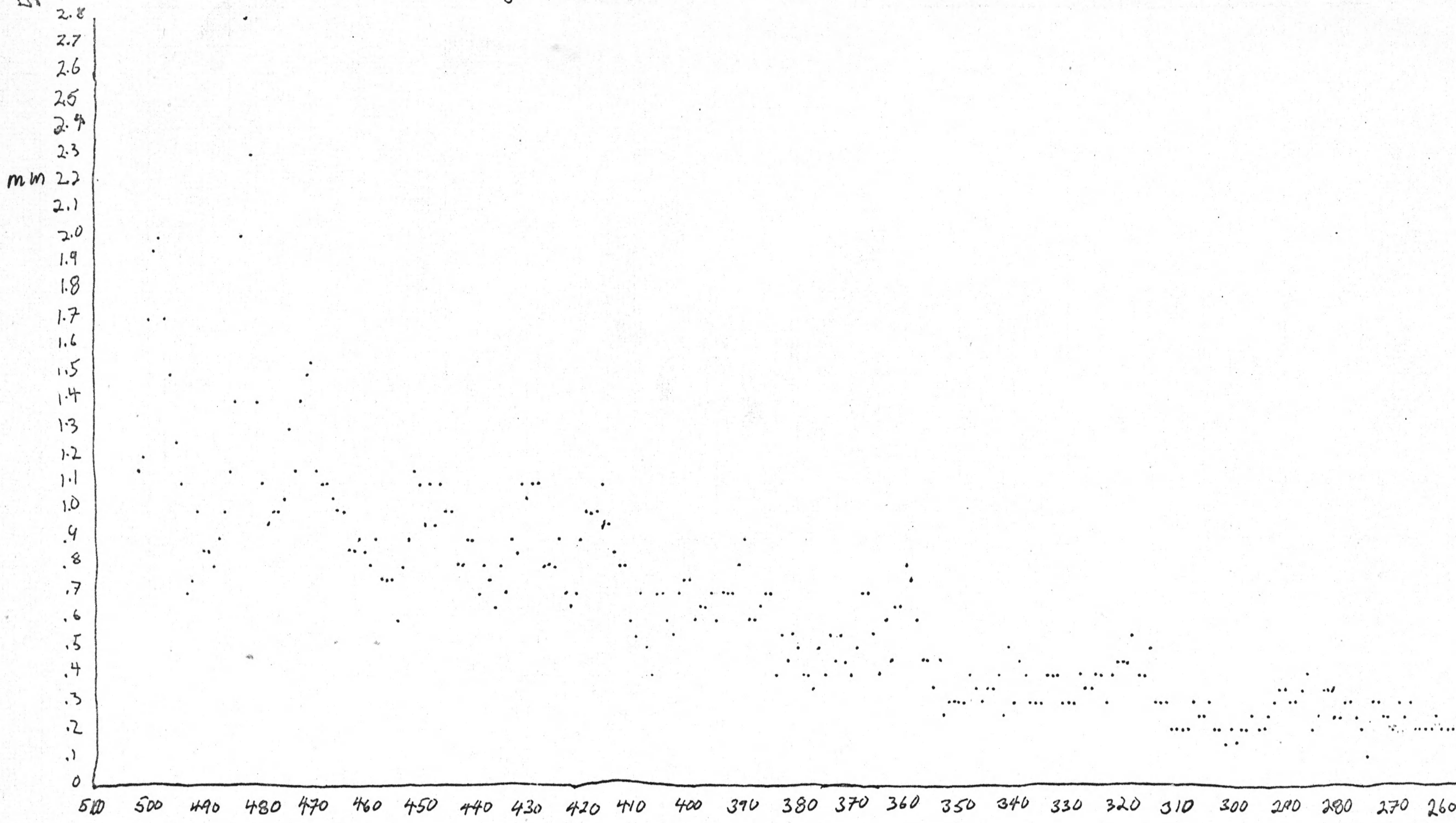
GT 12 X23 (see next page)



GT12X23 (cont. <90 yrs.)



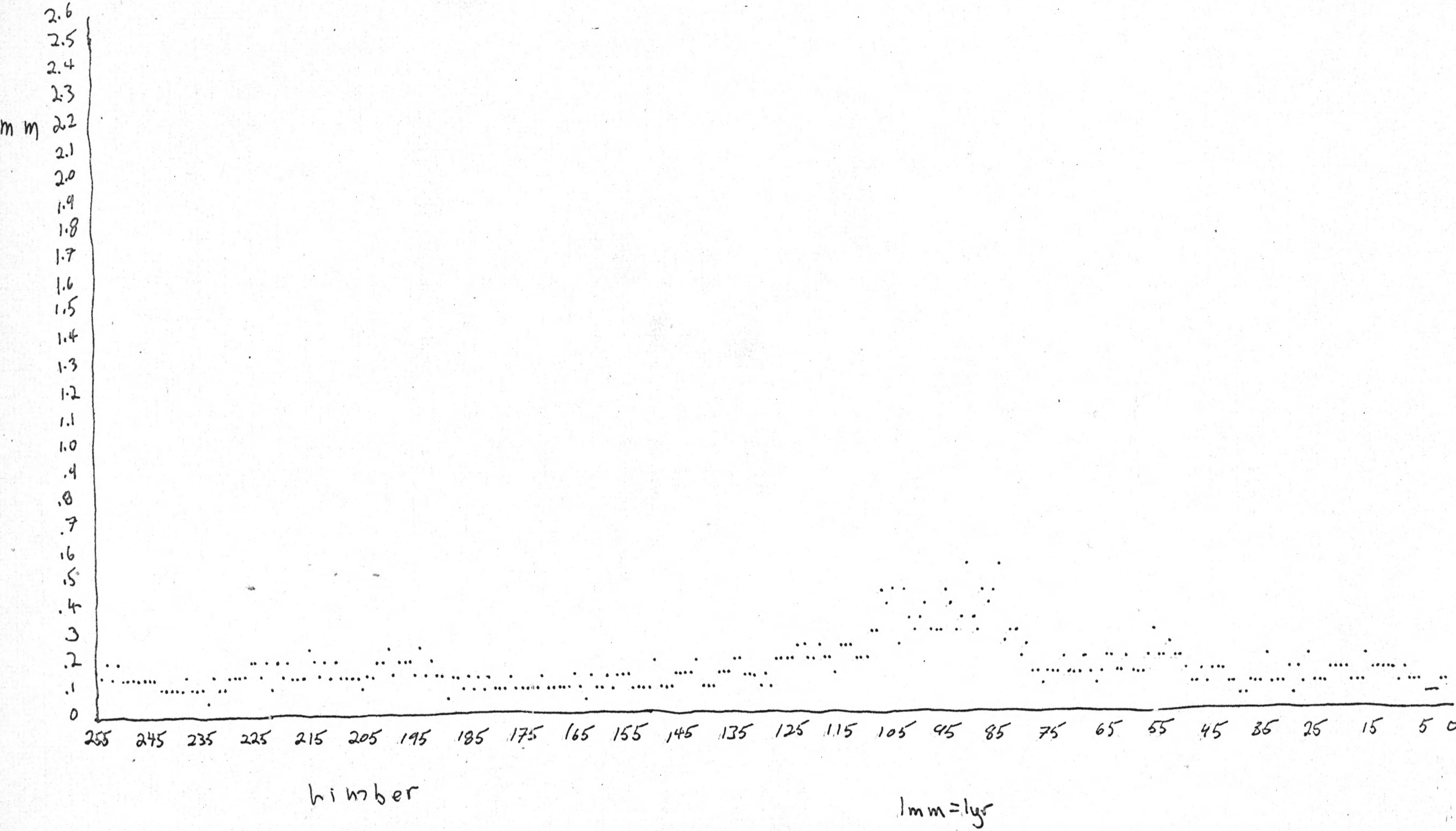
GT13Z8a (see next graph →)



himber

1mm = 1yr.

GT137 8.0 (cont. < 255)



Soil Testing

In walking the transects, we paused once in each section (X, Y, or Z) to collect soil samples of that particular area. In testing these samples for Potash, Phosphorous, and Nitrogen content, we were unable to obtain results with more variance than the accuracy of the test. If we had placed more emphasis on the soil testing aspect of this project while in the Golden Trout area, we would have collected a greater number of samples from each section so that comparisons would be more noticeable. Our hypothesis would be that there are only minute differences in soil content with the possible exception of the meadow area. This is probably due to the fact that a river runs continually through the meadow, moistens the ground, and carries down minerals from the Cottonwood Lake region, concentrating them in the flat meadow.

Summary

We were given an idea by Mr. Ernest DeGraff that the forest, in particular Lodgepole Pines, in the Golden Trout region is enroaching on the meadow. This is obvious at a glance, as certain sections of the meadow have already been crossed by stands of pines. This hypothesis becomes fact due to the evidence shown in our conclusions. That is, trees in the meadow, mainly Lodgepole, are very young and have just begun to close the meadow.

Professional Aids

Bryant Bannister

Mr. Bryant Bannister, director of the University of Arizona's Laboratory of Tree-Ring Research, has been of invaluable aid to us throughout the project. Although, we assume, quite a busy man, he not only took the time to reply courteously to our letters, but accompanied his personal ideas with various publications relating to dendrochronology. These very informative works presented results of similiar, although more advanced, studies in the field.. It was through reading these pamphlets that we gained most of our knowledge. Included in these pamphlets was a list of publications in dendrochronology since 1950, put together by the staff of the laboratory, in which Mr. Bannister had actually taken the trouble to check a book which he felt could be of special interest to us. This man also aided us in our search for an increment borer by giving us the address of the Ben Meadows Company in Atlanta, a manufacturer and supplier of these instruments. Mr. Bannister has our sincere thanks, and we recommend that a letter to him should be a prerequisite to any further study in dendrochronology.

Vernon Burandt

If ever one visits the Lone Pine area, if he is at all interested in the forests and mountains there, he should go out of his way to speak with Vern Burandt, Fish and Game Warden. Here is a man whose sincere dedication and will power seemed to us to be beyond compare. He is a man with a purpose, who does not falter in the face of public disfavor or official "advice." Whenever we spoke with him, the animated discussion lasted quite some time even, if he was late for an appointment. His main concern is the development of the Trail Peak recreational facility, which he opposes vehemently. It was through his discussions concerning this area that we learned of his outstanding personality and active mind.

He is the vision of a hardy backpacker, and seems to be personally aquainted with everything in the forest. In his back yard, he keeps a year-round organic garden from which he gleans his families vegtables. He once told us, in a discussion on attitudes toward ecology, that youth was the promise of the future. An example of his stalwart dedication to the wilderness and its tenants was cited to us by his wife. One morning, about 2:00 AM, the Highway Patrol telephoned Vern that an animal had hit by a car and was either dead or injured. Vern wanted to drive to the scene that instant, but dissuaded by his wife, remained home till morning, whereupon he drove immediately to the sight. The animal was dead, but had not been for long. The concern and feeling which he exhibited here for his animal protectorates, we feel is a most commendable quality.

He is a most remarkable man, and a great pleasure to know.

Earnest DeGraff

Mr. Earnet DeGraff, a candid, friendly man, performs the task of a forest ranger in the Mt. Whitney area. In our conversations we learned enough to discern the species of the trees to be cored. In addition, he had a wealth of practical knowledge not relevant to our particular project, but of great personal interest, such as his views on the regulation of campers in the national forests. He is in support of an effective but somewhat controversial form of backpacker regulation known as the forest permit. This is a permit for which a camper may apply, on which he states such information as what campgrounds he intends to use, what trails he plans to walk, the number of people in his party, and his destination. While some people feel this is an outrageous infringement on their freedom in the wilds, the forest permit is aimed at keeping those same wilds beautiful, so that others may enjoy them in years to come. One goal of this control is to reduce wear and tear on campsites and trails by diverting the streams of summer campers to equally beautiful, but less used areas of the wilderness as opposed to allowing them to congregate year after year in the same, popular area, resulting in the eventual ecological ruin of that area. Mr. DeGraff cited one case, an example of the hardships endured by a ranger, in which a well known wilderness organization had applied for a permit to visit a certain area on one of their organized outings. The ranger in reviewing the request, found the number in the party to be almost twice the permissable number allowed in one campsite. He informed the organization that their permit would be granted if they would merely split the party in two at the end of each day's hike and lodge in seperate but neighbouring campsites. This would prevent otherwise unavoidable trampling of the campgrounds in question. This was a simple request and would not have inconvenienced the campers very much, in that there was no rule against intervisitation between camps, but the organization decided to contest the decision and as last we heard were attempting to override Mr. DeGraff by challenging the forest service's legality in dening them a permit.

Whenever we visited his office in the Forest Service building on Main Street in Lone Pine, we assaulted him with a battery of questions, each of which he answered completely, and tirelessly. He once gave us over an hour of his time explaining differentiations in tree species. He is a pleasure to work with and an interesting man to know.

The Ben Meadows Company

We found the Ben Meadows company in Atlanta very hard to reach by mail, which necessitated several phone calls to Georgia. But once in contact, they proved to be very helpful and, by donating a $54.00, 18-inch, borer to our cause, saved us from much financial strain. When it became apparent, during the course of the project, that we would need another, longer borer to complete our work, the school purchased a $90.00, 24-inch, borer also from the Ben Meadows Company. We greatly appreciate the help of the Ben Meadows Company, and suggest that, if any other equipment along these lines is needed in the future, their catalogue be consulted. (This may be obtained through Mr. Warren.)

William Paterson, III

A florist in Montgomery, Mr. William Paterson, III, upon receiving a request from us regarding the aquisition of a soil testing kit, graciously donated a kit. Later, he sent us an article on the possible use of the results. Unfortunately, soil conditions in the Golden Trout area do not vary significantly, and no conclusions could be drawn along those lines. Mr. Paterson's gesture, however, was very much appreciated.

Afterword

Up to this point, what we have learned in the persuit of this project in Dendrochronology has been presented in the form of a "How to do this" manual with results shown by a series of graphs and tables. When we first concieved the project, none of us knew much more about Dendrochronology than perhaps the definition of the term, but in about ten weeks, a short time allotment for the study of any science, we have achieved some degree of competence in the field. To start from scratch in any form of study and to achieve even mediocre results, awakens a keen sense of achievement on the part of those involved. We feel this, and judge it to be of an importance at least equal to the actual completion of our work.

But, during our stay in the high sierras, we gained a kind of knowledge which could never be presented by a graph or taught through a manual. This experience of life, ~~which~~ for us had never been felt so keenly as in that log cabin, in a rich meadow, miles from civilization. Here, there is time to think. to really think, of the meaning of the past, the wonders of the present, or the promise of the future. Here, worldly worries seem to fade away, and the mind is occupied by only one thing: to live life as it should be lived, from day to day, milking each hour of its possibilities and reveling in the unsurpassed beauty of a land unspoiled by man. From high in the mountains, one can see the turmoil of what is everyday life for countless millions with perspective. The world seems actually to revolve more slowly and one is overwhelmed merely by this perception of time. Imagine yourself in the heart of Los Angeles if suddenly there was dead silence. The noise, hardly noticeable before, in ceasing, jars every nerve. Ears ring in the silence. This is the feeling one experiences when he is thrown from the city into the wilderness. At first the mind rushes about its business as before, but suddenly, it is done. It waits for the next set of problems and irritations to assault it, but none come. The vision of a life liberated from mundane and repetitious tasks, overwhelms it. Every nerve is jarred, and the being is totally perveded by the realization that it is not enough for man to exist, he must live, and in the crimson splashed mountain sunset, contemplate, and revive the fires of forgotten dreams.

Appendix I <u>Litter</u>

One of the few environmental problems that threatens the Golden Trout Cottonwood Lakes area is that of sanitation and refuse. Even though being a wilderness area, it presents a prime invitation for the thousands of riders, campers, and fishermen that flock there each year. Yet the refuse and sanitation problems which these people bring along with them gravely endangers the area, a threat to which many of our national parks have succumbed. On many occasions we have witnessed these problems both in the Golden Trout area and in the Cottonwood Lakes area and although there are many conscientious outdoorsmen, there still exist those who don't bother to pack out their litter.

During one of our several conversations with Ernie DeGraff, the problem of sanitation in the immediate area of the Golden Trout Camp was brought up. Mr. DeGraff explained to us about the possibility of there being a gradual seepage from the outhouses into the stream in the Golden Trout Camp and of Thacher's possible necessitated forfeiture of the lease on the cabins. Although he had no proof of water pollution, he explained to us of his intention to test the water above and below the cabins for possible pollution. Mr. DeGraff also explained to us the need to get rid of the garbage pits in the camp and to pack out all refuse to Lone Pine.(This summer Thacher intends to pack out all refuse). He related to us the immense problem of sanitation which has overun the nearby Whitney Portal area and which necessitated the possibility of portable toilets on the summit of Mt. Whitney! The problem could very well become acute in the Golden Trout Cottonwood Lakes area if the area is developed according to some of the proposals for the Trail Peak area.

Appendix II Computer Program

Unfortunately, the computer was not functioning properly at the end of our project, so we were not able to complete or use this program.

The purpose of these programs is to solve the following simultaneous equations:

$$a_0 \sum 1 + a_1 \sum t + a_2 \sum t^2 \text{-----------------} = \sum y_i$$
$$a_0 \sum t_i + a_1 \sum t_i^2 + a_2 \sum t_i^3 \text{-----------------} = \sum y_i t_i$$
$$a_0 \sum t_i^2 \text{---------------------------------} = \sum y_i t_i^2$$

$$a_0 \sum t_i^4 \text{----------------------} a_4 \sum t_i^8 = \sum y_i t_i^4.$$

"The value of the parameters so obtained are maximum likelyhood estimates, assuming that the deviations from the trend are random variables which are normally distributed with mean 0 and constant variance. This is also a Least Squares Fit."[1]

For a more thorough explanation see Estimates of Parameters in Chemical Reactions by Rolfe Petschek; or G.E.P. Box "Fitting Empirical Data" Ann. of The New York Academy of Science 0.86 pg. 798; or any discussion of regression analysis.

The first program does the necessary suming. The second program solves the simultaneous equations. The first program is a general program and could be used for any tree. The second program was developed around mock data and due to the problems with the

[1]Rolfe Petschek, Ph. D., 11:05 PM, 4.6.72

computer, was not made into a general form.

On the page after the programs there is a sheet showing the begining of the type out. The computer typed first the year then the value of the Least Squares Fit.

The final page of the appendix is the most interesting, it shows the mock data as points and the values of the Least Squares Fit as a solid line. The computer program could have been finally evolved to also give the annual ring index for each point. This is determined according to the formula x/z, where x is the actual ring width and z is the value of the Least Squares Fit curve. This number can be expressed as a percentage or straight value,i.e. 30% or .30.

C-FOCAL, 1969

```
01.10 A "MAXIMUM AGE",MA;F I=0,4;S YT(I)=0
01.20 F I=0,8;S TS(I)=0
01.30 F T=1,MA;D 2
01.35 T !!!,%10.03
01.40 F I=0,4;T "SUM Y*T↑",I,YT(I),!
01.50 F I=0,8;  T "SUM T↑",I,TS(I),!
01.60 Q

02.10 A Y;F J=0,4;S YT(J)=YT(J)+Y*T↑J
02.20 F J=0,8;S TS(J)=TS(J)+T↑J
*
```

C-FOCAL, 1969

```
01.10 F I=0,5;A A(I)
01.20 F I=0,3;S A(6+I)=A(I+1)
01.30 S A(10)=.4094262E+13; S A(11)=1159.28
01.40 F I=0,3;S A(12+I)=A(6+I+1)
01.50 S A(16)=.598337E+15; S A(17)=117887
01.60 F I=0,3;S A(18+I)=A(12+I+1)
01.70 S A(22)=.892626E+17;S A(23)=14122400
01.80 F I=0,3;S A(24+I)=A(18+I+1)
01.90 S A(28)=.1352794E+20;S A(29)=1830960000
01.95 F K=0,4;F J=0,4;D 4
01.99 Q

02.10 F I=0,5;S G(I)=A(6*J+I)-A(6*J+K)*(A(6*K+I)/A(6*K+K))
02.20 F I=0,5;S A(6*J+I)=G(I)

04.10 IF (K-J)4.2,4.3,4.2
04.20 D 2;R
04.30 R

05.10 T J,K,I,!
05.20 F I=0,5;T %,A(I),A(6+I),A(12+I),A(18+I),A(24+I),!

06.10 S G=A(5)/A(0)
06.20 S W=A(11)/A(7)
06.30 S E=A(17)/A(14)
06.40 S R=A(23)/A(21)
06.50 S T=A(29)/A(28)

10.10 F I=0,170;D 11

11.10 S A=G+W*I+E*I↑2
11.20 S A=A+R*I↑3+T*I↑4
11.30 T I,A,!
*
```

80

```
:170 :.14535E+5 :.165215E+7 :.211266E+9 :.288163E+11 :18.37
*D
:?01.00 @ 01.10
*D 5
= 0.500000E+01= 0.500000E+01= 0.000000E+00
= 0.170000E+03= 0.000000E+00= 0.000000E+00= 0.000000E+00= 0.000000E+00
=  0.000000E+00= 0.409408E+06= 0.000000E+00= 0.000000E+00= 0.000000E+00
=  0.000000E+00= 0.000000E+00= 0.788859E+09= 0.000000E+00= 0.000000E+00
=  0.000000E+00= 0.000000E+00= 0.000000E+00= 0.146340E+13= 0.000000E+00
=  0.000000E+00= 0.000000E+00= 0.000000E+00= 0.000000E+00= 0.264608E+16
=  0.575424E+02=-0.395911E+04= 0.102216E+06=-0.103941E+07= 0.343112E+07
*D 6
*D 10
= 0.000000E+00= 0.338485E+00
= 0.100000E+01= 0.328943E+00
= 0.200000E+01= 0.319657E+00
= 0.300000E+01= 0.310621E+00
= 0.400000E+01= 0.301831E+00
= 0.500000E+01= 0.293284E+00
= 0.600000E+01= 0.284976E+00
= 0.700000E+01= 0.276901E+00
= 0.800000E+01= 0.269056E+00
= 0.900000E+01= 0.261438E+00
= 0.100000E+02= 0.254042E+00
= 0.110000E+02= 0.246863E+00
= 0.120000E+02= 0.239899E+00
= 0.130000E+02= 0.233145E+00
= 0.140000E+02= 0.226598E+00
= 0.150000E+02= 0.220253E+00
= 0.160000E+02= 0.214106E+00
= 0.170000E+02= 0.208155E+00
= 0.180000E+02= 0.202395E+00
= 0.190000E+02= 0.196822E+00
= 0.200000E+02= 0.191433E+00
= 0.210000E+02= 0.186225E+00
= 0.220000E+02= 0.181192E+00
= 0.230000E+02= 0.176333E+00
= 0.240000E+02= 0.171643E+00
= 0.250000E+02= 0.167119E+00
= 0.260000E+02= 0.162757E+00
= 0.270000E+02= 0.158555E+00
= 0.280000E+02= 0.154507E+00
= 0.290000E+02= 0.150612E+00
= 0.300000E+02= 0.146865E+00
= 0.310000E+02= 0.143264E+00
= 0.320000E+02= 0.139804E+00
= 0.330000E+02= 0.136483E+00
= 0.340000E+02= 0.133298E+00
= 0.350000E+02= 0.130245E+00
= 0.360000E+02= 0.127321E+00
= 0.370000E+02= 0.124523E+00
= 0.380000E+02= 0.121848E+00
= 0.390000E+02= 0.119292E+00
= 0.400000E+02= 0.116353E+00
= 0.410000E+02= 0.114528E+00
= 0.420000E+02= 0.112313E+00
= 0.430000E+02= 0.110206E+00
= 0.440000E+02= 0.108203E+00
= 0.450000E+02= 0.106302E+00
= 0.460000E+02= 0.104500E+00
= 0.470000E+02= 0.102794E+00
= 0.480000E+02= 0.101182E+00
= 0.490000E+02= 0.996595E-01
= 0.500000E+02= 0.982249E-01
= 0.510000E+02= 0.968754E-01
```

mm

Mock Data

Least Squares Fit values

Z

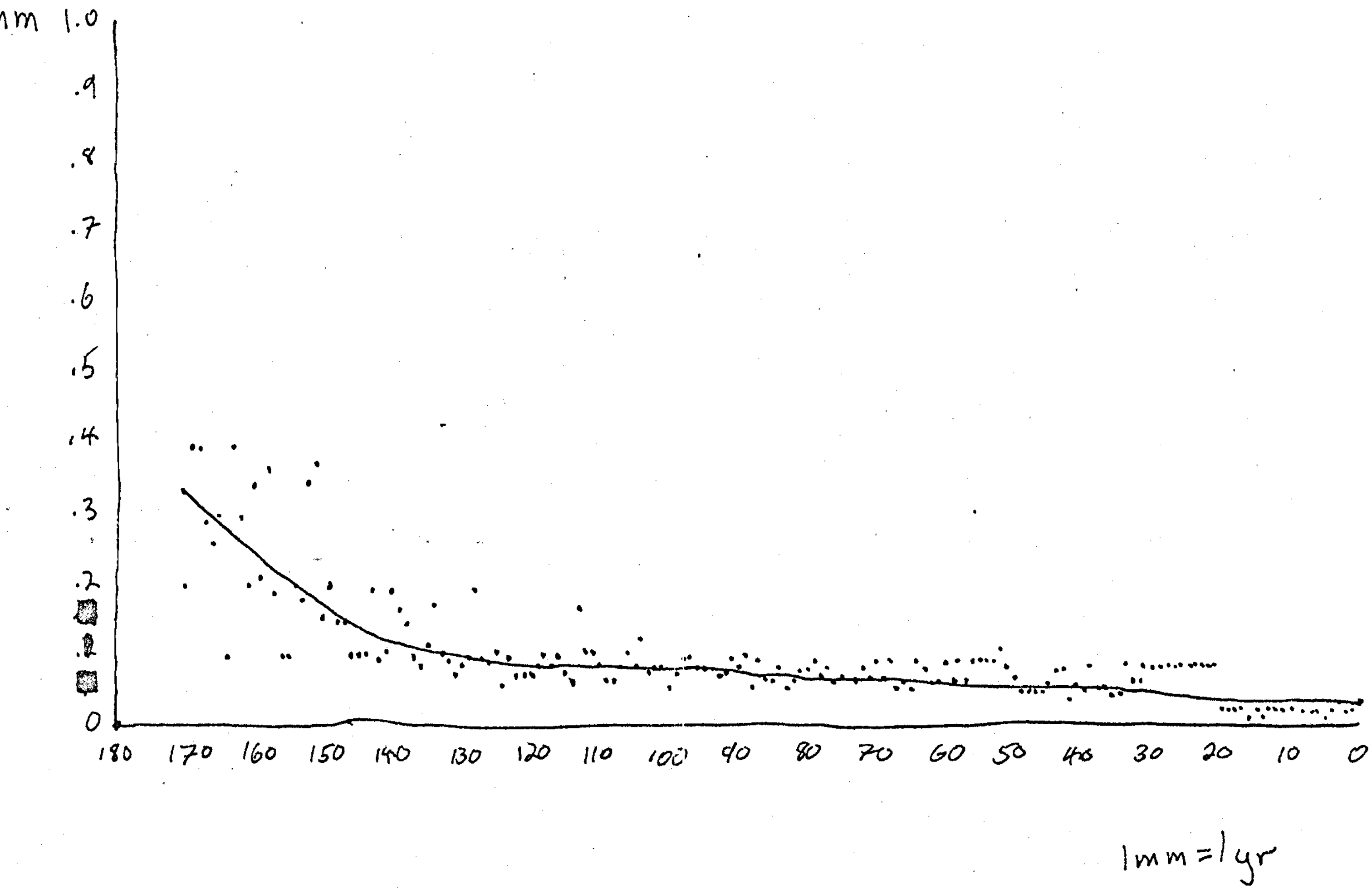
~~Change A~~

~~Limits on Ea~~

#(I)

N(u)(f)

Mock Data


mm
1.0
.9
.8
.7
.6
.5
.4
.3
.2
0
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1mm = 1yr

Appendix III Correspondence

This is all our formal correspondence with the exception of the final letters sent to most of these people with a copy of the report.

Appendix IV Catalogues

All of the catalogues we used were given to the Thacher School Library and can be found there.

Appendix V Map

This map shows the three main valley transects each at 57° off of magnetic north. (The second has as arrow head at the end to show the saddle which we aimed at in originally setting up the transect.) The other lines distinguish the X, Y, and Z sectors.

15'
389000m E.
390
391
392
393
394
395
10'
396
398
2357 II
(LONE PINE)
99
Army Pass
SEQUOIA NATIONAL PARK
TULARE CO
INYO CO
New Army Pass
High Lake
Long Lake
Muir Lake
Cottonwood Lakes
Hidden Lake
Cottonwood
Wonoga Peak
T 16 S
T 17 S
South Fork Lakes
Transect 3
Transect 2
Transect 1
Cirque Peak
Cirque Lake
Little
Cottonwood
Creek
Z
X
Y
Z
Fork
South
Creek
Chicken Spring Lake
Cottonwood Sawmill
Lost Chance Meadow
Cottonwood Pass
Horseshoe Meadow
Round Valley
Stokes
Poison Meadow
Trail Peak
Trail Pass
I N Y O
Mulkey Pass
Dutch Meadow
R 35 E
R 36 E
South Fork Meadows
Kern River
Bullfrog Meadow
Mulkey Meadows
Mulkey Creek
Bear Mdw
Muah Mtn
Sharknose Ridge
TULARE CO
INYO CO
Ash Meadow
McConnel Meadow
N A T I O N A L
Overholster Meadow
Freckles Meadow
East Potholes

Appendix VI Progress Reports

These are only contained in the original at the Thacher School, since they are probably not of interest to anyone else.