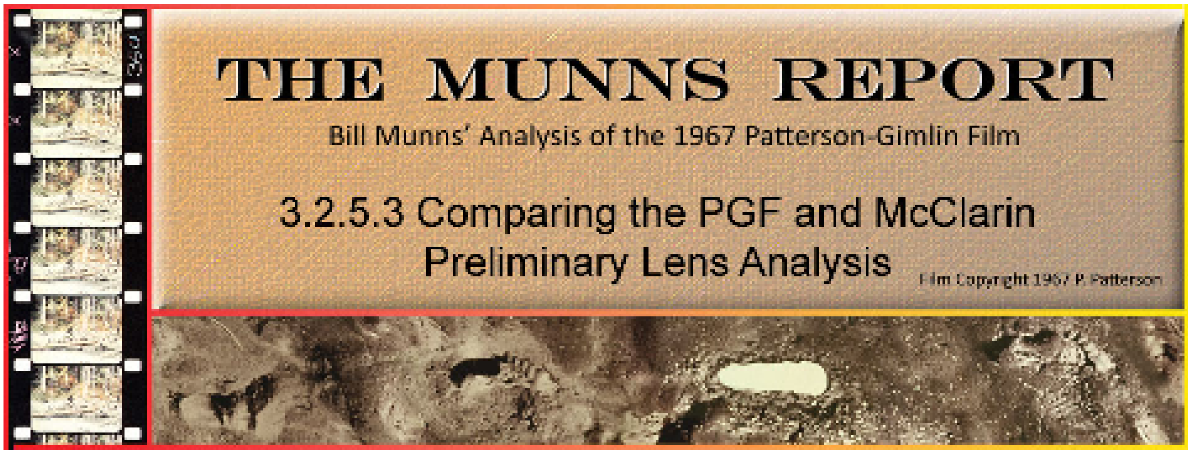


Release Version Part Two
(incorporating minor revisions from the Preview Version)

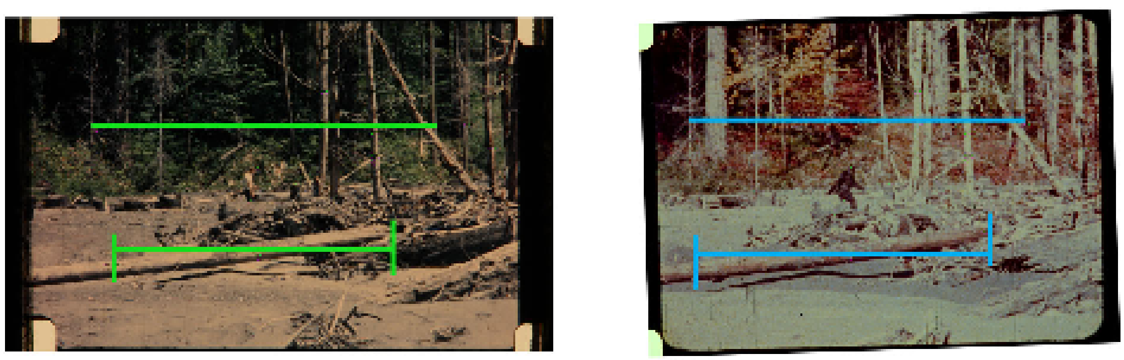
Comparing the PGF (Patterson-Gimlin Film) with John Green's film of Jim McClarin, and a Preliminary Revision of the Lens Analysis are in this document. The document has been split into two sections, and this is PART TWO

Index of Topics

Comparing Frames

Now we begin the actual comparison between the films. The image below shows the preliminary steps.

PGF and Green's McClarin Film Comparison. Color bars show background and foreground measures.



PGF Image is rotated so trees have identical vertical parallel aspect.

The preliminary steps were:

1. Rectifying each frame sample - This process requires the following steps be taken. First, the frames are corrected for rotation (in the scan) so the frame dividing line is true horizontal (in relation to the image edges). Then the scan is cropped to exactly one image frame and one dividing black frame separation, because this distance is camera standard specification of 0.300". Once cropped, the image is resized proportionately to 3000 pixels high (from about 2550 of the original scan, so the resizing is minor) and this produces an image where one pixel is 0.0001" and pixel measurements are very accurate. This rectifying is also described in the recent TMR Release PDF on The Verified Frame Count and Copy Inventory.

2. Overlaying frames for measurements - The PGF frame was overlaid onto the McClarin frame in a Photoshop file. The PGF frame needed to be rotated to get the trees in the background at true parallel vertical aspect (which is why in the above chart, you see the PGF frame tilted a bit). Once the frames were rectified first (step 1, above), this rotation does not alter the analysis. Once overlaid, a central distant background point was aligned to anchor the two images.

3. Measure a distant background set of objects and a close foreground object - In this case, easily identified trees in the background were used to measure the distant background in both frames.

The big log in foreground was used as the foreground object, and patterns of it's trunk and bark were used as locator points.

4. The color bars (blue for the PGF and green for John Green's film) are then marked in width. Note that using the color green for John Green's film was deliberate, so there wouldn't be any ambiguity between his name and the color markings on his film.

5. The color bars are measured in exact pixel dimensions.

The results were:

Background measure

PGF	3015 pixels		97.5% smaller
JG	3092 pixels	1.0255 greater	2.5% greater

Log Measure

PGF	2492 pixels		105% larger
JG	2365 pixels	0.949 less	94.9% smaller

The curious result is that the McClarin frame image has a wider background measure but a smaller foreground measure. The optics are now explained and considered.

A. Option #1 - Same focal length, different distance

This criteria would produce an image where all measures are proportionately lesser or greater, (one or the other, but not both) for foreground and background measures. So this is not the case.

B. Option #2 - Same position, different focal length

This also would result in all measures being lesser or greater uniformly different, because the longer of the two lenses simply acts as a magnifier of the seen objects. All are magnified uniformly.

C. Option #3 - Different position and different focal length lenses.

This combination is the only way the larger/smaller measures can be accomplished. So this is the solution. The PGF camera is closer to the scene than Green's camera, and has a slightly wider lens focal length. The challenge now is to try and determine what the distance and lens focal length differences are.

To get a sense of the possible solution, we need to start by assigning some assumptions, and then study the outcome of the computations derived from those assumptions. This will give us a preliminary guideline for the final solution. The base assumptions we must make are to assign an estimated distance from Green's camera to both foreground and background objects, and see what difference of PGF camera position and PGF lens will produce the measured results.

Test Calculations #1

For test #1, the assigned distances are 50' to the big log (foreground) and 250' to the distant trees in the background.

Then we chart how positions closer to the scene impact on the distance measure.

If the PGF camera is closer by	The BG is magnified	the FG is magnified
1'	100.40% (1.0040, actually)	102.04% (1.0204)
1.5'	100.60	103.09
2'	100.80	104.16
2.5'	101.01	105.26
3'	101.21	106.38
3.5'	101.42	107.52
4'	101.62	108.69
4.5'	101.83	109.89
5'	102.04	111.11
5.5'	102.24	112.35
6'	102.45	113.63

Now the lens must bring the BG (background) measure to 0.975% so we divide the magnified value into 0.975 and get a lens factor multiplier, for each distance.

Example: (1' difference)

0.975 divided by 1.0040 equals 0.9711
Reduce the foreground measure (1.0204) by this factor (0.9711) and we have a FG (foreground) measure of 0.99. But we need a foreground measure of 1.05, so this is not close.

Example 2 - (4' difference)
0.975 divided by 1.0162 equals 0.9594
Reduce the foreground measure (1.0869) by this factor (0.9594)and we have a foreground measure of 1.0428. This is clearly getting us closer to the 1.05 needed.

Example 3 - (4.5' difference)
0.975 divided by 1.0183 equals 0.9574
reduce the foreground measure (1.0989) by this factor (0.9574) and we have a foreground measure of 1.0521.
This is very close to the 1.05 needed, but slightly over. So a distance less than 4.5', but close to it, seems the ideal position.

Further refinement yields the following result.

4.375' closer and 19.16mm lens (compared to a true 20mm lens) produces the result. Lens focal length discrepancy is 0.84mm

Test Calculations #2

For test #2, the assigned distances are 50' to the big log (foreground) and 300' to the distant trees in the background.

Using the same methods, but skipping to the results, the calculations yield the following:

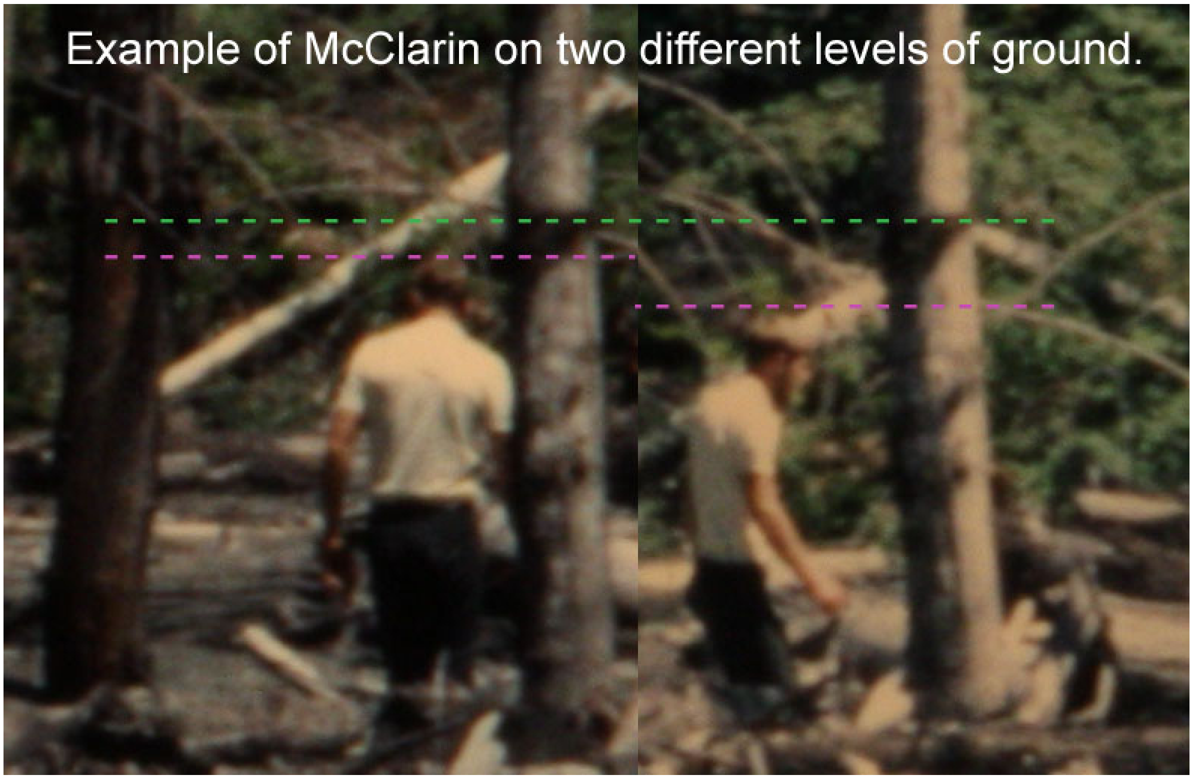
4.25' closer and   19.22 mm lens (compared to a true 20mm lens) produce result. Lens focal length discrepancy is 0.78mm

Clearly the difference of camera positions and the difference of lenses are close enough to give us approximations for now. Obviously more effort needs to be made in validating the source assumption distances, and that may alter the resulting calculations marginally.

But we could confidently say the distance difference between cameras may be between 4' and 4.5' and the difference of lenses may be about 4% of the focal length. This focal length discrepancy may be from two different lenses of described similar focal length, but one or both off spec in actual performing focal length. It may also be explained by the PGF camera having a non-Kodak lens on it, and the lens specs seat the lens slightly closer to the K-100 camera film plane, causing an under-spec focal length. This must be tested further. So we must explore the issue of lens specs as determined by bench tests, one of several experiments still to be done as time and resources permit.

Irregular Ground Shown

In two different frames from Green's footage, we see McClarin. In one, he's doing the walk. In another, he's simply turned back to camera and appears to be looking at the ground. In one, he is 5-6" higher up than in the other, yet his size seems to scale close enough to say he's at approximately the same distance from camera.



The tree to his right TC-2, is the level anchor. His height varies as compared to that fixed landscape reference point. So the ground is simply not level in that area, and we should not assume the ground is level elsewhere if we can't see it.

So we are cautioned to avoid making height comparisons between McClarin and the PGF subject based only on top of head position, and must use full body measures of each for any analysis.

The Height Comparison

Defining the variables and establishing a methodology for resolution.

Four general variables are identified as operative (and one which is not applicable, but sometimes has been used to create false positive conclusions), and determinations thus far are described.

1. The PGF camera is slightly closer to the scene than Green's camera. This, in theory (all other things being equal) would cause the PGF subject to be slightly smaller in calculation than McClarin. The estimate of distance difference is that the PGF camera was about 4' to 4.5' closer to the scene than Green's camera. But this calculation needs refinement and falsification of alternatives to be more precise and conclusive.

2. The PGF camera has a slightly wider angle lens (shorter focal length) than the camera and lens used by Green. This, in theory (all other things being equal) would cause the PGF subject to be slightly larger in calculation than McClarin. That the two lenses are of different focal length is conclusive but the extent is still a preliminary determination, subject to further study, refinement, and possible revision. But the current estimate of difference is between 0.84mm and 0.78mm (based on a 20mm model). Whether this could be accounted for by two lenses of described same focal length but off spec in analysis (like a 20mm lens being 20.3mm in benchtest spec, and the other lens a 20mm being 19.46mm in benchtest spec, which combined would produce a 0.84mm discrepancy in actual angle, like the example offered above) we cannot yet determine, but will continue to test for.

3. The McClarin walk path calculates at slightly further back than the PGF (with a 20mm lens spec) and very much further back (with a 25mm lens spec), and this in theory (all other things being equal) would calculate to McClarin being larger than the PGF subject. But which lens was on Green's camera must be finalized before we can conclude which path represents McClarin's true position.

4. The PGF subject walking posture is generally more compressed by stride (meaning walking height is far lower than standing height) than McClarin, and this will cause the PGF subject height to be increased when a standing straight height is calculated.

Non-Applicable Variable - The ground the subjects walk on is verifiably uneven, not level. This can impact measures to the top of the head. As such, it has the potential to create false comparisons and confuse the real issues. So any height calculation of each subject (PGF and McClarin) must be a body height calculation, not just a top of head calculation relative to apparent landscapes, and a full body height calculation will null out any issue of irregular ground.

So we have four operative variables to consider in comparing McClarin to the PGF subject (two suggesting the PGF subject height be diminished or reduced, and two suggesting the PGF subject height be enlarged or increased), and if an analysis does not acknowledge, factor, and describe each, the comparison is incomplete and unreliable.

Sample Calculation

Please do not take this as a conclusion. It is not. It is simply an example of how we may balance the four variables, and I am using estimated (hypothetical) numbers which are simply approximated by the evidence so far.

The base hypotheticals are:

If Patty is at 102' from the PGF camera and 106.375' from Green's camera location,

and if Jim was 107' from the PGF camera location and 111.375' from Green's camera location (at one point such as the lookback position),

and if both Patty and Jim measured the same pixel height, head to toe, in rectified images,

then the calculation may go like the following:

A. Patty's same image height at a lesser distance (PGF Camera being closer) results in a reduction of 0.9588 (A)

B. A PGF lens of slightly shorter focal length results in an increase of 1.0416 (B) for a 19.2mm lens vs 20mm lens

C. If Jim is further back (the hypothetical being 5' further back) then Patty's height is reduced by 0.9532 (C)

D. If Patty's walking posture and longer stride requires her standing true height to be increased, the posture re-alignment increases her height by x 1.08 (D)

Multiplying (A) 0.9588 by (B) 1.0416 by (C) 0.9532 by (D) 1.08 yields a final total multiplier of 102.81%

If Jim is 77" (in boots, head up) , then 77" x 1.0281 = 79.16" or (6' 7.16")

Patty would calculate to be 79.16" (6' 7.16")

Let me repeat, this is not a conclusion. It is a sample calculation that shows the process of balancing the variables, if base numbers can be determined, and in this sample, the base numbers are simply hypotheticals for illustrative purpose. Also note Jim's height varies depending on the posture of his head. (See Appendix 1 below, for Jim's own remarks)

Lens Formula Calculation Sample

As noted above, the numbers are hypothetical at present, with refinement of the analysis and more filming tests to hopefully finalize the numbers, especially the lens issue. But I was in discussions with an interested person who wondered how the lens formula would handle some of these numbers, and that inspired me to do a check and see if the numbers were in the ballpark, so to speak.

I used a file with a rectified McClarin frame at the lookback position, and derived a body height calculation of 0.046" on the film image. Taking the above numbers (the hypotheticals) I used, a distance of 111.375' and a 20mm lens (which is 0.7874") and the solving for subject height, which equals distance times image height divided by focal length.

So 111.375' x 0.046 divided by 0.7874 = 6.5' (6' 6")

McClarin should measure at about 6' 4" to 6' 5" (in boots, and depending on his head posture), so I'd say the calculations were in the ballpark.

If, as I noted above, the 20mm on Green's camera might be slightly over spec, like 20.3mm (0.7992"), then the calculation results in Jim being 6.41' or 6' 4.9" tall. Slightly closer to his verified height.

Suffice to say, the other variables might be adjusted and a different calculation might result.

But until the lens is finalized, this is just an example of plausibility for the 20mm prospect.

Work to be Done

The following efforts still need to be done so we can hopefully finalize this analysis:

1. Filming tests should be done with the Keystone camera and 25mm lens, to see how a man walks the path as calculated, to see if a man can even do the walk in 26 steps, and if so, is his walking posture anything similar to McClarin's. If not, this would confidently eliminate the 25mm lens option.

2. Filming with a camera and 20mm lens (such as the Bell&Howell I have) filming the same walk, but with measurements set to the calculation of 20mm lens spec. to see if this walk more closely matches McClarin's walking posture, step for step.

3. Filming tests on 25mm and 20mm lenses should be done to test actual viewing angle and actual focal length, as compared to rated spec. description.

4. Experiments should be done to see how easy it is to modify a camera to "DIY Ultra 16mm". I have two B&H cameras, so I can use one to try and do the aperture modification, and then re-assemble and film test to see if the frame shape matches the McClarin footage. But I will also need to get a second Keystone K-50 camera to try the aperture modification on it as well.

5. Film test the K-100 camera with "C" mount lenses that are not Kodak supplied, and see if they produce quality images and perform to focal length spec.

The result of these efforts should allow us to finally determine the lens on both John Green's camera and the PGF camera, and help us finalize the comparison of McClarin to the PGF subject.

Appendix 1

In the preparation of this report, I contacted Jim McClarin and asked him to read through it and correct any statements that he might find in error, since he was there and I was not. Jim was gracious enough to do so, and also allow me to print his reply. He did note three typos (which I corrected) and I excluded that part of his reply.

Jim also made some general comments about the filming, and his recollections of the camera issue. He clearly states his recollection is vague on some issues, which we frankly must expect for any person trying to recall an event 42 years ago. So these notes are included simply as a reference.

(My inquiry)

Date: Fri, 14 Jan 2011 21:31:44 -0600

Jim:

What I would hope for is that you read through it, and if there's anything describing the filming of you that is in error, that you can tell me what and where to correct.

If you would like to offer any other comments, I welcome them. And please let me know if you would consent to my acknowledging any revisions that you suggested, or comments you made, if I can quote you in the document or not, as you prefer.

Thanks,

Bill

(Jim McClarin's reply)

Hi Bill,

I´m glad you´re doing such a thorough investigation. I think all of us involved were amateurs, not realizing the possible variations among cameras, lenses, and formats, especially DIY adaptations.

I vaguely recall conversation with Green concerning whether Green´s camera and Patterson´s were alike and my even more vague recollection was that he indicated he was filming with the same type of camera Patterson used. That wispy memory may be dead wrong. Also, I don´t recall

John saying he had BOUGHT the camera and I think I was under the impression it was rented, same as Roger´s. If so, he may have purchased the other camera later or decided not to use it in favor of trying to duplicate Roger´s results. Again, hardly a high confidence memory.

One more reason for full body comparison: PG subject reportedly left the prints at the scene that were considerably deeper than mine when I saw them a week or two later.

My "known" height was based on my completely straining erect height of 6 feet 4 1/4 inches plus an estimated (not measured) boot heel height of 3/4 inches. My field height may well have been as much as an inch less due to relaxing into a normally stoop-shouldered posture that I have had to one degree or another since spending most of a summer with pneumonia between 6th and 7th grade, much of the time with my head propped forward reading in bed or on the couch. If only we had had some sort of surveyor´s stake to measure me, trees, logs, etc. for the camera to record.

Feel free to mention any aspect of our correspondence.

Jim

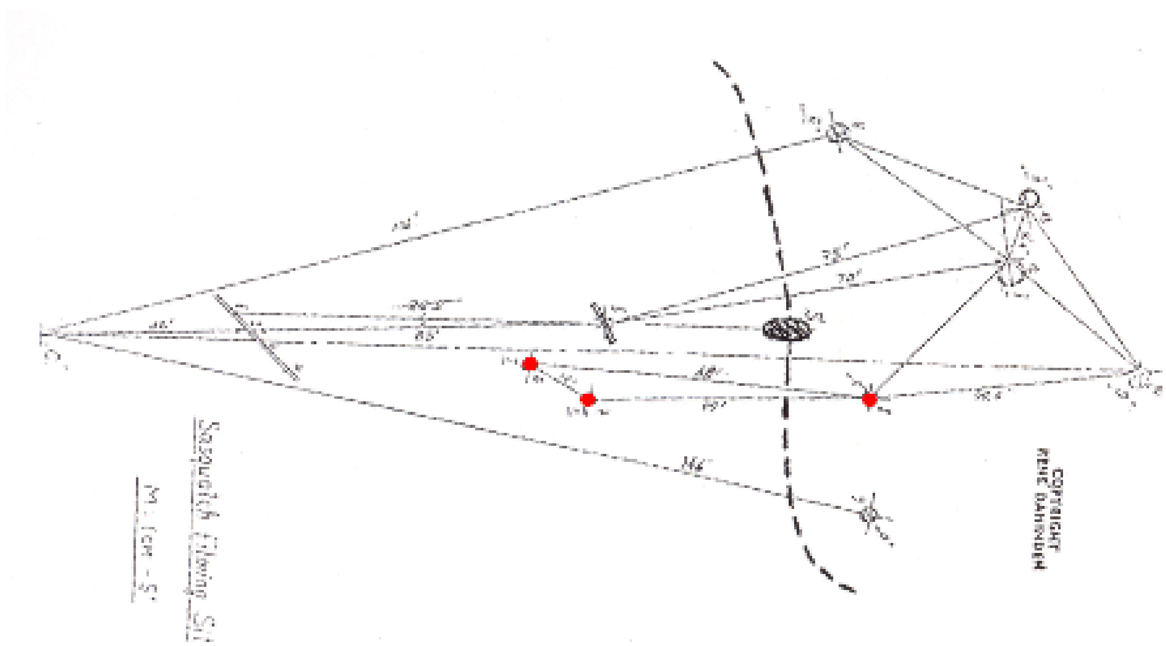
APPENDIX 2

Site Tree Angles Studies

The chart to follow illustrates these examples. In Part One of this release, the chart explaining the components was shown, but repeated here for convenience to the reader.

Discrepancy #3

Another theoretical modeling takes the basic site measurements of Green and Dahinden and constructs a triangle of three trees, as described by Dahinden (58', 49' and 12' apart for the three distances) to construct a triangle. The Dahinden measurement chart is below, with the three trees forming the triangle marked with red dots. They will be rotated 180 degrees in the subsequent charts.



Then using Green's 105' and 115' for measurements to two of the three trees from his position, we can create additional geometry to locate his camera.

DISCLAIMER: In the past, when I have showed these site measurements of Dahinden and Green, some people have taken the numbers into a CAD software program and got results that made them doubt the analysis.

The error was actually that in doing so, they failed to realize that these measurements by both men are, apparently, rounded to the foot, and thus are not precise in inches or fractions of an inch, as a CAD analysis would be.

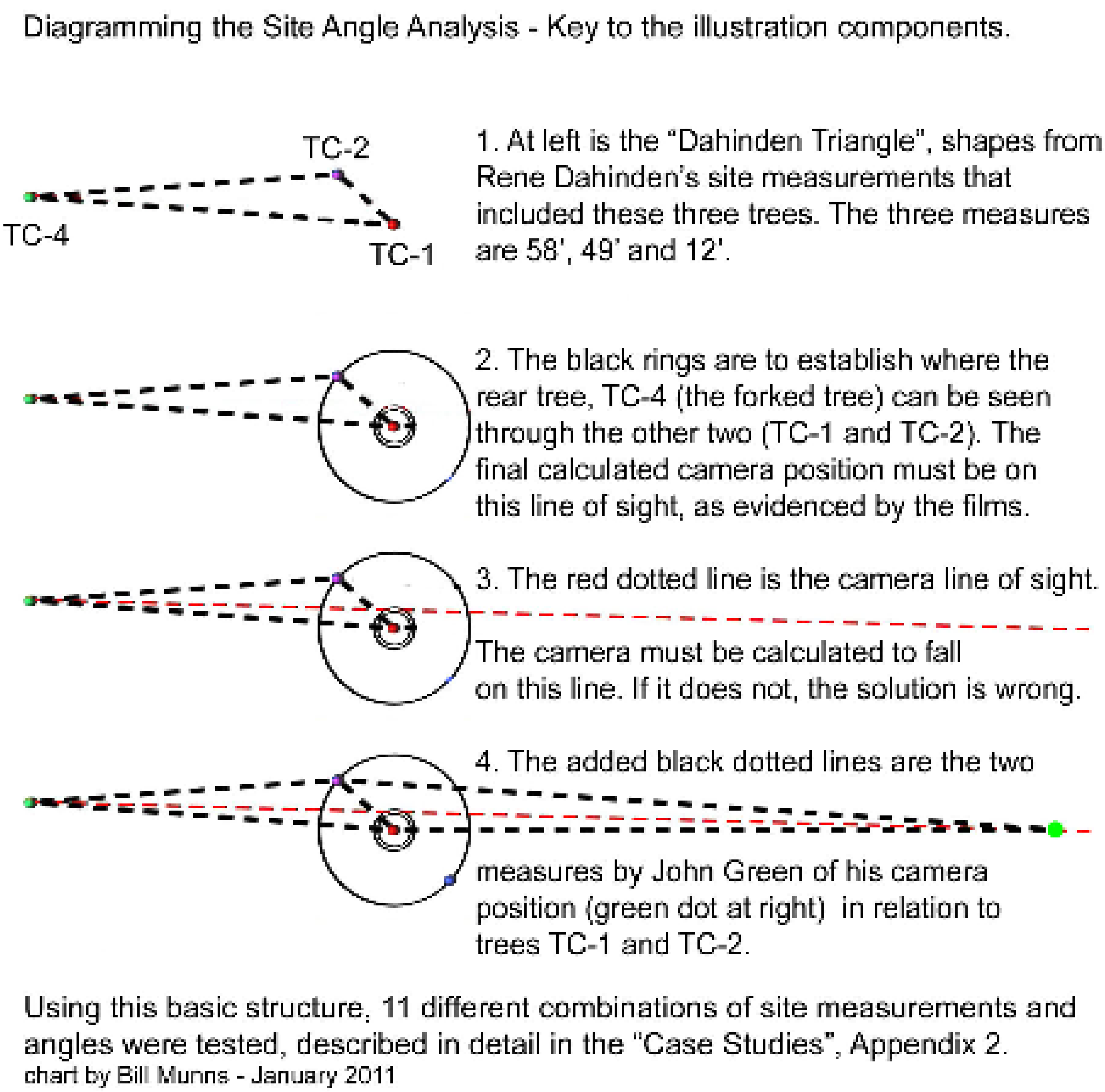
So this disclaimer is included simply to caution people that the site measurement numbers are presumed to have been rounded to the foot, and thus could be off by several inches. That is why I did the 11 Case Studies, starting with first the five numbers pure and exact (which failed) and then tested 10 variations with slight adjustments of one or two numbers to show what will work.

I have also seen examples of people trying to say my analysis is flawed because the measurements are "unreliable", not sufficiently precise compared to the level of precision we could achieve today if we did a site measurement. True, the numbers are not as precise as today's technology could achieve, but still, it is important to acknowledge that there has not been any credible offering of proof that the measurements are worthless. They are just "rough" by today's level of measuring precision, and some error correction is needed.

So please take that into consideration in any evaluation of the measurements and determinations from them.

This model was tested with 11 different specifications of distances, because the five pure (exact) numbers failed to deliver a solution with has the camera's line of sight correct. The 11 cases are shown and described in APPENDIX 2 at the end of this document.

The following chart shows how the case study was set up.



Case # 1

Measurement Specifications - Pure numbers: 58', 49', 12', 105' 115'
Results - Impossible configuration because of lost line of sight.

Green Angle - 3.46 (this is the angle formed by John's two measurements from his camera position to trees TC-1 and TC-2)

Case # 2

Measurement Specifications - Pure numbers for 58', 49', 12', 115' and adjusted 105'
Results - Excellent solution with one adjustment
Adjusted measurement #1 105' needs to be increased to 105.762
Error 0.762 feet 9.14"
Percentage of error - 1.00725 (0.725%)

Green Angle - 3.97 degrees

Note: The Green measurement from his position to TC-4 (the forked tree) is 162', but the total of 105' and 58' is 163', so there's a discrepancy of 1'. If the 105' measure is extended by the error, then the TC-4 measure is now off by only 2.86", significantly reducing the error.

An alternate solution of reducing the 115' measure to align with the 105' endpoint can be done, but does not reduce the 162-163' discrepancy.

Case # 3

Measurement Specifications - Pure numbers: 58', 49', 105', 115' adjusted number 12' becomes 12.5'
Results - Impossible configuration because of lost line of sight.
Adjusted measurement #1 12' becomes 12.5'
Error 6"
Percentage of error - 1.04166 (4.166%)

Green Angle - 3.92

Case #3a

Measurement Specifications - Pure numbers: 58', 49', 115' Adjusted numbers are 12' and 105'
Results -
Adjusted measurement #1 12' becomes 12.5'
Error 6"
Percentage of error - 1.04166 (4.166%)
Adjusted measurement #2 105' becomes 105.686'
Error 0.686' (8.232")
Percentage of error 1.00653 (0.653%)
Green Angle - 4.34

Note: The Green measurement from his position to TC-4 (the forked tree) is 162', but the total of 105' and 58' is 163, so there's a discrepancy of 1'. If the 105' measure is extended by the error, then the TC-4 measure is now off by only 3.768", significantly reducing the error.

Case #3b

Measurement Specifications - Pure numbers: 58', 49', 105', and 115' Adjusted number is 12' (reduced by 6" to be 11.5')
Results - Impossible configuration because of lost line of sight.
Adjusted measurement #1 12' becomes 11.5'
Error -6"
Percentage of error - 1.04347 (4.347%)

Green Angle - 2.97

Case #3c

Measurement Specifications - Pure numbers: 58', 49', 115' Adjusted numbers are 12' and 105'
Results -
Adjusted measurement #1 12' becomes 11.5'
Error -6"
Percentage of error - 1.04347 (4.347%)
Adjusted measurement #2 105' becomes 105.81
Error -0.81' (9.72")
Percentage of error 1.007714 (0.7714%)
Green Angle - 3.63

Note: The Green measurement from his position to TC-4 (the forked tree) is 162', but the total of 105' and 58' is 163, so there's a discrepancy of 1'. If the 105' measure is extended by the error, then the TC-4 measure is now off by 2.28"

Case #4

12' segment adjusted for +3" error and pure numbers for rest
12.25'
Results - Impossible configuration because of lost line of sight.

Green angles 3.69

Case #4a

12' segment expanded by +3" and allow for adjustment of second measure
12.25'
58, 49, and 115 pure
Adjustment #1 - 12.25' from 12'
error 0.25' (3")
Percentage of error - 1.02083 (2.083%)
Adjustment #2
105' becomes 105.714'
error 0.714' (8.568")
Percentage of error - 1.0068 (0.68%)

Green angle 4.16

Note: The Green measurement from his position to TC-4 (the forked tree) is 162', but the total of 105' and 58' is 163, so there's a discrepancy of 1'. If the 105' measure is extended by the error, then the TC-4 measure is now off by 3.432"

Case #4b

12' segment adjusted for -3" error and pure numbers for rest
12' segment becomes 11.75'
Results - Impossible configuration because of lost line of sight.

Green angle is 3.21

Case #4c

12' segment adjusted for -3" error and a second segment adjusted
12' becomes 11.75'
58, 49, and 115 pure
Adjustment #1 -   11.75' from 12'
error   -0.25'   (-3")
Percentage of error - 1.02127   (2.127%)
Adjustment #2
105' becomes 105.835'
error   0.835' (10.02")
Percentage of error - 1.00795   (0.795%)

Green angle 3.83

Note: The Green measurement from his position to TC-4 (the forked tree) is 162', but the total of 105' and 58' is 163, so there's a discrepancy of 1'.   If the 105' measure is extended by the error, then the TC-4 measure is now off by 1.98"

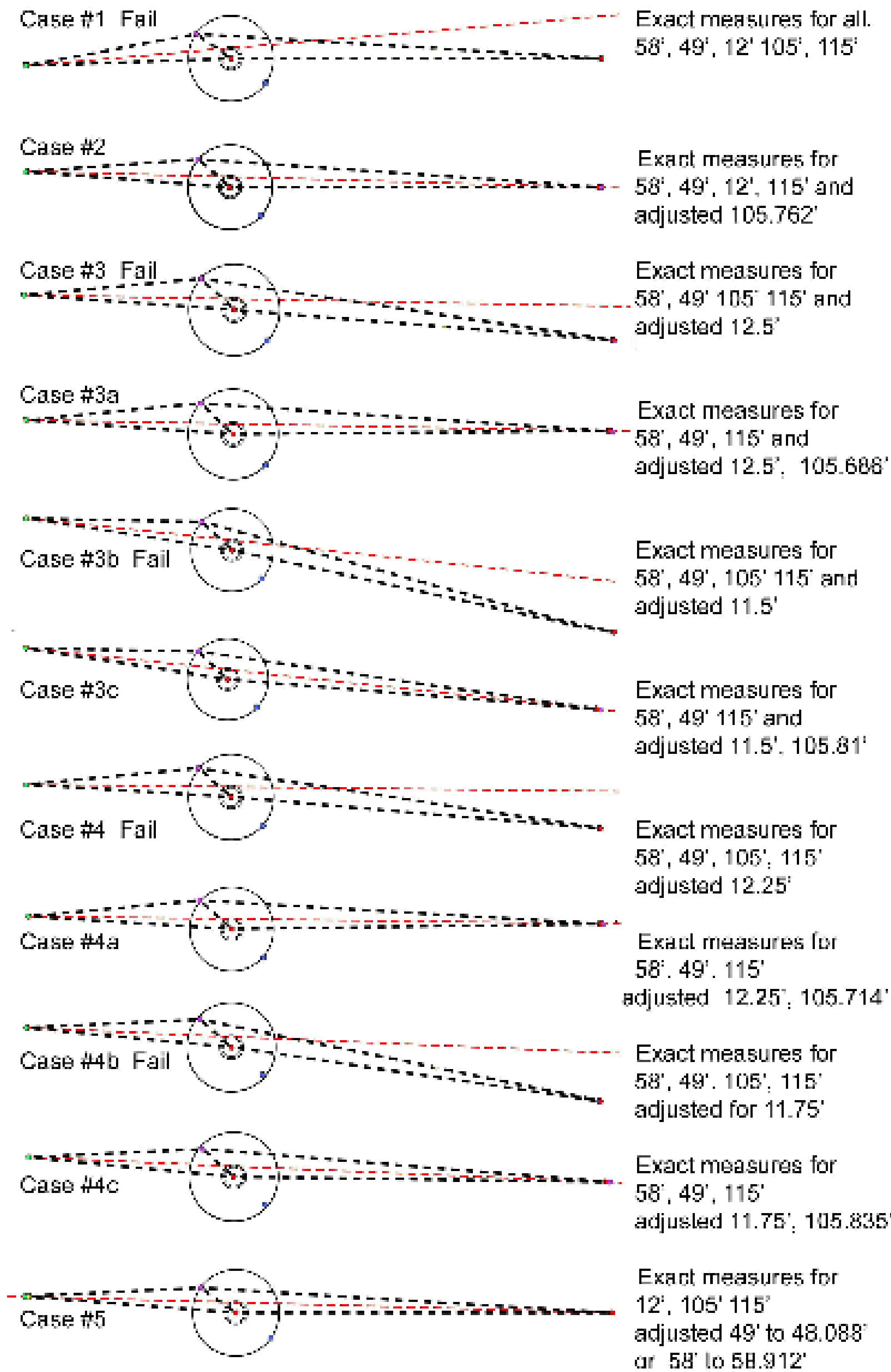
Case #5

Measurements 12', 105' and 115' are exact, and either 49' or 58' is adjusted

Results: Either 49' needs to be reduced to 48.088' or 58' needs to be increased to 58.912'
Margin of error -   1.01896 (1.896%) on 49' leg
.01572   (1.572%) on 58' leg

Compared to case #2 (also only one error), this is twice the margin of error (or more), by a more experienced surveyor, over a shorter distance , where there was no obstruction of debris to hinder the measuring. So all things considered, the error is less likely on the Dahinden side.

Green angle 3.46


Case #1 Fail
Exact measures for all.
58', 49', 12' 105', 115'
Case #2
Exact measures for
58', 49', 12', 115' and
adjusted 105.762'
Case #3 Fail
Exact measures for
58', 49' 105' 115' and
adjusted 12.5'
Case #3a
Exact measures for
58', 49', 115' and
adjusted 12.5', 105.686'
Case #3b Fail
Exact measures for
58', 49', 105' 115' and
adjusted 11.5'
Case #3c
Exact measures for
58', 49' 115' and
adjusted 11.5', 105.81'
Case #4 Fail
Exact measures for
58', 49', 105', 115'
adjusted 12.25'
Case #4a
Exact measures for
58', 49', 115'
adjusted 12.25', 105.714'
Case #4b Fail
Exact measures for
58', 49', 105', 115'
adjusted for 11.75'
Case #4c
Exact measures for
58', 49', 115'
adjusted 11.75', 105.835'
Case #5
Exact measures for
12', 105' 115'
adjusted 49' to 48.088'
or 58' to 58.912'

Successful angles: average 3.898 (all 6 averaged)

case 2 - 3.97
case 3a - 4.34
case 3c - 3.63
case 4a - 4.16
case 4c - 3.83
case 5 - 3.46

Unsuccessful angles average 3.45 (all 5 averaged)

Case 1 - 3.46
Case 3 - 3.92
case 3b - 2.97
case 4 - 3.69
case 4b - 3.21

Disclaimer - I have tried to proof read this material several times, but a typo or error in a number may still exist. I welcome any report of an error, but the overall trend of these numbers is reasonably consistent.

That overall and reasonable trend guides the analysis.

Conclusion

The four larger numbers (58', 49', 105' and 115') will apparently fail every time if calculated as pure and exact numbers, whether the smallest number, 12', is kept exact or tested for variances. In all five examples shown, when the large 4 numbers are pure and exact, the diagram failed to put the camera on a correct line of sight for the TC-4 Forked tree between the two closer trees (TC-1 and TC-2).

So at least one of those larger numbers should be in error, but the error is likely under 1%, not an unreasonable error for a man using a measuring tape a long distance (over 100'), and with a debris field between the two measured positions.

If we apply Occam's razor (the simplest solution is the more likely), then Case 2 appears to be the simplest solution, because it has only one error to correct (lengthening the 105' measure) and it intriguingly reduces the discrepancy between Green's 162' measure to the TC-4 tree to be much closer to the total distance when his 105' measure is added to Dahinden's 58' measure.

Case 2 is easier than Case 5, because (as stated above), compared to case #2 (also only one error), Case 5 is twice the margin of error, by a more experienced surveyor, over a shorter distance , where there was no obstruction of debris to hinder the measuring. So all things considered, the error is less likely on the Dahinden side (Case 5).

The angles measured on the 6 successful triangles average out to 3.898.

The angles (from center of TC-1 to TC-2) are:

15mm	4.85 degrees
20mm	3.68 degrees
25mm	2.94 degrees

So the angle average puts the filming lens between the 20mm and the 15mm (but far closer to the 20mm), and tends to exclude the 25mm as least likely. This gives probable cause to explore the 20mm lens further.

The single optimum case, Case #2 yields an angle of 3.97. That is 0.31 away from the 20mm and 0.88 away from the 15mm, and 1.03 away from the 25mm angle.
This gives probable cause to explore the 20mm lens further.

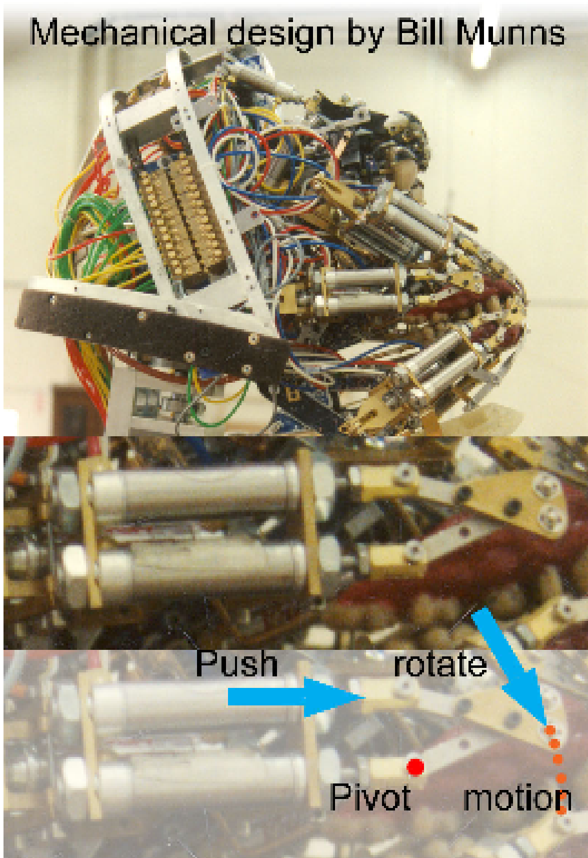
APPENDIX 3

Why do the triangles swing so far from the red dotted line of sight?

In the Appendix 2 charts above, you may have noticed that small shifts of the measure of one segment cause some very severe swings of the Green measurement triangle away from the red dotted line of sight. This may seem strange to you, but once I began this study, I recognized it instantly, because it is a geometric phenomenon I used very successfully in my years of working on robotics and animatronics, and designing mechanical actuators to create compound movements.

Basically, a single motion actuator (be it a pneumatic or hydraulic cylinder, or a servo motor pushing a cable or rod) tends to cause a motion in a straight line, a push-pull sort of action. But a lot of facial animation requires the capability of compound motions, push-pull plus swing left-right, and any combination of these two directional motions, to create a full range of motion capability.

In my design work, I found that using two push-pull actuators with their ends running near parallel, and then having a flexible or rotational capability to converge into a single point (forming a triangle of sorts) allowed for this compound motion (push-pull and swing left-right). All you needed to do is slide one actuator in or out slightly further than the other, and a swing left or right occurred.



Gigantopithecus robot head.

The ape head shown at left was made for a commercial for the AST Computers. The facial motions are driven by RC servo motors. The double push effect is shown at left. Design by Bill Munns

In two working examples (above, from my career) each one uses the principle, although the Giganto mechanism uses pneumatic cylinders while the AST ape head uses RC servo motors as actuators.

But for both, the operational principle is the same. Push out both actuators equally, and the end contact point (which attaches to the skin material around the mouth) will push out more in the same direction (toward the teeth, in this case). Pull both actuators in, and the end point pulls back in the same direction (away from the teeth, in this case). But if we push the top actuator out a bit more than the lower one, the end contact point will swing down in a rotational swing. If the lower actuator is pushed out a bit more than the upper, the end contact point will swing upward.

So having studied these effects of a triangulated mechanism causing lateral swinging motions, I readily saw the same effect occurring when John Green's measurements (that converge on his camera position) will swing laterally away from the line of sight when one measure is pushed out (extended) slightly more than another, in a change of measured distance.

An understanding of this curious geometric phenomenon helps understand how these Bluff Creek Tree triangle measures are actually quite close to perfect measures (but not exact to fractions of an inch), and allow for very little margin of error before the line of sight in lost. And the line of sight factor eliminates most theoretical alternatives. So the models shown which have successful camera positions on the line of sight, are thus fairly reliable alternatives to consider.

This ends Part Two of this release. It is a continuation from the first PDF document for Part One, which did explain how the PGF and McClarin filmings cameras are compared.

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Bill Munns Part Two of Two Documents.