A Brief CHARA Site Report - History of the Hale-Pease 50-Foot Stellar Interferometer

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Thank you all for inviting me to this wonderful country and to the beautiful city of Nice.

I'm supposed to provide a CHARA Site Report but I'll have to confess it will not as complete as I would like it to be since having been on the job now for only 8 months, I have yet to really get my arms around the array.

My background is in solar physics, and in that position I did very little interferometry -- intentionally, anyway! Previous to this job, I worked for the University of California at Los Angeles as Manager of their Solar Physics program on the 150-foot solar tower, also at Mt Wilson.

[Slide 1 – Solar tower]

Because of the solar program, I have lived and worked on Mount Wilson for over 31 years. If you don't believe me, take a look at this:

[Side 2 –Me with hair]

In that amount of time, a person will experience just about everything which can happen on a mountain top observatory, so when the solar project lost its funding last July, I suppose my experience is one of the reasons Hal and Theo thought I might could a reasonable candidate for the CHARA Site Manager position when Bob Cadman retired.

Now I've been given 20 minutes to do this report, but actually can sum up everything I need to say in about 20 seconds with these 2 statements:

(1) The CHARA interferometer array is still there on Mount Wilson.

[Slide 3 - Aerial view]

And (2) as site manager, my philosophy is this: I consider it my job to do my best to keep the CHARA equipment perfectly functional at all times and to insure that each observing run will be as efficient as possible so good science will be accomplished. After all this is our ultimate purpose right? And so that's my purpose too.

Oh, and one more thing: It's also expected that I do the required sun-dance to keep away cloudy days – which we never have at Mt. Wilson, of course!

[Slide 4 – Fog]

Well, there you have it, so I guess I can step down now . . . . Oh I see I still have 17 minutes left? Well, in that case, let me show you a couple of things I have done at my job in the last 8 months:

One item is that the former Site Manager's mobile home has been turned into a CHARA guest cottage for visiting observers. (Now called the Cadman Cottage) Not much to look at perhaps, but it's comfortable and quiet, and its three bedrooms will sleep 4.

[Slide 5 & 6– Cadman Cottage]

The Cadman Cottage has a great view of the San Gabriel Mountains behind it, and on a clear day one can easily see the peak where Michelson placed the return mirrors for his Velocity of Light experiments in the 1920's.

[Slide 7– Antonio]

To get this wonderful view, I first needed to clear out some of the other buildings the former site manager had collected. Here was my method:

[Slide 8 – Destruction of trailer.]

So destroying things is one of my new jobs as site manager!

Another thing I'm required to do is snow removal. We do sometimes get snow at Mount Wilson, and a small storm might look something like this:

[Slide 9 – Big snow]

And you remove it by the usual means:

[Slide 10 – Bobcat]

However, the large parking lot in front of the CHARA office, presents a problem because there is only one good outlet for all that space. If the depth of the snow gets deeper than about 60 centimeters you can no longer plow to the corners so you need to start moving it somewhere else with the skip loader. As I said, there is only one good outlet for the parking lot, so to extend the space, one has to build what I call a "Snow Bridge" off into open space. Here's an example of one I built during our most recent snow storm of about 100 centimeters.

[Slide 11 – Snow Bridge]

We have a plan to replace each of the aging light-pipe joint vacuum seals

[Slide12 - Vacuum seal]

but as you know, some of these joints are not so easy to gain access to. Rather than hang-on the best you can (as seen here)

[Slide 13 – Bob on knees]

Laszlo and I designed a platform to work from.

[Slide 14 - Platform]

The platform is finished, but we have not had a chance to try it out yet. One of the questions still to be resolved is an efficient procedure for hoisting it into place and securing it there!

Another one of my tasks is repairing malfunctioning equipment. Not long ago the vacuum pump system for our light pipes refused to operate properly. I decided to dissemble it to see what the problem was and right away was startled at what I found. There - luckily trapped by the inlet screen - was a cork-board stick pin!

[Slide 15 –Stick pin]

[Slide 16 – Stick pin close]

How this got into the vacuum system I have no idea! (We have subsequently found other stick pins in other parts of the vacuum lines, by the way.) Along with the stick pin, there were also small shavings of PVC plastic found in other places, and sure enough,

when I dissembled the roughing pump, there was squashed plastic on the outside of the very close tolerance chambers for the vanes.

This all need to be cleaned out, of course, and after that, the pumps ran fine.

Realuminizing the CHARA telescope mirrors is another duty I'm involved with, and here are some images illustrating that,

[Slides 17-21 aluminizing]

Besides these more common duties, the Site Manager is occasionally called upon to deal with some of the local fauna which might otherwise disrupt the observations. Here I am removing a venomous rattlesnake from a pathway.

[Slide 22 – Snake removal]

That snake was alive, by the way.

So as you can see, other than the usual tasks of keeping the air conditioning running, ordering parts for the staff, and emptying the trash, the role of Site Manager does has its interesting aspects.

Now I could complain about all the work I have to do to get the site to my own liking, but instead of that, I thought I might switch over to something dear to my heart and perhaps more interesting to you. More specifically the historic, but defunct, Mount Wilson 50-Foot Stellar Interferometer.

When you drive back into the grounds of the observatory and just before you make the turn north toward the CHARA facility, you might notice this large gray building in front of you.

[Slide 23 - 50-foot building today]

Many, if not most of you, know that this building was erected to contain the Pease 50-foot stellar interferometer built during the late 1920's. Since I am one of the last people to have seen it in its complete form before being demolished in 1978, I thought I might talk briefly about its history in the short time I have left.

More properly, it should be called the Hale-Pease Stellar Interferometer because immediately following the success of the famous Michelson 20-Foot Interferometer -- mounted on the 100-Inch telescope in 1920 -- it was George Ellery Hale who first conceived of, drew up plans for, and pushed for the construction of an interferometer with a longer baseline. Be that as it may, this interesting instrument is so closely associated with Francis Pease, most people today just call it the "Pease 50-Foot Interferometer"

[Slide 24 – Pease]

In Hale's typical conservative manner of increasing telescope aperture in small, incremental steps (usually double of what he had before), a 50-foot baseline was decided upon for the next step up. It's interesting to note that in his origin plans, Hale wanted to build the interferometer using two separate telescopes spaced 50 feet apart but cost considerations forced him to settle upon a single frame unit housed in a single building.

Now anytime Hale had an idea for a new instrument he would sketch up the plans in a rough form then send them down the hall for Pease to work out the details. The 50-foot interferometer was no exception, and here is Pease's final design concept from 1922.

[Slide 25 - 50-foot plans]

By the way, Pease himself never achieved an advanced degree in Mechanical or Optical engineering, but it didn't matter as evidenced by his excellent results in just about everything that he ever built. All of the Staff Members at the offices of the Mount Wilson Observatory knew that Pease could handle anything which was thrown at him, and usually do it better than they had expected. This made Pease a VERY busy man. (Just like Laszlo these days!)

So in 1922 construction began, and like any good architect, Hale had a little model built to help envision the concept.

[Slide 26 - model]

As with the 60-inch telescope, the whole apparatus was to be constructed in Pasadena, tested, then disassembled and removed up to Mount Wilson for reassembly.

By 1923 the shop had the center frame and polar axis done.

[Slide 27 – Center axis in yard]

As with so many telescopes of that era, the drive mechanism was a simple fly-weight governor clock being used to drive the 18,000 lb steel frame mechanism. This clock still exists as a museum display item on Mount Wilson.

[Slide 28 – Drive clock]

As soon as the center section was finished, someone on the staff realized that this would make a great optical platform for an upcoming total solar eclipse in Southern California during September of 1923, so they festooned the interferometer mount with all kinds of eclipse cameras and the like.

[Slide 29 - Eclipse cameras]

[Slide 30 - Eclipse cameras]

[Slide 31 - Eclipse cameras]

The eclipse was a total wash-out, by the way, with an overcast covering all of Southern California and northern Mexico. But that's a different talk . . . .

1924 and 1925 went by with little work being done on the 50-foot. Hale had Pease intimately involved in everything that the observatory was doing at that time – including thinking up plans for a possible 300 inch telescope,

[Slide 32 - 300 inch plans]

. . . and designing a private solar observatory, also for Hale.

Albert Michelson had Pease measuring the Speed of Light, trying to detect the Ether Drift, and bagging a few more star diameters with the 20-foot whenever he had the chance.

[Slide 33 - Pease at 100-Inch eyepiece]

Also, the observatory had been suffering from several years of drought, so the construction crew on Mount Wilson simply didn't have enough water available to mix all of the concrete necessary for the telescope housing.

The 40-inch primary mirror blank did arrive from Saint Gobain in 1925, however, and it was handed over to the optical shop for figuring

Eventually the rains returned to southern California so the final construction phase began in earnest. Even so, it was slow going along the way.

[Slide 34 – Frame on truck]

By 1927, the 50-foot interferometer frame had been installed (they called this the “Bridge”), and the housing and roll off roof had been completed.

[Slide 35 – Partially done house]

Also by 1927, the optical shop had finished five flat Pyrex feed mirrors but they were still working (2 years later) to figure the plate glass 40-inch primary.

[Slide 36 - Optical diagram]

In 1928 the figuring of the 40 inch primary was completed and ready to install, but Pease has been given the task of designing the then settled-upon 200-Inch telescope, so had little time left for the 50-foot.

[Slide 37– 40-inch index card]

In 1929 the instrument’s construction is finally completed so Pease now has to tackle the job of final optical and mechanical alignments. It was discovered right away that there was flexure in the frame which needed to be dealt with.

[Slide 38 - Ladd underneath]

By 1930 Pease is able to get fringes out to 34 feet, but discovers the primary mirror is shifting as a function of central meridian distance.

[Slide 39 – Mirror Cell]

After he performs (and I quote here from the annual report) “the difficult work of adjusting and using for measurement the 50-Foot Interferometer “ Pease is able to get fringes out at 44 feet.

[Slide 40 - Pease at eyepiece]

In 1931, Michelson dies, so besides doing much of the design work for the 200-Inch, Pease has an obligation to finish-up the Velocity of Light experiments now being carried out in Irvine, California. He has little time to wait around for the clear skies and good seeing necessary to obtain fringes with his finicky 50-foot interferometer. Little is done during the following year.

Finally, between 1933 and 1937 Pease finds time to do more observing on the 50-foot, but never really obtains much from the instrument. As far as I can tell, he was never able to make it out to the full aperture of 50-feet, and after more than 12 years of planning, construction and adjustments, only publishes firm data for 3 stars from the instrument---and then only in the Mount Wilson Annual Reports of the Director. These were: a Ceti at 115 mas, a Scorpii at 29 mas, and a Bootis at 19 mas.

[Slide 41 – completed from north]

In February of 1938 Pease died at the young age of 57, and the 50-foot interferometer project is dropped. Given the finicky nature of the observations, I don’t think anyone else on the Mount Wilson staff had the courage to carry on with the 50-foot where Pease left off, and as far as I can tell, the instrument was never used again.

In 1978 the Superintendant for the Carnegie Observatory decided he needed space for an office and carpentry shop, so got the

approval to gut the building out. Just before this happened, I took a few images for history's sake, and here they are:

[Slides 42-46 My slides]

[SLIDE – 47 - Pease on SN cover.] [END]

There has been much speculation why the 50-foot was never used following Pease's death. Some say that because of its close proximity to the ground, seeing prevented good observations. But knowing what we do now about seeing on Mount Wilson, I don't think seeing was a factor.

Some have suggested polarization effects off the mirrors, but for visual observations alone, I don't think the various forms of induced circular polarization would have much effect.

I think the real culprit was mechanical instability, and only Pease had the patience and tolerance to deal with such an annoyance. Pease had successfully designed many large telescopes in his career - and with complete success - but I think this one was the one that completely challenged his talents.

A friend of mine was a graduate student at Mount Wilson in the 1950's and at the time was thinking of resurrecting the 50-foot at some future point. He quickly discovered that it wasn't practical.

He recently related to me that he entered the building and gave the 50-foot a gentle push broadside to the frame. He was astonished to watch it oscillate back and forth with a frequency of about a half second and with an amplitude of about a ½ inch. He concluded then that the open instrument would be unusable in any kind of wind, let alone physically moving it about the sky.

Further support of the mechanical instability argument can be found from an interesting statement (should I say confession?) found in the pages of the Annual Report of the Director for 1936: “Observations with the 50-foot Interferometer continue, but the extremely exacting requirements of this instrument in the way of stellar definition have prevented many measurements of the diameter of stars. . . ”

The unstated instability details of those “extremely exacting requirements” are probably what did-in the instrument as a whole.

Thank you, and looking forward to seeing you all back on Mount Wilson.