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EARLY HISTORY
OF THE
HIGH ALTITUDE OBSERVATORY

July 5, 1966

_____: Walt, first of all, what do you think the purpose of this conversation is?

WALT: How did it start? It started when Dan and I were driving back from Climax and I got to reminiscing with Dan a little bit about some of the historical things about the establishment of the observatory. I told Dan some of the stories about how I had gotten involved and about the first pictures with the coronagraph when it got to operating and so on and he said that he thought that it was a shame that none of this was recorded anywhere because these things tend to get forgotten. I was a little decedent about doing it, though, because your memory tends to exaggerate the role it plays and all kinds of things like that.

_____: Maybe I ought to ask you straightforward and historical questions and let the antidotes come out where they may rather than try and hunt around for the antidotes [chuckle].

How was the decision made to establish a coronagraph station in this country? Who was behind it?

WALT: It was really the brain child of Menzal at Harvard. It goes back actually to . . . the coronagraph was invented by Leal in 1930. Leal was a French astronomer and he had been down in India. This is recorded in his early papers. H. O. Barnard, who is the Director at Silan Observatory, suggested an idea to make a coronagraph by taking a photograph of the sun's corona without an eclipse. He had built one and carried it on his own shoulders up to the Peak _____ in Southern France in 1930. It had been successful and it was such a surprise that it had succeeded where other coronagraphs had failed that a lot of astronomers were skeptical about it and, for example, Mitchell who wrote a book a couple of years after the coronagraph had been operated, made some comment about it was surprising this would work whereas other people had tried and failed -- implying skepticism. Menzal went over to Europe about 1935 (sometime around there) and he saw Leal's first prominence movies and he became convinced that Harvard should build a coronagraph. Menzal had grown up in Colorado and figured that he would find high mountain places in Colorado where he could run

one. To make a long story short, he got the first grant, as a matter of fact if I remember correctly, was from the U.S. Weather Bureau to build a coronagraph because of the possible influence of the sun on the changing of climate. He was interested in studying solar activity and prominences and the corona was one manifestation of important solar activity. The grant that really started the High Altitude Observatory was from the U.S. Weather Bureau. I am sure that is correct. That was before I came on the scene.

_____: When did you first hear about a coronagraph?

WALT: Well, in the fall of 1938 I came to Harvard to do graduate work. I had already gone to Eastman Kodak to work and was on leave from Eastman Kodak to go to graduate school and I was going to do my doctorate in physical chemistry under Otto Olgenburg. That was my plan at least. I had a rough time getting through my first year of graduate courses in the physics department. In particular I could not get through one under Wendell Thury and so I took a fill-in course which happened to be astrophysics under Menzal. I took this course in the fall of 1938 and by the end of the semester I had gotten very interested in astronomy as a career. I had thought that astronomy was very exciting. I had taken

astronomy in college, but there wasn't a chance of making a living as an astronomer. It was silly to think about going into a career. It could be a good hobby, but not a career. I was sort of half-way engaged to a girl at Kodak [chuckle] while I was working at Kodak and she jilted me in December and I decided "what the hell -- I would become an astronomer!" It didn't matter if I didn't make a living. At the end of that first semester I went one day, I'll never forget it, I went over to the observatory and told Chapley that I wanted to become an astronomer. I told Menzal at the same time. At Harvard you had to take the Ph.D. qualifying exams every year and I entered the astronomy department in February and on February 2 or February 3 I had to take the qualifying exams. I got the lowest post-grades ever given, I think, on the first try. That was when I heard about the coronagraph because Menzal was interested in my background in optics. I had done some design work at Kodak and I was greatly interested in optics and there were no other graduate students who had any background in optics at all. He sort of gave me the idea or the possibility of working on the coronagraph. The Weather Bureau grant had run out by then and I guess all the money for the coronagraph had

run out. The coronagraph was only partly built. It was designed by a man named Hobart French who was an assistant in the observatory, but they had run out of money. The coronagraph was partly built by the Mann Instrument Company in Cambridge and I sort of, as a beginning graduate student, inherited this pile of half finished designs and equipment. With Menzal's blessing, I made a Ph.D. thesis out of completing it and doing some research with it. In February of 1939 I got involved in it.

_____: How was the site selected?

WALT: In the summer of 1939 Menzal came out to Colorado to pick a site. He looked around and he knew Leadville. He was looking for a site at very high altitude where he would have clear weather and where you would also be able to get support such as electric power, telephone and all the various things. Menzal actually went up to Climax and talked with the Climax Mine officials and they expressed an interest in giving some help. He made the plans right then and there to build the observatory at Climax the following year.

_____: So it was really the only place that high in the Colorado Rockies where power was available?

WALT: He didn't even limit it to Colorado. He hunted anywhere really in the United States. That was the place where there was a chance of getting somebody to be willing to support it and also having the necessary requirements. We thought of Mt. Wilson, but that didn't seem suitable because it was too near the city. A lot of other places had been thought of, but that was the place that was chosen. The Climax Company gave a tremendous amount of encouragement. It would not have been possible at all without it. Menzal rounded up a lot of other support -- Kansas City Structural Steel Company, for example, built the dome free; Sears, Roebuck and Company in Denver provided the furnishings for the house; Climax Company built the house free; and all such things like that.

During 1939 and the spring of 1940 I worked with Hobart French and Menzal and actually got the coronagraph sort of whipped into shape so that it could take prominence pictures. We set it up out at the Harvard Massachusetts site of the Harvard observatory. We actually got prominence pictures in March of 1940 from Massachusetts. Those were the first actual photographs

of the sun taken with the thing. They were just still pictures of a prominence. Then it was dismantled in May and June after I had finished my course work in the spring. The observatory planned to ship me to Colorado by train, shipped the coronagraph out, and I was to set it up in Colorado. Meanwhile I had met Janet and we decided to get married in June of 1940 and so the observatory offered to put as much money into a car as they would into a plane ticket to get me to Colorado. I bought an old, used Grande Page for $150 on the agreement that I would pay the repairs and drive it out to Colorado carrying part of the coronagraph, my wife and myself with me. We got married in the first part of June and started out about the end of June to drive to Colorado with all this junk in the car. We got as far as Eastern Massachusetts before we had the first breakdown of the car [chuckle]. My first real stop was Rochester, New York. We then stopped at McMath Halbert Observatory. We got into the outskirts of Pontiac, Michigan and the car broke down again and we had to phone up McMath who had to send out a tow truck to get us into the McMath Observatory where we rested two or three days and got the car fixed [chuckle]. McMath told us all about taking movies of the prominences. The McMath Observatory had done the first prominence

movies with the spectroheliograph and a motion picture camera. They had started out to take pictures of planets and stuff, but the prominences seemed so spectacular in movies that they took the first prominence movies. Then we finally drove on and succeeded in getting to Colorado early in July. Menzal was already out here and had the observatory about two-thirds built. We drove up to Climax in mid-July of 1940 and the observatory was not quite finished, but we moved in to a house connected with the observatory there, and I got the first prominence pictures with the coronagraph on January 1, 1941. I finally got the coronagraph in operation in the dome at Climax and got the first photographs of the sun's corona with it in the summer or September of 1941. That is when I got the first actual photographs of the coronal spectrum.

_____: First of all, the site isn't the same one as being used today.

WALT: No, the site was on the southeast edge. It was the highest point on the southeast point of the mining town of Climax. It was just out of the village of the mining town. The house was precisely on the Continental Divide. It was on the lower extremity of what was called Sirisco Ridge. It was 11,521 feet above sea

level. There was a little road about one-quarter of a mile that led up from the mining town up to the observatory. The Climax Company built the road and kept it snow plowed in the winter and so on. The house was electrically heated so that we wouldn't have any chimney to disturb the air around the observatory. I don't think we had a telephone the first year, I am not sure. It was a pretty comfortable place and we got started running the coronagraph.

_____: Did Janet think she was moving to the end of the earth?

WALT: The newspapers back home and everywhere except in Colorado, of course, talked about the pioneers who had gone off to the ends of the world. The Boston Globe had stories about how the house had to be chained down to the mountain to keep it from blowing away. They learned that Mt. Washington was only 6,000 feet high and it had to have the observatory chained down so if it was 11,500 feet above sea level, it must really have to be chained down! Of course, our parents had thought we had disappeared from the face of the earth too and it was pretty exciting because I had never been east of Illinois and I don't think Janet had been much west of Illinois or much west of New Jersey. I am not really sure how far she had been. So we felt pretty far from home.

_____: What was it like getting there? I presume there weren't many paved roads in the Colorado mountains.

WALT: Roads weren't bad. It was awfully hot and this was just after the end of the "Dust Bowl Years" and there were a lot of places where the trees were still dead from the droughts in the mid-1930s. It was the tail end of the Depression so the economy in the region was not the best, although it was beginning to come back. I remember we got to Hastings, Nebraska and the car broke down again. The temperature never dropped below 100 degrees and we couldn't get parts for a Grande Page in Hastings, Nebraska. We had to ship to the factory some place. We had also by then had run out of our money, so I finally sent a collect telegram to the observatory asking for money [chuckle]. Apparently, Chapley posted it on the bulletin board and said "Pikes Peak or Bust - Busted." They shipped us some money. I had, I think, $1,000 as a stipend for my first year at Climax and that was a pretty handsome sum.

_____: How was getting up into the mountains in those days? The paths were not even paved were they?

WALT: No. Almost all the roads from Denver to Climax were dirt roads. Loveland Pass was so narrow that there were places where the bus had to stop and back up to get around the hair pin on the east side. That was really narrow in those days. It was dusty. I can really remember for years just eating the dust all the way up the Pass and all the way down the Pass. Cars didn't have as good radiators in those days as they do now with a cooling system. You would always have to drive a little ways and then stop and boil out. You would try to stop by a stream where you could get some water to fill the radiator again. The Grande Page was particularly in bad shape.

In those days the road up through Climax didn't go where it now goes, but it went down on the west side of the valley right through the little town of Cocomo. The town of Robinson was still there too with the smoldering _____ which is now under the tailing _____. Menzal had, as I said, been out earlier and he was in Denver to meet us when we came through Denver and he had another car and drove ahead. Janet and I came along in the Grande Page. We had transferred a good deal of the heavy gear to Menzal's car because we didn't think our car would make the mountains. We

finally got to Cocomo and Menzal pulled up to one of the old broken down log cabins that looked just about the way they do now, all delapidated and the windows fallen in. He said, "Well here is your house kids." Then we drove on a few miles farther to Climax and saw the place where we were going to live and it looked mighty good by comparison. It wasn't finished yet so we had to go down to Leadville. We lived in the _____ Hotel in Leadville for about three weeks while the house up in Climax was finished. Then we moved in about August 15. Menzal introduced us to fishing in Colorado and both of Menzal's daughters were also out. We went fishing up above Buena Vista that first summer and had quite a time of it. It was fun.

_____: Leadville is a pretty depressing looking place now. What was it like then?

WALT: It was much worse then. It was before Camp Hale and any of the buildup. Most of Leadville was pretty ramshakle. Climax was the only really prosperous operating enterprise. There were a few mines. Safeway was right down in the middle of town. The manager of the Safeway is still the manager of the Safeway up there in Leadville, Steve Berkovich. Baby Doe Tabor had died just a couple of years before and the

Leadville Chamber of Commerce had sort of all gotten together and agreed they would honor any bills she had ran up in Safeway or one other store there in town just so she didn't starve to death. She had died in 1936 or 1937 just before we came.

The trusses on the way up to Georgtown, the loop, was still there although the train had been discontinued a year or so before. There was still a narrow gauge train up to Climax from Leadville. A wide gauge had not been put in yet. That carried passengers as well as freight every day from Leadville to Climax. Climax then was the kind of a mining town that you read about. It was a complete company dictatorship. You couldn't pound a picture in the wall without getting permission from the line superintendent. It was a pretty fantastic mining community.

There was no refrigeration for the milk, for example. The milk came up in a truck in the morning from Denver and the store was just outside the gate of the Climax Company. It was run by George Kohler, the brother of Bill Kohler, the Vice President of the Climax Company in charge of operations down in Denver. They had an arrangement where they deducted, they sold script based on next month's pay check to the miners. They didn't

have any refrigeration for the milk. I finally found out that by sneaking downstairs to the store you could get the milk that had come up that day. The milk that was upstairs was from the preceding day being sold off. About the third of the time it was sour by the time you tried to drink it anyway. I remember one day I sneaked down the backstairs to get my day fresher quart of milk. I found the little grocery clerk that we called "Squeaky," a little, tiny tubercular-looking guy sitting there pulling the caps off and licking them. If they were sweet, he was sticking it back on and sending it upstairs [chuckle]. After that we drank canned milk! [chuckle]

_____: When you decided to bring the coronagraph to Colorado, was your concept of what you were after anything like the concept of coronal studies today?

WALT: Well, it was really quite interesting because we knew of the probability that clues to radio forecasting would lie in the study of solar activity and we didn't quite realize the full significance of solar flares. At that time the coronal gases had not yet been identified. We didn't know the temperatures. We didn't know, for example, that the green line of the corona was Iron 14. It had up until just about 1940 it had

been called Coronium which was supposed to be some new element. About 1939 or 1940 Ed Lane (the war had started in Europe) had made the suggested identification. I think in 1936 Grotian had suggested it, but nobody had believed it. In 1940 the real suggestion had been made. The news did not travel from Europe as easily as it does now a days because of the war. So it wasn't very wide spread. We didn't really know what the green coronal line originated in. Menzal believed in the high temperature theory of the corona. By and large I think people pretty much believed in a low temperature corona. Based on a high temperature corona, you would expect large affects on radio communication and so on. Menzal had a pretty clear idea of what we were after, but the observation was so extremely difficult. It had only been proven a few years before that the corona changed from day to day with Leal's first photographs.

_____: Until that time the sun had been thought of as completely constant or close to it.

WALT: It had been thought that maybe the corona had changed only from month to month very, very slowly. It wasn't known that the corona rotated ridgedly or that the active regions would rotate around the sun spots and so

on, the active regions in the corona. The pictures of the coronal activity were pretty primative. On the other hand, Menzal had a pretty clear idea of the affects on radio and we were looking for these. When I began to get daily observations of the coronal activity, I began the collection of photographic plates that ran right through until a year or so ago when we stopped taking routine coronal plates as a first priority item at Climax. I began those in September or October of 1941. By December of 1941 I had enough data that both J. H. Dillinger in Washington and I had independently concluded that there were radio communications disturbances much more common three to four days after a bright region of the corona appeared on the east lim of the sun than at other times. In other words, the bright coronal region at the east lim of the sun suggested that there would be radio fade out in a few days, long distance short-wave radio fade out. Pearl Harbor was December of 1941 and before Pearl Harber we were sending our information to the Carnigie Institution of Washington where D. H. Dillinger, who is this famous radio propagation guy, created the first radio propagation laboratory. It wasn't called that. After the war came on it was organized as the Interservice Radio Propagation Laboratory and it was

under the Joint Chiefs of Staff. Dana Bailey was the liaison officer from the Combined Commuications Board of the Joint Chiefs of Staff to this branch of the Carnigie Institution. Allen Chapley was in that branch of the Carnigie Institution right after the war working in radio propagation. Both Dillinger and I had noted this affect. I was then, of course, busily writing my Ph.D. thesis and my Ph.D. thesis was classified, not classified very highly, because of the fact that I had put some of the preliminary results of the Radio Communications relationship, this four day affect, into my first draft of my thesis.

_____: It was known by the time the coronal studies began the connection between radio blackouts and the auroral displays and magnetic storms?

WALT: Yes, it was. It was already suspected that these were the results of charged particles coming from the sun. I have forgotten whose hypothesis this was. It was probably Merle Tuve and maybe Lloyd Berkner, maybe Appleton or Dillinger. All of these people were working in the _____. The flare affect on radio fadeouts and so on had been discovered only around 1935 if I remember correctly. All of this was really quite new then. It was quite surprising that for a while we

had better routine observations of the sun's corona than we had of most of the other features of solar activity. Considerably better observations in terms of continuity than we had of solar flares. The solar flare networks were a post-war development rather than during-the war-development. In fact, even in 1946 we were not taking any flare observations at all at Climax. We were taking only routine coronal and prominence observations. I had already noted the striking relationship between extremely strong surge activity on the sun and bright, high temperature coronal regions. I had noted from looking at the flare data of other observatories, even though we weren't taking any at Climax, the regions which had very strong surge activity were also the same regions that had also displayed in other people's observations (like Mt. Wilson) had displayed the great flare activity. Of course, there was a tremendous amount of flare and prominence observations done by the Mt. Wilson group. During the life of George Elleroy Hale and during the active career of Ellerman and to a lesser extent mostly with the emphasis on prominences in the latter years of Pettit's life. Ellerman and Hale were active from about 1916 or 1917 right on up to the 1930s. Pettit was from the early 1930s to the mid-1940s.

_____: How were the observations that you took at Climax tied in to other observations and used by the military during the war?

WALT: The routine at Climax was the following: As soon as the sun would come up if it was clear, I would get the coronagraph going and I would look at the east lim of the sun. This is the lim of the sun that is approaching. If you saw an active region in the east lim of the sun you expected a disturbance in radio communications later. I would look at the east lim of the sun visually immediately and I had developed enough experience with the brightness to estimate the brightness of the corona on a scale of 0 to 40, 0 being the faintest and 40 being the brightest that the coronal intensity ever got as close to the edge of the sun as I could see. I later calibrated this distance and found it was the order of 30 or 40 seconds of arc from the edge of the sun. I would estimate this on the 0 to 40 scale. For example, it is 22 at 90 degrees on the east edge of the sun and at 135 it is 16 and these are the two peaks. I would take that information and code it in a telegram which I would call. By then we did have telephones in order to send these messages. I would telephone through the Climax Mine switchboard to

Leadville where we put it on the Western Union wire. It went to the Carnegie Institution of Washington, Department of Celestial Magnetism, 5241 Broad Ranch Road, N.W., Washington 15, D.C., Attention JNO A. Fleming. J. A. Fleming was the Director of the Carnegie Institution. Then having sent this telegram, or Janet would usually send the telegram while I would be back in the observatory again, I would attempt to get a photograph of the east lim of the sun and then if it was still clear enough, I would get a photograph of the west lim of the sun. Then I would take these photographic plates in and develop them myself. As soon as the plate was developed and fixed, I would put it on a light box and make a quantitative estimate of the intensity using a little thing I called a "fly spanker" which was not as big as a fly swatter, just a little tiny thing like this [chuckle]. The name was the name of a device to use to measure variable stars at the Harvard Observatory. It was called a "fly spanker." This little tiny thing that you would put down had a whole bunch of artificial stars and you got the one that matched the brightness of the star on the plate. I had the same thing with coronal lines. I had made a bunch of artificial coronal lines of various brightnesses and when I found the one that matched, I just

read the number off of the scale. I developed the photographic plates uniformly and I had standard intensity spots on the photograph from a standard light source that I had made, calibrated the bulb and all that sort of thing. If there were any appreciable error in the previous telegram that I had sent, I sent a correction telegram to DTM. If there were no appreciable error, I waited until the photographic plate was dry at the end of day then I measured it every five degrees. Then I sent another coded telegram with the precise values of the coronal intensity --- five degrees by five degrees completely around the entire circumference of the sun. It used to take 15 or 20 minutes to get the visual observation then about 45 minutes to get the photographic observations completely around the sun. If that was done, the crucial part of my work was done. After that I would attempt to get a prominence movie or hunt for some changes in prominence activity or something like that. It was during this time that I discovered the solar spicules.

One day when there was no other activity to look for I watched visually and discovered the spiculae near one of the poles of the sun.

_____: You might talk a little bit about that. Some of the thoughts that ran through your mind during the days and weeks after you first found it.

WALT: The truth of the matter is I really didn't realize that I discovered anything very important right off the bat. There were no prominences of any size because the activity of the sun was very low. This was in 1942. I had become very interested in making drawings of the prominences because I realized that you could see fine details in the prominences visually, but you never seemed to be able to photograph. The film was not fast enough, God knows what all were the reasons. You could see these details even though you couldn't photograph them. So I made a lot of drawings of prominences showing the internal filament structure. One particular day I remember especially there was just absolutely no decent prominence worth looking at. I decided to scan very slowly completely around the sun going to the polar regions just for the devil of it where I had never looked because the big prominences never occurred there. While I was watching, I noticed that there were some very, very fine, very beautiful small filamentary structures. To my amazement just after looking away for a couple of minutes and looking back I found that

they were changed in their position. In particular I remember with reference to one little, sort of, permanent prominence. I got very interested and I watched very carefully one particular region and saw that I could see these evolutionary changes. I still didn't think of this as very important or a significant discovery, but I decided to see if I couldn't photograph it. It was weeks before I got any kind of a successful film. Finally in December of 1942 I got about 75 frames of a film that showed the spiculae pretty well and I measured them and found their lifetime which was the order of three and one-half minutes and I made some drawings from the film, sort of a composite, showing the way it formed as a little blister at the edge of the sun and then a little jet went out at the top which was about three seconds by about ten seconds of arc and then the whole thing faded away in position. This was the first publication. I published the results of this 50 or 75 frames of this first film. I had told Chapley about these little spikes. Well, you got to find a good name for them. He said, "Look something up in the dictionary." He said, "What about spiculae?" I looked in the dictionary and sure enough there was a word "spiculae" so that was the word I assigned. That stuck.

Menzal came out in the summer of 1942 because I had to take my Ph.D. final exams at Climax. They were administered by the Chief Geologist at the Climax Mine. He came up on his day off and sat with me and administered the exams for Harvard University. I went back in the summer of 1942 and took my orals while Menzal came out to Colorado and worked in the observatory keeping it going while I was away until I got back. So Menzal was not at my final oral exams. I finished all my orals in 1942, but it was after commencement before I could get back there so I didn't get my degree until 1943 even though I finished the work in 1942.

_____: In those days it was strictly a one-man operation.

WALT: Yes, it was a one-man operation. Janet used to help out. I made a photoelectric aiming device about 1941. Before that Janet used to have to come out and punch the controls to speed up the telescope or slow it down so that it stayed guiding whenever we were trying to take a movie of the prominences.

_____: You had to say zeroed in on the sun by hand.

WALT: Yes. I would watch the image through sort of a light divider and yell at Janet, "More right ascention, positive deck, negative deck." and she would punch the bottons. We would do that for 45 minutes or so. All of the first prominences were taken that way which is hand control of the guiding of the telescope. Then I developed this photoelectric device. I am not sure if this maybe was my first publication from Climax because this was not important solar physics, this is not classified or anything [chuckle] and I published a description of the photoelectric servomechanism to aim the telescope. I called it for a while my "photoelectric wife." [chuckle] After that was done it took only one person to run the telescope instead of two. I could remember Janet would bring my soup out at lunch if it was clear and I would eat in the dome. The observatory was connected to our house so you didn't have to go outside. It was mighty cold in there. It used to be well below zero many times when I started out in the morning as it still is [chuckle].

I had forgotten when the first assistant came, but the daughter of the mill superintendent, Mary Ellen Duggin, came to work part-time or maybe full-time as sort of a general secretary, assistant, film developer and so on.

Then later she got married and went away. A gal who was a teacher in the Climax school got fed up teaching school and she came to work. She worked for several years at the observatory.

_____: What did the people at the mines think of this operation?

WALT: There was a lot of interest. For one thing the engineers and the geologists took a great deal of interest in it and were quite excited about it. Of course, we didn't talk anything about the classified part of it. We didn't talk anything about its being used for radio forecasting and a lot people would think it was a weather observatory and I wouldn't disabuse them of this. In fact, I did quite a lot of studying of weather phenomena in order to be knowledgeable enough so that while I wouldn't deliberately mislead anybody into thinking I was working on weather, it would be a plausible thing for them to think. We had a very informal, friendly working relationship with the people in the mine. I used to have to depend on the mine for a lot of things. Mine shops if anything went seriously wrong in the observatory they would always help. The carpenters would help thaw out the pipes when the pipes for the water system froze. We were

constantly dependent on the mine and the mine was always helping us out in little, not secret, unofficial ways. Of course, they kept our road plowed out so the guys who drove the snow plow tractors got to be good friends and the guys who collected the trash. We even had trash collection up there.

_____: Did you get all your food through the company store?

WALT: No, we did most of it in Leadville. The company store was pretty expensive. We got milk and daily supplies at the company store. Once a week we went to Leadville and did the big shopping. The families would all get together because gas rationing was on and make a once a week big shopping tour.

Towards the end of the war the Navy assigned Lieutenant Lou Larmore, a naval air officer, to Climax to assist. That was the first beginning of really professional assistance up there. By then I also had a guy who lived in Leadville who help out with machine work for the observatory. Larmore worked full-time. He said that he ought to get flight pay because he had been in the naval air force for two or three years and had never been as high as he was at the observatory at Climax [chuckle].