The Air Force at Sac Peak

Reminiscences of the First 29 Years of the National Solar Observatory (NSO)

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ABSTRACT

This is a short history of the first 29yr (1947-1976) ("The Air Force Era") of Sac Peak (formally known as the Sacramento Peak Observatory, or SPO). It traces events leading to the establishment of Sac Peak as an Air Force research center, mentions key personnel responsible for selecting Sunspot as the site of this new solar observatory, describes the buildup of the resident scientific staff, and construction of the major instrumentation that made Sac Peak the world's preeminent facility for solar research. We also mention some of the support people and family members who lived and worked at Sac Peak during that time. We discuss what life was like in those early days for the residents of this remote site, located in the Lincoln National Forest in southern New Mexico at an elevation of 2800m some 60km from shopping and medical facilities.

The date of this final Sac Peak workshop is most interesting, because it marks exactly 70yr since the first employee, Rudy Cook, arrived in August 1947 from Colorado.

Much of the source material for this presentation came from Ramsey¹, Zirker², and Liebowicz^{3,4}. A portion of this paper was presented as part of a series of sessions entitled "Sac Peak History" at NSO Workshop 30 on 7 August 2017, Sunspot, New Mexico, USA.

HOW IT BEGAN

Sac Peak was the brainchild of Harvard astrophysicist Prof. Donald Menzel, later to become director of the Harvard College Observatory (HCO) and president of the American Astronomical Society (AAS). It was 1947, the beginning of the Cold War. Menzel had wanted the Navy to become involved in building a new solar observatory, but it was not interested, so the Air Force (AF) became the main sponsor of U.S. ground based solar research. Menzel had a close working relationship with Prof. Marcus O'Day, a director at nearby Air Force Geophysics Directorate [later to become Air Force Cambridge Research Laboratory (AFCRL)]. Together they convinced AF Headquarters and Congress that it was vital to the defense of the U.S. to be able to provide accurate forecasting of solar activity events that can disrupt vital military communications at the Earth and destroy military satellites in earth orbit. Indeed, during World War II (WW2), military pilots and communications personnel had experienced frequent radio outages due to solar activity.

In September 1947 the AF awarded a study contract to Harvard and the High Altitude Observatory (HAO) to determine a suitable site and recommend appropriate instrumentation. Menzel, assuming that the AF contract would be approved, had already undertaken site surveys earlier in the summer of 1947. Together with O'Day and his former Harvard student Walter (Walt) Orr Roberts (PhD1943), then at HAO, which is located on the campus of the University of Colorado [CU]), they conducted several sur-

veys. For one of these, Menzel convinced Ralph Damon, president of American Airlines (AA), a person very interested in solar astronomy, to fly with them on an AA plane to look at possible sites.

After considering a number other locations (including White Mountain at the Nevada-California border, the Big Bend country in southern Texas, and several in the Sierra Nevada mountains of California), Roberts and Menzel, in August 1947, chose a mountain ridge named Sacramento Peak in the Lincoln National Forest in the Sacramento Mountains in southern New Mexico. From their initial survey, it appeared to have long periods of clear sky with stable atmospheric conditions (good seeing), was high enough (at 2800m) for coronal observations, and was relatively close (70km) to Holloman Air Force Base (HAFB), located 15km beyond the town of Alamogordo, which could provide logistical support for the proposed AF observatory. Sac Peak would also benefit from its large distance from population centers which cause both air and light pollution. Particularly important to O'Day would be the ability to monitor from Sac Peak his non-solar projects at AFCRL; namely, to permit direct line-of-sight observations of the White Sands Missile Range some 80km away in the Tularosa Basin, where frequent AF rocket and balloon launches were being made.

In contrast to Sac Peak, HAO's solar observatory, which had been built in 1940 by Menzel and Roberts, was located in Climax, CO at an altitude of 3500m. It was not considered for the new observatory because heavy snows and extremely cold weather prevented observations at least four months during the winter, while clouds and rain and poor seeing often meant that sufficient usable data was difficult to obtain during the rest of the year. Living conditions were very arduous for observers and their families. John (Jack) Wainwright Evans (PhD1938), another Menzel protégé and the future Sac Peak director, had lived with his family at Climax. He, more than anyone, knew that Climax would be unsuitable for a new observatory. His wife Betty told a humorous story: "I wrote to cake mix manufacturer Betty Crocker that they provide recipes for baking at sea level, at 3000, 5000, and 7000 ft elevations. I live at 11,500 ft. How do I change the recipe?" The answer from Betty Crocker: "No one lives at 11,500 ft"!

Following the aerial site survey, Menzel and Roberts convinced the AF of the importance of building a new solar observatory, the world's largest, in the U.S. Southwest to study all aspects of solar astronomy, but especially solar activity. They recommended that Sac Peak be the location. In April 1948 the Department of Defense (DOD) Research and Development Board gave final approval, and awarded a contract to Harvard and HAO to design the observatory. Zirker (p.3) writes that the "mission of the observatory was to study solar activity and its geophysical effects and to develop prediction techniques. Theoretical and analytical work was to be done at Harvard, and the observational work was to be carried out at Sac Peak under a subcontract with HAO."

Even before the AF contract was signed, Roberts had jump-started the ground-based site survey process in the summer of 1947 by convincing Menzel to hire Rudy Cook as Sac Peak's first employee, to begin daily weather and solar observations. Cook, just back from WW2 military service, had met Roberts some years earlier when Rudy's Leadville, CO high school science class had visited HAO's Climax Observatory, just five miles away. Serendipitously, Rudy had just visited Climax again and met Roberts, who decided that Rudy would be an excellent choice for Sac Peak.

In early August Evans drove Rudy and a Boulder student in his jam-packed 4-door Ford sedan from Boulder to Sac Peak, a distance of over 1100km. Not only was the trip uncomfortable, but the ending was dreadful. After traveling the last 19km on a terrible dirt road in a pouring rainstorm as they approached Sac Peak, they were forced to set up camp overnight in an abandoned railroad boxcar 8km before reaching their destination. The next day they drove the 70km to Holloman where Rudy was given a jeep-like weapons carrier to haul materials to Sac Peak.

After five days Evans and the student returned to Boulder, leaving Rudy alone in the mountain wilderness. During the first week he dug a pit for an outdoor toilet and erected a cover. Digging a hole at Sac Peak by hand is unbelievably difficult, as the "soil" is over 90% large rocks and smaller stones from the last ice age, and the remainder is sticky, cement-like mud. (I know this from personal experience when, 20yr later, I dug eight 50cm deep, 27cm diameter holes for concrete piers for an A-frame house next to our Air Force home, to serve as an art studio for my wife and living quarters for visitors. I was only able to dig two holes in an eight-hour day) Rudy also dug a garbage pit and built an outdoor shower and enclosure (of course the water was cold, so showers were short, very short!). The shower consisted of a person standing in a wash tub, using a water-filled bucket with a hole in the bottom.

Two weeks later, Holloman gave Rudy a 5m trailer to live in. Somehow he managed to pull it 61km to Sac Peak. Driving to and from Sac Peak was an ordeal. This mountain road (actually three roads) was a narrow, one-lane, rocky, rutted, muddy dirt road. It began 16km after climbing on paved highway NM82 from Alamogordo, which lies in the desert at 1300m, to the tiny rural community of High Rolls (population 200, 2000m elevation). The first section of this terrible road extended 11km up Karr Canyon to the mountain-top ridge of the Sacramento Mountains at 2600m, then 6km down to the Sacramento River, and finally up a very steep 7km narrow road (Water Canyon) to Sac Peak. Often after springtime snow thaw the mud was as much as 50cm deep, impassable except with four-wheel drive vehicles. The dirt road was improved by the AF several years later, after a visiting AF General had to ford the Sacramento River on foot, while in fulldress formal uniform. Finally, in 1962, 15yr after Sac Peak began, the road from Cloudcroft was paved. The Sac Peak road was moved from Water Canyon to Rice Canyon in 1974, and sections rebuilt and widened in the early 1980s. Then it became a NM state highway. Instead of giving it the proposed number NM372, the highway department agreed, after pressure from two local legislators, with my suggestion to number it NM6563 (for a reason obvious to astronomers) since it led to two world-famous observatories in Sunspot. (Fortunately there was a precedent for unusual NM highway numbers: The road to the International Space Hall of Fame in Alamogordo had been given the number NM2001).

After donating the weapon carrier and the trailer, Holloman provided Rudy with a small gasoline generator for electricity and a water trailer to bring water from the Sacramento River (misnomer: creek is a more accurate descriptor for this small water flow). Rudy had to drive 16km roundtrip from Sac Peak to the river for water. Roberts then hired a second employee, Lee Davis, before winter set in, so that Rudy would not be alone in the harsh climate. Rudy and Lee assembled a Sears garage which was used for sleeping, office, and shop space, and HAFB provided a second trailer (5.2m) and a larger diesel generator. The two men also cut trees to provide an access road to the site.

1948-1952: BUILDING INFRASTRUCTURE AND INSTRUMENTATION AND FIRST OBSERVATIONS

In late autumn of 1948 two pre-fab houses were erected, just before the start of the bitter winter of 1948-1949 with its unusually heavy snowfall. Often the road was impassable, and once the weapon carrier overturned (without injuries, but requiring lengthy repairs). Lee Davis wrote: "One morning we left the Peak at 8am and did not reach Alamogordo until 5pm. We had to winch from tree to tree as the mud and snow were so deep." Once it was necessary to air drop winter clothing to the stranded residents and work crews. Despite the horrible weather, construction crews from HAFB built a power plant, water and sewer lines, a graded road, and a radio link to the base. For the next 19yr this low-quality, frequently unusable, link would provide the only telephone service to the outside world for both official and residential use. There were no private phone lines; residents were given HAFB extension numbers, and were billed each month by the Air Force for their phone service. Quonset huts were erected to house observers, construction workers, and support personnel.

The first significant scientific observations began in May 1949 by a team from HAO and HCO, using an 11cm Lyot-type coronagraph-spectrograph combination. (Although Lyot had invented the coronagraph almost two decades earlier in 1931, this was only the second such instrument built in the U.S.) It was mounted on a 2.4m spar, and recorded coronal activity and prominences at the solar limb on a regular schedule. The instruments were mounted in the open, and had to be covered with a tarpaulin at night and in bad weather. Development of a flare patrol camera began. Harry Ramsey, the first college-graduate employee at SPO, was hired by Menzel as an observer. Ramsey's degree was in biology and chemistry. He had no astronomy or physics background.

In November 1949 the tunnel on highway NM82 was completed, providing much improved travel between Alamogordo, High Rolls-Mountain Park, and Cloudcroft at the top of the mountain, and thus also between Cloudcroft and Sac Peak. No longer would it be necessary to use the primitive Haynes or Karr canyon roads from High Rolls to the ridge.

In 1950 a Sears grain bin (slightly modified!) was installed to house a 3m spar on which a 15cm prominence telescope and $H\alpha$ filter were mounted. Daily flare patrol observations with this instrument began in March 1951. (Jumping a decade ahead, in 1963 the patrol instruments were moved and installed on a 3.6m spar in a new Hilltop dome.)

In the summer of 1950, Cornell University obtained an AF contract to monitor solar radio noise at Sac Peak. Two engineers installed and began operating receivers at 50&200MHz in December. These observations continued until 1954, when it had become clear that radio interference from HAFB and WSMR made solar radio noise measurements impractical.

Meanwhile, construction of Sac Peak's infrastructure continued unabated in 1951 and 1952. This included the main lab, which contained office facilities, library, photo lab, computer facilities, film vault, machine and electronics workshops. Most importantly for

observing, the Big Dome (later renamed the John W. Evans Solar Facility [ESF]), which was to house the 40cm coronagraph and 7.9m spar being built at HAO in Boulder, was completed. The Dome had a conical shape (to permit winter snows to slide off easily), with a rectangular opening which rotated to follow the sun during the day. In July 1952, HAO completed the spar and it was installed in the Big Dome (without optics, which would be added in September 1953, more than a year later).

LIFE AT SAC PEAK FOR RESIDENTS AND VISITORS

In addition to structures and instrumentation needed for scientific observations, of-fice space and resident housing were being built. These included a dormitory (called Visiting Officers' Quarters, or VOQ in AF lingo) for bachelors and short-stay visitors, and a community center with conference space, administrative offices, dining room, kitchen, barber shop, and a 3m long bar. (In following years, an AF-employed bartender served drinks three days a week during after-work Happy Hours [and also sold bottles of alcohol], and two AF barbers kept male employees neatly shorn). Breakfast and lunch were prepared and served on weekdays for employees and residents by AF employee Foye Varbel. Children did not understand the name Varbel and changed it to (an almost) homophone Wild Bill, which became his moniker for everyone at SPO. The conference space was utilized to show first-run movies several times weekly. The reels were provided by HAFB, and PhD staff members took turns serving as projectionists (even though this evening duty was not included in their official job descriptions!).

The AF also staffed a fire department, provided a nurse, and a high-ranking sergeant who coordinated logistical support between HAFB and SPO.

Four employees from nearby mountain communities became mainstays for many years at Sac Peak: Marie Cope, husband Hubert, daughter Rebecca and son-in-law Eddie Coleman. Marie became the first postmaster (no one was allowed to call her postmistress) and also operated the small BX (Base Exchange) that provided some groceries, toiletries, and household supplies, so that residents would not have to make as many 80 mile round trips to Alamogordo for food, cleaning supplies, etc. This was especially helpful when winter snows made the roads difficult or impassable. Her husband Hubert worked as a machinist and also drove the school bus.

The first permanent housing for families was constructed in 1952, as six redwood homes (five duplex, one single family) were built on "Coronal Loop". Six years later another six single family redwoods were built on "Hound Dog Hill". Thus 17 families were housed along the western ridge of the mountain with magnificent views extending 290km almost to Arizona, and overlooking the White Sands National Monument and Missile Range (as O'Day had required during the site survey). Short-term scientific visitors were housed in the VOQ, which had originally been occupied by AF personnel during the construction phase of SPO. Scientists who came for three months to one year, often with families, lived in the same houses as permanent staff members. In 1966, 21 collapsible relocatable homes were trucked in and assembled on site. This completed Sac Peak's residential housing.

In the first 70 years of SPO there have been five nearby forest fires. Although none required an emergency evacuation, on several occasions residents were urged to depart by car to Cloudcroft or Alamogordo. In 1955, as a precaution, a 400m gravel airstrip

was built as a helicopter landing and takeoff facility, to be used for emergency evacuations and for important visiting dignitaries. Each adult resident was required to be instructed in the use of an emergency evacuation route in case of an approaching forest fire. It started behind the Big Dome and followed a steep downhill trail (called the "Cow Trail"; we often met cattle on this narrow trail and wisely permitted the bulls to have the right-of-way) westward to the West Side road, where people could be transported to High Rolls and Alamogordo. If West Side road was also blocked, the escapees could continue on down the side of a cliff on an even narrower single-file trail (commonly known as the Eye Brow Trail because of the high wall on the left, and a sheer drop on the right) (I preferred the name Rattlesnake Alley because twice I encountered a rattlesnake there--once directly in the path, and once hearing the distinct rattle sound in the bushes adjacent to the trail) past Frenchy's cabin (built a century earlier by a hermit), and on to the desert below. Total distance on this trail from Sac Peak to the bottom was about 16km.

Forest fires were not the only hazard. Residents frequently encountered large black bears, not only on nearby forest trails, but at their homes. I almost bumped into one late on a dark evening when I left the main lab. We were both shocked. I backed slowly back into the building, and the bear ran away. One day my wife Patricia was working in her studio and heard steps on the back deck. She looked out as a bear slowly walked across and disappeared. On another occasion, when I was away on a trip, she heard the garage door open, and peeked through the door between kitchen and garage to see a large bear opening the garage. She closed the kitchen door quickly!

A frequent danger at Sac Peak was lightning. Violent storms often occurred, especially during the summer monsoon season, and were always accompanied by thunder and lightning. Usually the lightning struck the top of the water tower or the Tower Telescope, made an exciting display and lots of noise, but were harmless. But they also sometimes damaged electronics, and once while a couple was asleep in their metal-framed bed, lightning raced through the house, across the bed, and out the other side, leaving burn marks in the walls, but amazingly no injury to the occupants.

An AF General, on an inspection of Sac Peak, remarked: "This is a deplorable situation: all these civilian scientists enjoying their work and getting paid for it! This looks more like a vacation retreat than an AF laboratory. Perhaps it is too attractive to be a serious work site." Actually, of course, because of the isolated remote location, the long commute to Alamogordo, Las Cruces or El Paso for shopping, medical care, or outside social activity, and only a small number of residents to provide a normal, active social life, it was difficult to hire and maintain a permanent scientific staff, especially those with school-age children. When the Evans family arrived in 1952, the Cloudcroft school was a rural, county (not municipal) school serving mainly farmers and ranchers. This school, which Sac Peak children attended (commuting 60km daily on a sometimes dangerous road), was a total mess, with no good books, with school papers and books scattered on the floors, no seniors going on to college, school board members in frequent fist fights. So Betty Evans successfully ran for the Board, and served for nine years, mostly as chairperson. The transformation during her tenure was remarkable. The school became, scholastically, one of the top three in NM.

Because of the remote location, residents had to provide many of the necessities and accourrements that are easily found in cities. Since the entire PhD staff was male,

wives provided many needed items. Alice Dunn served as librarian for some years. She was also an ardent fan of the Metropolitan Opera. During its Saturday performances, Sac Peak children (and adults!) were instructed never, never to disturb Alice. Laura Dennison, and later Lorette Zirker, published a monthly newspaper called "The Sunspotter" of Sac Peak events. My wife, Patricia, became a master at dealing with the AF bureaucracy, and won a number of battles to improve life for families at SPO. Together with Judy Stover, wife of computer programmer Rod, she started a nursery and pre-kindergarten school in an abandoned metal Quonset house. Some of the children were foreign born and knew little or no English. Patricia also started an annual road cleanup campaign, for the 26km of NM6563 from Sunspot to its intersection with NM130 near Cloudcroft. Several dozen SPO residents always joined in this all-day project. Because the small redwood homes (only about 100m²) had no dining room, she decided to convert the one-car garage to a dining room and tiny office. The AF agreed only when she promised to restore the dining room to a garage when we left. Of course, some other residents followed her lead, and none of the converted garages were ever restored. More difficult to achieve was Patricia's plan to erect a 55m² A-frame next to our AF home. She needed it to house visitors and for her painting and sculpture art studio. It would need utility connections from the main house. Approval took guite a bit longer, first by officials at Hanscom AFB, then by AF headquarters at the Pentagon in Washington, before she was permitted to proceed. When we later moved to Alamogordo, we donated the A-frame to the observatory, and it was used occasionally by other SPO families. (A massive storm during the winter of 2016-2017 broke many trees. Some fell onto structures, including one that crushed the A-frame and another that damaged the converted garage.)

1952-1976: THE EVANS-DUNN ERA

Jack Evans became the first Director ("Superintendent", in AF parlance) of what the AF had named the "Upper Air Research Observatory", in September 1952. One of his first non-scientific tasks was to provide a postal name for this remote little mountain village. He held a contest for residents to suggest names for the location of the observatory. The judge of the contest entries, and the winner of the competition, were one and the same: Jack Evans! So the site became Sunspot, NM 88349. The AF changed the official name of Sac Peak several times in those years, but the one that stuck was "Sacramento Peak Observatory", so designated on 1 May 1956.

During the Evans tenure, from 1952 to 1975, the original all-Harvard-PhD four-member staff (Jack Evans, Dick Dunn, Jim and Connie Warwick) first added Henry and Elske Smith in 1955, then Frank Orrall and Jack Zirker in 1956. There were about 20 support personnel. The Smiths and Warwicks only remained for a short time. The remaining four scientists were joined in the next few years by a number of young PhDs, including, at various times: Dick White, Jacques Beckers, George Simon, Dick Altrock, Dick Fisher, Bill Wagner, David Rust, Steve Musman, Charles Hyder, Dick Canfield, Ed Dennison. None of the newer scientists were from Harvard. The number of support personnel grew to about 40.

Noteworthy is the letter of invitation Evans wrote to prospective PhD staff members. A portion of the irresistible letter that I received read as follows: "Dear Dr. Simon: I have

your entirely encouraging letter of 19 June concerning your plans regarding Sacramento Peak. Let me encourage you to visit us, even if you do not think the chances of your wanting to stay are too good. We would like the opportunity to improve said chances..... I note with pleasure that you and Pat sound like mountain hikers. If so, you will enjoy Sac Peak. The mountains here are delightfully different from the most of New Mexico. The observatory is in a beautiful green forest of pine, oak, and aspen, full of deer, turkey, bears and smaller fry, with a magnificent view from the picture windows out over the Tularosa Basin (White Sands) 5,000 feet below. If these things appeal to you, you will like it.....The purpose of the Observatory is to learn as much as possible about the sun, either theoretically or observationally – preferably both. I firmly believe that each senior staff member does the best research when he is working on problems of his own choosing in his own way. Hence, if you come here, you will be free to do exactly as you like, scientifically..... I do not much care whether the people here do theoretical or observational work, or both, as long as it is done well and is meaningful..... Finally, I see to it that the staff members have no administrative duties, since this is a very deadening burden. We do have periodic staff meetings to settle policy matters and air opinions, but this is about the extent of the administrative work.Better come have a look at this heaven on earth..... Sincerely yours, John W. Evans"

As Zirker writes (p.5), "Evans' first and best catch was Richard B. Dunn, a promising graduate student at Harvard.....Dunn joined Evans in 1953 while still completing his doctoral thesis under Menzel." In those years, Sac Peak scientists traveled to numerous solar eclipses, and there were frequent scientific collaborations with solar physicists from many countries. With this large group of scientists, Sac Peak became a highly productive research facility. During these 15yr a number of unique, state-of-the art instruments were built and put into service. For details, see Zirker, pp 5-14.

Making instruments for the telescopes required extremely accurate machining. Head of the machine shop was a Dane, George Streander, whose work was so precise and took so long, that Dunn often became frustrated with the slow pace of progress. Dunn hired two German machinists, Frank Schoeps and Horst Mauter. Schoeps always drove his car from home to the shop (distance 300m) because he had been in the German army in WW2 and had marched into Russia and back, and vowed that he would never walk again. Mauter later became head observer, first at the ESF, and later at the Vacuum Tower Telescope (VTT) (see below). Mauter arrived during the Cold War with the Soviet Union, and dug an underground bomb shelter behind his home. It was big enough to hold 6-8 people for parties he and wife Traute held there. Fortunately the shelter was never needed for its original purpose.

Despite all the progress being made, Dunn was not content. It had long been noted that air currents in the light path within solar telescopes cause image distortion, preventing high resolution observations of small solar features. So in 1958 he proposed building a huge evacuated telescope, named the vacuum tower telescope (VTT). Dunn's VTT would eliminate these internal distortions, though of course it could do nothing to prevent the distortions (bad "seeing") due to air movements in the earth's atmosphere between the telescope and outer space. Zirker (pp.8-10) gives more details about the VTT. AFCRL finally succeeded in obtaining money from Congress early in 1966, and construction began immediately. It was completed in 1969 (and dedicated on 15 October). At the time it was the world's largest evacuated solar telescope. From then until now, 48 years later, the VTT (renamed Richard B. Dunn Solar Telescope [DST] in 1970) has provided many of the highest resolution ground-based solar observations. (Jumping ahead

again: NSO is now building the much larger [4m aperture] Daniel K. Inouye Solar Telescope [DKIST] on top of Mt. Haleakala in Hawaii. It is hoped that DKIST, although not evacuated, but located at a superior site, using many of Dunn's innovations in solar telescope design, together with much-improved technology, will produce even better images of the sun, and for longer periods of time.)

Three Sac Peak scientists won prestigious awards: Both Evans and Dunn received the Hale Prize of the Solar Physics Division, and Dimitri Mihalas (a two year member of the PhD staff) was elected to membership in the National Academy of Sciences.

A very significant and highly successful venture was the AF-funded summer research program at SPO for graduate students from the U.S. and abroad. Many of these students and young scientists whose careers started at Sac Peak later became directors or principal scientists at other solar institutes in many countries. Some are here this week participating in this final Sac Peak workshop. The list includes five NSO directors (in chronological order): Dunn (interim), Zirker, John Leibacher, Beckers, Steve Keil; Directors of other institutes and solar organizations: DKIST:Thomas Rimmele; High Altitude Observatory:Michael Knölker; Kiepenheuer Institut:Oskar von der Lühe; MultiMirror Observatory:Beckers; NASA Ames Research Center:Simon (Pete) Worden; IRSOL:Michele Bianda; CRAAG:Toufik Abdelatif; NASA Goddard Solar:Richard Fisher; NSF Solar:Bill Wagner; U.Hawaii Solar:Jeff Kuhn; SOHO project scientist:Bernhard Fleck. Additionally, two students became astronauts and each flew on three Space Shuttle missions: George Nelson and Pam Melroy.

The author was chosen as a Payload Specialist astronaut for the Sunlab I mission to be launched in 1968. His Sac Peak colleagues wrote to the NASA Administrator: "You are welcome to him. Maybe you can arrange to make it a one-way trip." Unfortunately, in 1966, the Challenger disaster occurred, and NASA cancelled many upcoming missions, including Sunlab I.

1974-1976: THE TRANSITION FROM AIR FORCE TO NSF SPONSORSHIP

During the AF years, Sac Peak managers were required annually (often more frequently) to give progress reports to upper level AF managers, sometimes at AFCRL headquarters in Massachusetts, or before Review Boards in Washington, DC or Los Angeles. The questions of interest were always: How's flare prediction coming along? How are DoD assets being affected by solar activity? How reliable are your forecasts? How much warning time is there between a forecast of activity and its occurrence? When the Soviet threat of war was considered to be significant, money for basic solar research by AF scientists was easy to obtain. This fear of a possible WW3 provided the funding for the building of Sac Peak's infrastructure and support of a large technical and support staff, for 29 years. But in the early 1970s, with fear of Soviet aggression decreasing, and Congressional support for basic research within the DoD declining in favor of the civilian agencies NSF and NASA, the Air Force decided in 1974 to stop funding for Sac Peak, that the facility would be closed, and personnel let go.

After several high-level meetings among AF, Congressional, NSF, NASA, and academic personnel, a compromise was reached, in which SPO would remain open, NSF would become its manager, and the AF would continue to keep four scientists and two support people on the AF payroll, and contribute a proportionate share of SPO's operat-

ing expenses. The transition from AF to NSF occurred officially on 30 June 1976. Five months later, on 14 Dec 1976, Don Menzel, the "father" of Sac Peak, died.

Sac Peak became an independent observatory (SPO) under AURA (Association of Universities for Research in Astronomy, headquartered in Tucson). The solar group at Kitt Peak National Observatory (KPNO) remained under AURA also. Zirker became the AURA director of SPO, charged with paving the way for combining the two solar staffs into a new National Solar Observatory (NSO). This occurred in 1982, with Zirker becoming acting director, 26yr after he had joined the Sac Peak staff. Most members of the Sac Peak and KPNO-Solar staffs eventually combined to form the newly formed National Solar Observatory (NSO).

Dunn had one more project in mind before the transition from AF to NSF was to occur. The AF wanted to have continuous monitoring of solar activity, so he proposed the SOON (Solar Observing Optical Network). SOON would consist of five identical telescopes located at different longitudes, so that at least one or two sites would be able to see the sun at all times. Observations would be in continuum, $H\alpha$, and line-of-sight magnetic field. The locations would be HAFB NM, Ramey AFB PR, Learmonth AF Station (western Australia), Palehua HI, and San Vito di Normanni (near Brindisi in Italy's 'boot'). The first telescope was built at SPO, the others by the Navy in Indiana. All five telescopes were in operation from 1986 to 1997. Palehua was then closed to scavenge parts for an "improved" version (ISOON). Ramey was shut in 2003, but the other three SOON telescopes are still in operation, 32 years after the first one began observations in 1976. Data flows in real time to Offutt AFB NE and to analysts in Boulder CO to provide info for solar activity predictions. In 1996, 20y after the AF turned over SPO to NSF, the AF finally approved construction of ISOON. The first telescope was built and tested at SPO. When completed in 2002 it met or exceeded all its specifications. Later the AF moved it to Kirtland AFB in Albuquerque NM. It has not yet been brought to an operational state at that site, nor have any other ISOONs been built.

SOME FINAL THOUGHTS

For many of the people who worked at, or visited Sac Peak, and who knew Dick Dunn and Horst Mauter, there remains the troubling memory and mystery of their early deaths. Both men spent much time working at the bottom of the 60m VTT pit, where poisonous mercury fumes from leaks at the top accumulated. It is possible that this foul air contributed to their final illnesses.

It has often been said that all good things must come to an end. And so it is with Sac Peak. This workshop has been a very sad time for me, and probably for other attendees who have been at earlier of these annual Sac Peak summer gatherings. There are more foreign scientists at this workshop than from the U.S. More significantly, most of the Sac Peak staff has moved to Boulder or Hawaii or Tucson or Albuquerque, and some have lost their jobs. Only the DST is being used. The ESF is not operating, the main lab is locked, the library is gone, the machine shop is closed. Except during this workshop week, the dining room is closed. It was easy to sense that many workshop attendees, who have been here in years past, also feel my sadness. I think that NSO has a great future, with the DKIST soon to be operational, and a large and enthusiastic staff in Boulder. I believe that NSO will be as successful, or more so, as in the past. I certainly

hope so. But I doubt that it will have the same esprit de corps which was so evident and so critical to the success of Sac Peak.

I arrived at SPO in 1963, 16 years after its 1947 founding. So I do not have first-hand knowledge of what happened during those first years under AF sponsorship. Of the original four PhD staff members, only Zirker, aged 90 at the time of this workshop, is still alive. When he is gone, the final connection to the first years of SPO will be forever lost.

A very big thank you goes to the staffs here in Sunspot and in Boulder, and to NSO Director Valentin Pillet, who made the workshop so successful. Thanks to all of you who traveled so far to attend this final Sac Peak workshop. And most of all, as we say in New Mexico: **Muchas Gracias** to Steve Keil and Rob Rutten who organized and directed the scientific programme.

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REFERENCES

- 1. Ramsey, J: 1997, 1999, *In the Beginning: Sacramento Peak Observatory*, Morris Publishing (also 2nd Printing, 2002, Epic Press).
- 2. Zirker, J. B.: 1998, Solar Phys. 182, 1.
- 3. Liebowicz, R.P.: 1985, "From the Cambridge Field Station to the AFGL 1945-1985", AFGL-TR-85-0201, Special Report No. 252.
- 4. Liebowicz, R.P.: 1994, "Postwar Solar Physics: A Case Study of Military Academic Considerations", History of Science Society, New Orleans, October