

## A YEAR AT SUNSPOT

### Reminiscences of 1977–1978 at the Sacramento Peak Observatory

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*Forty years ago I spent a year with my family at the Sacramento Peak Observatory in Sunspot, New Mexico. In August 2017 the U.S. National Solar Observatory ended its presence there with a Farewell Workshop. These reminiscences are in that context. My aim is to paint the atmosphere<sup>1</sup>.*

**W**hen. I got my PhD at Utrecht University in the summer of 1976. My thesis adviser, Kees Zwaan<sup>2</sup>, had spent a year at Sac Peak, loved it greatly (wore a bolo tie ever since), and suggested I should go there rather than Caltech/Big Bear or KPNO/Tucson as other major solar observatories. I already held tenure<sup>3</sup>; this was a post-PhD one-year outing to see solar physics beyond Utrecht and hopefully obtain ideas and observations to take home and never move again.

I applied for a Dutch Science Foundation fellowship to cover travel and stay but didn’t get it. However, in the interview chair J.H. Bannier<sup>4</sup> told me I might qualify for a NATO grant and asked whether I had moral objections. Not me, hard to say yes for going to an USAF-founded and -funded facility. Also, I had already unscrupulously used NATO money to travel through Europe<sup>5</sup> – and did so later for

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<sup>1</sup>Plus name dropping. Literally the Sac Peak atmosphere is most invigorating! Cool, dust-free (but not pollen-free for those so afflicted), with a fresh pine-tree aroma and pleasantly thin thanks to 2800 m altitude. Kim Streater who grew up as a Sac Peak kid would say “When I get back up there I can open my lungs and breathe, breathe!”. The only complainer was Dimitri Mihalas who moved from Boulder to Sac Peak to escape Denver’s pollution, but then saw to his dismay the yellow plume from El Paso threatening him on the horizon – 100 km away (at sunset one sees Gila ranges further away than the length of Holland). Back home I could initially play Bach sonatas with significantly fewer breathing gasps, as the opening andante of the flute Partita (BWV 1013), a flow of semiquavers where any break is sin. The best solar flutist is András Ludmány at Debrecen. Three years later he composed a Bach sonata for me that was also too hard for me, but he performed it later in a joint concert at Santa Cruz de Tenerife.

<sup>2</sup>Zwaan was the last of the former career pattern in which one became a high-school physics or math teacher after leaving university with a “doctorandus” degree (now Masters) and spent a decade of evening work to produce a PhD thesis of sufficient quality to compete for the scarce professorships – or stay a teacher; many older teachers indeed held a PhD (nowadays most are not academic). Zwaan so wrote a fat thesis earning him “cum laude” but he also represented the transition by getting a grant from the Science Foundation to complete the last part part-time at Sonnenborgh Observatory.

<sup>3</sup>During a few years Kees de Jager, who led the rapid expansion of Sonnenborgh Observatory during the generous science funding in the 1960s after Minnaert’s frugal reign, had a nice habit of inviting young graduates to become staff member; this happened to Henny Lamers, John Heise, Peter Hoyng and myself even without applying for the job. This was the start of the new career pattern with funded PhD-studentships, initially paid by the university, later also the science foundation and nowadays the EU. Beforehand, Kees had already funded my graduation by appointing me and another student as research assistants sharing this position’s funding, not telling us that we were essentially competing for the full job and salary with our graduation research. Kees is presently 96, lives on the island of Texel, continues publishing solar-cycle studies, and remains my life’s example (apart from his running marathons until my present age; km now).

<sup>4</sup>Ex-student of Minnaert, then math teacher until he was picked as science administrator after World War II, longtime director of the science foundation, co-founder of CERN, ESO, ESRO ⇒ ESA. He didn’t like my application statement that Minnaert’s solar spectrograph at Sonnenborgh was ripe for a museum, defining my need to go abroad, and asked whether I thought that he belonged in a museum too for having graduated with that instrument. Later it got a second life as a sun-as-star spectrograph (Oranje 1982) contributing to three more theses, but now it is indeed a museum exhibit.

<sup>5</sup>After finding that NATO wanted conference organizers to enlist young students, supposedly easier imprinted with

the 1988 Capri solar-stellar granulation workshop and the 1993 Soesterberg solar-stellar magnetism workshop. The Sac Peak Farewell workshop would have fit this milk-NATO strategy well though not solar-stellar, but NATO is no longer into science.

The upshot is that we (me, Rietje – Rita in the US – and our children Katrien and Martijn, then just 5 and nearly 4) arrived at Sunspot in August 1977 (forty years before the Farewell) and returned home in October 1978.

**F**irst impressions. George Simon had visited Utrecht just before. He gave a Sonnenborgh colloquium on the five-minute oscillations, the hottest solar physics topic at the time. The unexpected highlight was that he also complained it was hot, asked whether he might take off his jacket, then surprisingly bared himself further taking off his tie and also his shirt – to show the T-shirt underneath. It featured Jacques Beckers in massive curly hairdo. I forgot George’s excuse and context; of course Jacques came from Utrecht but did his PhD work in Australia and I now wonder what the intended message or pun or nastiness was<sup>6</sup>.

The next day we had George and Pat over for dinner and he drew us a map of Alamogordo and the then Sunspot road, instructing us to get a rental car at the airport and load up on groceries at the Piggly Wiggly. Just the name! When we got there (flying the “Vomit Comet” from Albuquerque, indeed a bumpy ride) we therefore did our first-ever shopping in America at the Piggly Wiggly. I was flabbergasted to hear a most inviting “Hello, how are you today” from the cashier girl; to me it sounded like “please make love to me” which I didn’t expect for my very first encounter with a girl in the US. I thought I knew American culture pretty well from reading Time Magazine and John Updike and the like for years, but this was a surprise.

A yet more pleasant surprise was to meet a bunch of deer before the Davis Ranch<sup>7</sup>, and then to find George Nelson and family awaiting us at the observatory gate, the girls in pajamas while the rest of Sac Peak was playing volleyball. Pinky had been a visiting student of Tony Hearn at Utrecht and was now summer student with Jacques; we knew him well. He ran before our car to direct us to our relocatable #3069<sup>8</sup> and then went on for volleyball, making Gerda Beckers come over and say hello as fellow-Dutch. This was an immediate introduction to the big-family style of life at Sac Peak and the importance of volleyball there<sup>9</sup>. We knew it was an isolated community but hadn’t appreciated that because of that the social fabric was very strong. We have never lived anywhere with so much interaction among neighbors and the whole rest of the local community. America at its best in a most unlikely place<sup>10</sup>.

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NATO doctrine. My brilliant study mate Hans Rosenberg and I so traveled to Greece and Newcastle, where Chandrasekhar honored us in a dinner speech in the great hall of Northumbria Castle as the only students amidst eight or so Nobel winners.

<sup>6</sup>I later copied the gimmick in an IAU meeting in Canada having the Sac Peak Tower on my T-shirt; Jacques shouted from the back that I shouldn’t show the mirror – seventy meters down in my crotch.

<sup>7</sup>Not yet appreciating that the humps besides the road are former railroad grades, even put-aside ties still present.

<sup>8</sup>In recent years Craig Gullixson’s. The so-called relocatables were pre-fab houses, all identical with three bedrooms and an open kitchen with two-way cupboards as divider, a design we copied later in Lingezicht.

<sup>9</sup>I had at least one summer student accepted by Steve Keil by selling him as good volleyballer: Rieks Jager, later project manager for ALMA, ELT-METIS, and more.

<sup>10</sup>No other observatory we visited had so much personnel living on the spot. At Kitt Peak people housed in Tucson, at NAOJ in surrounding Tokyo, at Meudon in Paris suburbs, at Big Bear in Big Bear City. At the Kiev Main Astronomical Observatory only a happy few had housing on the beautiful observatory grounds. At the monumental Naples Osservatorio di Capodimonte only the privileged director, as at Arcetri. At the Roque de los Muchachos the observers stay in the

**W**ork. First I had to revamp my Utrecht Algol codes into Fortran. There were two computers, a Xerox Sigma 5 in the Mainlab filling its basement and a Sigma 3 in the Tower. Both read laboriously punched cards<sup>11</sup>, spit out lineprinter sheets in giant stacks, and filled magnetic reel tapes. The Sigma 5 even had huge multi-platter disk packs storing as much as 100 megabytes! One was reserved by the manager, Charles (Chuck) Bridges, for his butterfly catalogs, his main passion apart from nightly running the Cow Trail down to the West Side Road and back up for exercise. The Sigma 5 was booked per job for half or full hours, butterflies took most nights. There was a monitor near the entrance door to the Mainlab showing who had it; when my name was up Jacques would shout “Another rotten job!”, but most of the daytime went to Franz Deubner Fourier-transforming microphotometered Tower spectra to measure differentially-rotating deep-bound  $p$ -modes.

Yes, spectrograms were on film! A fantastic detector re pixels. Dick Dunn’s Echelle Spectrograph ESG fed spectra over a full meter length to 70-mm film at a frame rate of five seconds cadence: at 100 linepairs/mm resolution a 4 K×4 K detector, like SDO’s but faster. Better yet was the ingenious multiplexing scheme with a pre-disperser prism spectrograph feeding a slit plane in which multiple slits could be moved (by shifting cover-up plates held by clamps or magnets) to select different pieces of spectrum from different overlapping orders (not spread out transversely as common for nighttime échelle spectrographs but all overlapping each other at varying dispersion and shift) to get to the film, with wide-band filters mounted above the film to select the proper segment of the desired order<sup>12</sup>. This ingenious scheme permitted to make lines of interest from all over the spectrum lie close together but

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Residencia while most telescope staff drives the mountain (except a few permitted to sleep in the SST building, a historical exception there); we enjoyed spending DOT summers in a cabin besides a deep barranco but an hour drive or bike down and isolated. At Hida Observatory and Sayan Observatory we found similar isolated-site companionship but with too small permanent populations. At Sunspot during our year Jack Evans, Jacques Beckers and George Simon had already moved to Alamogordo, Dick Dunn to Las Cruces, Lou Gilliam and Christy Ott to Cloudcroft, but I guess we still amounted to 80–100 persons (in 10 one-family and 3 double redwoods, 21 one-family relocatables, 2 trailers, 7 BOQ apartments). Later the population declined but the start of Apache Point Observatory added some (including Bruce Gillespie who earlier took the fabulous Ca II K spectroheliogram on the proceedings of Bruce Lites’ 1984 workshop). The close-knit but sizable Sunspot community has been very special.

<sup>11</sup>But there and at Utrecht the card punchers, big noisy apparatus, printed the content of the 80-column card along the top (still familiar from 80-character fits headers; I still set emacs to 80-character lines for my programs). During my two-month stay at Kiev two years later during the bleak Brezhnev stagnation I found that their main computer, an illicit IBM-360 clone, could competitively run Fortran codes including Natasha Shchukina’s iterative two-level approximation NLTE program, the same approach as Avrett’s Pandora invented independently, but also that the Kiev punch machine did not print what got punched. Natasha used to quickly scan through the card pile (in foot-long boxes) flipping each up against the light to detect a typo or find the location to replace or insert cards by reading the eight-bit encoding holes in each column as characters, but I didn’t master that art and quit programming there. Her Lena (aka Khomenko, then 3) probably played with punch cards; my desk still rests on stacks of them applied as floor equalizer. Earlier Utrecht University had relied on punched paper tape with eight holes per character; 255 = erase was used to mask errors by inserting a row of eight holes manually with a stylus and a tape-holder with guiding holes (we also had fancy tape winders, even powered ones). Replacing a subroutine was done by cutting that segment out of a tape (one typed programs with stretches of blank tape between subroutines) and splice the new one in its place. Then there came the battle between the mathematicians and physicist Tini Veltman whether to adhere to Algol’60 and paper tape or go modern by moving to Fortran and punch cards. Luckily Veltman won – we got the CDC 6600 he knew from CERN where he developed “schoonschip”, the engine for his Nobel-winning electro-weak renormalization with my co-student Gerard ’t Hooft.

<sup>12</sup>I once spent half an hour folded up in the closed ESG box to get my eyes dark adapted for precisely positioning a polarizer on a large-Landé blend between H & K – hard to see since so very violet. I might do better now, my current cataract-replacing plastic eye lenses have higher ultraviolet transmission. Horst let me out on me tapping the V-sign he knew from having been on the bad side – deep into Russia which scared him enough to build a cold-war atomic-bomb shelter for #3049 on Hound Dog Hill on the suspicion Holloman was a primary ICBM target.

still separate across the film, so that one didn't register long swaths of non-interesting continuum but just desired spectral segments with interesting lines, at 70-mm film extent along the slit for spatial resolution. There was a program to compute layouts for any set of desired lines. Jacques Beckers had the most comprehensive setup called HIRKHAD, combining Ca II H & K, the Ca II IR triplet, H $\alpha$ , the Na I D lines, and more, I think also a Zeeman-sensitive Fe I line and a non-Zeeman-sensitive Fe I velocity line. Nowadays you may get such combinations at the SST combining CRISP and CHROMIS (but I would like to add Ba II 4554, He I D3, He I 10830).

At that time the only means for digital recording were large unwieldy single-pixel photomultiplier tubes in Peltier cooling boxes (I used one at the 1970 Mexico eclipse as real-time exposure meter in the spectrograph just before less wieldy though-the-lens metering became an asset of Asahi Pentax Spotmatic cameras, and a moving one at the Utrecht solar spectrometer to scan the spectrum digitally onto punched paper tape). However, Dick Dunn was already pioneering 1D solid-state detection with his Diode Array, still very large in itself to accommodate 512 pin diodes and enclosed in a large steel box mounted off the ESG on the table edge. The time of mounting spectrographs etc. as individual optical components on human-sized benches came only with the small size of CCD pixels. At that time there wasn't even much room for optical benches because the Sigma 3 with its Hollerith punch-card reader, line printer and many cabinets occupied much of the co-rotating telescope table.

The efficient Tower team led by Horst Mauter (with Dick Mann and Gary Willis rotating on a 3-day late, 3-day early, 3-day off schedule) would have your miles of film developed and ready for science the next day. The snag was that they then had to get microphotometered; even Dunn's "fast microphotometer" next to the Sigma 5 and noisily zipping boustrophedonically over the film couldn't keep up. At Utrecht I had been a microphotometer buff myself, digitizing a Houtgast-built one<sup>13</sup> to spit out punched paper tape at 100 samples/s, but when I returned home with many large cans of ESG films and smaller cans of corresponding 35-mm slitjaw films I had no clue how to handle them – they rusted away. Like almost all other film cans still locked away for posterity (if ever) in the plate vault in the Mainlab basement.

The same happened with the early-generation floppy<sup>14</sup> disks from the PDP-8 computer at the Big Dome from a project using Jack Evans' double-pass spectrograph to register the full H & K wings center-to-limb including absolute calibration of the "flux" spectrum using Jacques' 5-mm cylindrical sun-as-a-star telescope feed<sup>15</sup>. having Lou Gilliam spent a night with a standard lamp in a convenient

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<sup>13</sup>Houtgast was the colorful second to Minnaert in the 1930s. During World War II he replaced Minnaert who was interned by the Germans with other leading Dutch scientists, and then permitted Kees de Jager to hide from the Germans in the observatory. His brilliant PhD thesis ([Houtgast 1942](#), my birth year) settled the open issue whether one should account for coherence in scattering; the answer that complete redistribution suffices for most lines has been gospel since, with partial redistribution limited to only a few lines (Ca II H & K, Mg II h & k, Ly $\alpha$  – and Ba II 4554 Å) and a few characters (including Han Uitenbroek and me). After the war Houtgast moved into a personal niche of eclipse expeditions (I think because Kees de Jager rather than he was selected by Minnaert as successor), taking me on three that defined my career. Earlier he equipped the microphotometer used to produce the Utrecht Atlas of [Minnaert et al. \(1940\)](#), for which Mulders had taken the plates at Mount Wilson before becoming science director at the NSF, with very clever analog computing to convert the measured plate transmission into incident intensity by letting a slit-formatted galvanometer beam scan the non-linear calibration curve that was determined for each plate and then cut out from cardboard using nail scissors. The design is shown in the Atlas prefaces, in English but also in Esperanto in keeping with Minnaert's idealism.

<sup>14</sup>These were still indeed floppy (bendable).

<sup>15</sup>The "world's shortest and most astigmatic solar telescope" with which Jacques and Lou Gilliam registered the flux atlas ([Beckers et al. 1976](#)), by far the handiest and most useful of all printed solar atlases. It has convenient letter size, not the unwieldy large formats of the earlier Utrecht Atlas and the later Jungfraujoeh and FTS atlases, and all line

nearby tree (I believe to monitor coelostat-induced polarization affecting the grating transmission), and the same happened with the magnetic reel tape from the last week of our US caper when I registered the full H & K profiles at super spectral resolution with the Fourier Transform Spectrometer at Kitt Peak (still the bluest on offer in the FTS database), also center-to-limb. The upshot of all this, I am ashamed to say, is that although I like observing and am not bad at it, the subsequent data reduction is far beyond me so that my track record in publishing results from my own data is ashamedly lousy.

Fortunately, there were other ESG films at Sac Peak that turned out paper-producing, all taken by Jacques Beckers. They weren't even microphotometered but just printed by photographer Dick Faller to prepare the publication figures. The first came to my office as a 70-mm film in the hands of Lawrence Cram who had found it in the large film cabinet in the Tower where he regularly sat inspecting spectra per film viewer<sup>16</sup> that had been taken by others. He asked how a little Fe II line could appear in emission at the center of the disk. It led to [Cram et al. \(1980\)](#) showing that the little line responds to radiation from deeper even than its background continuum (the inner Ca II H wing). Bruce Lites got involved while he was visiting to observe, I think with David Elmore's Stokes-2 at the Big Dome, since he was willing to set up a suitable NLTE Fe II computation using his SOSO version of the Auer-Mihalas complete linearization code on the Cray supercomputer at Boulder. We visited him there for this work, starting a life-long friendship.

A similar full-linearization setup for Ba II was done for me by Bob Milkey at Tucson whom we also visited a few times<sup>17</sup> to confirm the empirical evidence of partial redistribution that I had found in my thesis work ([Rutten & Milkey 1979](#)).

The second set of Beckers spectra were brought by Bob Stencel, also visiting (we reciprocally visited

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identifications from the table by [Moore et al. \(1966\)](#) added alongside with a program by Chuck Bridges. I used to take my much-annotated copy wherever I went observing and also still have a Kurucz-generated digital version of it. Before that, somebody at Sac Peak (female I suspect) had been given the laborious job of writing all identifications along the line dips in a copy of the Utrecht Atlas that laid ready for inspection besides the ESG spectrograph in the Tower, an example that Kees Zwaan followed at Utrecht when he returned from his year at Sac Peak by putting his personal computer Ed van der Zalm, my later coworker and friend, to the same task; that annotated copy is now on display in the present Sonnenborgh Museum as a gift from me. I didn't know Kees got the idea at Sac Peak until I saw the ESG copy; Dick Mann commented that Kees should have asked a copy instead – he had it on microfilm and could easily produce another print with their spectrum-printing machine. At Utrecht personnel as Ed hired to do tabular calculations were then called “computer”, as in the acknowledgment in the [Moore et al. \(1966\)](#) line table. In the late sixties there were half a dozen at work at Sonnenborgh, mostly manually converting spectrum plate densities into intensities and variable-star measurements into light curves. At that time at Sac Peak Jack Evans would hire “the girls” – the astronomer's wives – for such jobs: lady computers as were Annie Cannon at Harvard and Annie Maunder at Greenwich, of better fame than Joseph Stalin whose only employment was as computer at Tiflis Observatory.

<sup>16</sup>A two-spool device with between the spools a meter-long back-lit bed for the film to slide through with a large magnifier mounted in the middle; the best ones accommodated the 70-mm spectra film and both 35-mm slitjaw films in parallel for simultaneous and time-delay image comparisons. I had one such constructed in Utrecht after my return and wonder what happened to it. Recently I wrote an IDL many-movie viewer for similar inspection and time-delay blinking (showex.pro in my imagelib) – business as usual.

<sup>17</sup>During one of those visits Karen Harvey kindly refilled her swimming pool just for our kids; they had already been cheated out of the Alamogordo swimming pool where water below 25 centigrade was judged unfit for humans. They adamantly convinced Karen that they loved cold water. Later in Boulder they were accepted without problem into the deep CU Olympic pool even though they couldn't swim. No swimming wheresoever at Sac Peak was the largest minus of the site for them; they tried a pool off Bluff Springs but came out with too many leeches. Unfortunately we didn't yet know the Scott Able Canyon creek on the way to Timberon that probably was still year-long running at that time, very scenic with beautiful and children-ready travertine slides. Now dry alas since the water drain for Orogrande (the much-ticketed slow-down hamlet on the 54 from El Paso) was moved to the upper creek.

at Goddard on our way back), who had asked Jacques for good limb spectra and got his best. They covered the extended Ca II H & K wings with a curved slit just inside the limb and with remarkable spatial resolution thanks to superb seeing that people sort of jealously attributed to Jacques as a special streak of his<sup>18</sup>. Bob's prints of these spectra led to [Rutten & Stencel \(1980\)](#), an undercited publication also treating occurrence of emission before the regular onset of the flash spectrum that I think still poses questions such as the strange behavior of the Y II limb emission lines. But also the other publications didn't make it into Hirsch-index ones; only later did I improve my standing<sup>19</sup>.

Before these director Jack Zirker had complained about my lack of productivity, not directly to me but via Jacques and also Tony Hearn when he visited, triggering a comment from Lawrence Cram (who was writing important publications at the time using HIRKHAD spectra): "How can he get something important if he just mucks around with Ba II and Y II lines?". Indeed I was. Later on I did somewhat better by moving up in the periodic system, first to Fe I with Bruce Lites' brilliant NLTE thesis as inspiration, then to Ca II H & K and their grains, then the alkalis, then to Ca II 8542 and finally all the way up to H $\alpha$  which at last I think I understand (although it made me a terrorist suspect<sup>20</sup>), and with He I and He II as tempting goal on my horizon – presently I work on Tom Schad multi-slit 10830 Å imaging spectrometry from the DST, a spin-off of the Farewell.

But so I always remained spectrally oriented and always remained within the photosphere and chromosphere, whereas my contemporaries of that time ranged far wider. Exemplary in the table below are Tim Brown, who went to other stars and then to planets and became Sac Peak's highest hirscher, and Jeff Linsky who after his thesis with Gene Avrett on H & K moved to Boulder and other stars.

**People.** Let me start on Sac Peak people of that time by embroidering the Hirsch theme. [Table 1](#) gives total publication numbers (everything on ADS), Hirsch indices (the number of publications with at least as many citations according to ADS), and the ratio of these two numbers. I collected them for all colleagues that I remember working at or visiting Sac Peak during our 1977–1978 year there. Some had to be estimated due to too many namesakes on ADS (Jack Thomas, Rich Robinson).

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<sup>18</sup>Indeed I had my best seeing that year on a day when I fell in for him because he had to stay in Alamogordo for jury duty – proud of being US citizen. I suspect that the Tower might have been situated better just south of the Big Dome, more like the Sloan telescope at the very edge of the steepest south-facing slope, or indeed on Apache Point. Similarly, I think that the SST (and the DOT) should have been put on La Palma's Pico de la Nieve on the east rim of the Caldera, having much better upslopes for the prevailing north-east winds to bring laminar conditions and push the caldera chimney plume from solar wall heating away from the line of sight until late afternoon. Nowadays one should mount automated Beckers SHABARs ([Sliepen et al. 2010](#)) at many locations and also on quads and do precise micro-comparisons.

<sup>19</sup>Never suffering "publish or perish" permitted me to develop at my own slow speed. My highest hirscher is one of my only two publications addressing other stars, [Carlsson et al. \(1994\)](#), addressing lithium NLTE in other stars. While it had a negative result and remains the most boring analysis we ever did, it remains my best cited – many more astronomers are into galactic abundances than into solar spectrometry: leave solar if you wanna hirsch.

<sup>20</sup>Lesson 1: don't forget your laptop in a plane. Lesson 2: don't leave an open email on your screen. Lesson 3: don't display emails about bombs. Even if these are just Ellerman bombs of 1917 vintage (well – Ellermans release more energy than the champion 50-megaton Tsar bomb of 1961, also a hydrogen one). Lesson 4: the Dutch border police took three months to identify me as Ellerman bomber, don't fear them if you are a bad guy. Lesson 5: the NSA didn't blacklist me yet, the world ain't too bad yet. But maybe these very sentences will do me in per Google Scholar. Lesson 6: don't try to compete with Sami Solanki. During the Farewell I hoped to score the 100th citation of [Ellerman \(1917\)](#) in its centennial year (its citation score shot up dramatically the last years, thanks to ADS and partly thanks to me, implying that your nice discoveries do get credit eventually – just sit back and wait a hundred years!) – but it looks like the centennial 100th citation was [Bharti et al. \(2017\)](#) including ubiquitous Sami.

Table 1: Publication tallies collected from ADS in January 2018. Left: Sac Peak staff and summer students during 1977–1978. Right: Sac Peak visitors during 1977–1978. Rich Robinson and Jack Thomas have ADS-confusing namesakes.

	pubs	Hirsch	ratio		pubs	Hirsch	ratio
Dick Altrock	158	17	0.11	Martin Altschuler	45	16	0.22
Jacques Beckers	326	33	0.10	Grant Athay	226	37	0.16
Tim Brown	529	76	0.14	Larry Auer	126	34	0.27
Lawrence Cram	228	34	0.15	Bart Bok	262	21	0.08
Franz Deubner	169	23	0.14	Dick Canfield	363	43	0.12
Dick Dunn	112	14	0.13	Stirling Colgate	265	35	0.13
Jack Evans	61	13	0.21	Eric Fossat	223	32	0.14
Harry Jones	143	18	0.13	Phil Goode	351	43	0.12
Steve Keil	125	18	0.14	Tony Hearn	68	13	0.19
Don Neidig	73	16	0.22	Henry Hill	135	12	0.09
Steve Musman	55	14	0.25	Joe Hollweg	228	52	0.23
Rich Robinson	?	plm 34	?	Stuart Jordan	76	11	0.15
Rob Rutten	227	32	0.14	Henny Lamers	452	60	0.13
Tim Schneeberger	46	10	0.22	Jeff Linsky	>1000	76	> 0.08
George Simon	111	23	0.21	Bruce Lites	292	55	0.19
Ray Smartt	145	15	0.10	Dermott Mullan	324	33	0.10
Tuck Stebbins	95	16	0.17	Gene Parker	479	69	0.14
Pete Worden	195	30	0.15	Henk Spruit	301	61	0.20
Jack Zirker	175	22	0.13	Bob Stencel	484	35	0.07
Mark Giampapa	271	39	0.14	Jan Stenflo	346	46	0.13
Jeff Kuhn	254	27	0.11	Dick Thomas	242	28	0.12
George Nelson	28	11	0.39	Jack Thomas	?	plm 33	?
				Charles Wolff	73	18	0.25

Tim Brown has ADS competition from a physics T.M. Brown but not producing hirschers galorely like Tim does. Stirling Colgate’s ADS astronomy-only record excludes many still-secret publications from the H-bomb development (actual bombs, not Ellerman’s 1917 ones)<sup>21</sup>.

Hirsch indices have become the most common way to evaluate publication standings for scientists; even Google Scholar posts them. They grow with time and age, especially academic age. They remain low for people leaving the field – if Einstein had died in 1906 his Hirsch index would remain three forever. They also grow faster nowadays than before ADS made getting and citing astronomy publications so easy<sup>22</sup>.

I add the ratio  $h/N$  which I call “quality” since it indicates the mean impact per publication:  $h/N=0.10$  (not bad) means one has to write ten publications to add one hirscher. This is a loaded quantity: for

<sup>21</sup>He was far too smart for an empty life as toothpaste millionaire. At his Sac Peak seminar: “I love bombs! The bigger the better! When I found that solar flares are much bigger bombs than the ones I was helping to make I moved to them! And then I found that supernovae are even bigger bombs!” At the time he started a robotic supernova-finder on the Magdalena Ridge beyond Socorro and later delved into cosmic ray acceleration, but he did not become a big-banger.

<sup>22</sup>ADS magnificently restores ancient literature to full worth – as Ellerman’s 1917 publication.

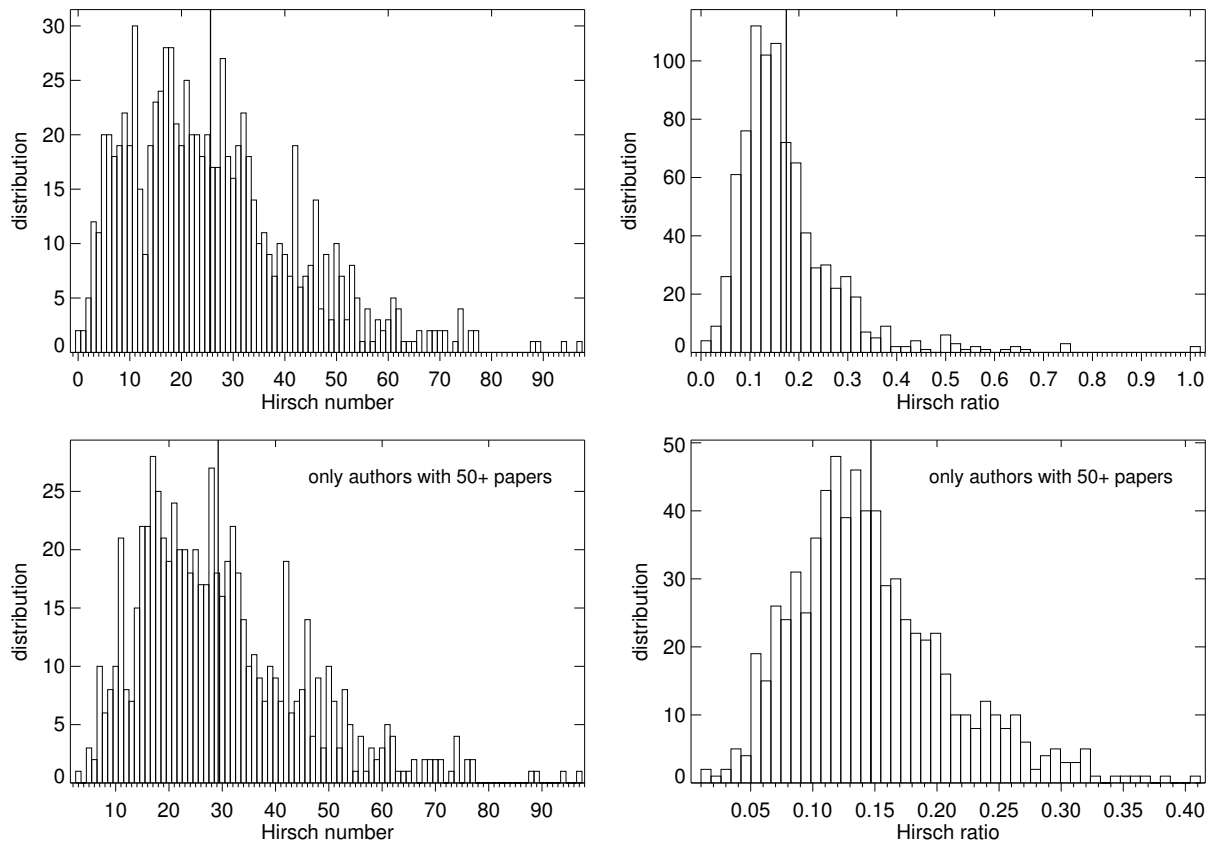


Figure 1: ADS-based Hirsch statistics for 800+ solar physicists per January 2018. Upper panels:  $h$  and “quality” ratio  $h/N$  distributions for all. Lower panels: only for those with at least 50 publications, effectively a limitation to seniors who didn’t leave the field and so removing the initial hump and bi-modal shape seen top-left. Vertical lines: median values.

Tim Brown a new publication must be cited twice as often as for me to count – noblesse oblige! Starting scientists publishing their solid PhD publications but no conference dallies usually reach higher quality than 0.10<sup>23</sup>; it usually goes down with seniority to about this value.

The high-quality champion of prolific senior types in our field ( $N$  above 100) was the late David Hummer ( $N = 160, h = 52$ , ratio 0.33), ten times “better” than Jay Pasachoff ( $N = 702, h = 22$ , ratio 0.03) who instead is a prolific popularizer. The very “worst” was Norman Lockyer ( $N = 302, h = 3$ , ratio 0.01), discoverer of the chromosphere and helium which he both named but who lived before

<sup>23</sup>I began my hirsching when Hardi Peter asked me to give concluding remarks at the 12th European Solar Physics Meeting at Freiburg in 2008. I accepted on the condition that I might insult all 200+ colleagues attending and did so by hirsching all presenters (the pdf still sits on my website). I finished by announcing the two “best speakers” based on their Hirsch: Manfred Schüssler who gave the opening talk, so superb that I also made him give the opening talk at the Sac Peak Farewell – where I blundered as his chair when the displayed countdown clock turned to be out of whack and I hadn’t noted when he started; I cut him 10 minutes short without realizing this even though he reacted in surprise. I did apologize later, getting the gracious response that it kept him from addressing the ugly solar physics wrongness of the magnetic Prandtl number (but it sits in his presentation file on the NSO meeting website which I hope will last longer than the Freiburg ESPM one which was promised for eternity and which ADS still links for every talk but has vanished). The other best speaker at Freiburg was Tobias Felipe who only had  $h = 1$  but also  $h/N = 1$ , suggesting outstanding quality.



the era of citing others ADS-accessibly while largely filling *Nature* which he founded and edited for 50 years. So much for calling this ratio a quality indicator! The highest ratio in these Sac Peak tables has Pinky Nelson: it surely takes quality to become a highly successful astronaut<sup>24</sup>.

Figure 1 shows Hirsch statistics for 800+ solar-physics colleagues<sup>25</sup>. Comparison of Table 1 with these distributions shows that the Sac Peak staff at that time scores normally (with outlier Tim Brown taking care of the high-*h* tail) but that the visitor distribution was lopsided to high quality, partly by including stellar types<sup>26</sup>.

Another number that I may add in future is the Hirsch derivative with time. Google Scholar sort of does that already by also showing the partial *h*-index for recent years. I expect that for myself it will confirm I am a late-bloomer.

Yet another temporal ratio of interest is “*ache/age*”, but for that I have to find everybody’s birth date. Reaching unity or larger in this ratio is a tremendous feat. I am fairly confident that Tim Brown hasn’t reached 76 years yet and qualifies, but Gene Parker and Jeff Linsky seem to outlive their hirsch (I certainly do; my ambition is to end up at  $h/age = 0.3$ ). Other senior colleagues with claim-to-fame  $h/age > 1$  at present are ubiquitous Sami Solanki, Martin Asplund, Axel Brandenburg.

I now turn from hirsching Sac Peakers to Sac Peak personalities. At that time the staff was still more Airforce (“blue squad” in Zirker speak) then NSF; at its start 25 years earlier<sup>27</sup> Sac Peak was entirely Airforce<sup>28</sup>. The joining with Kitt Peak into NSO came later. Over the years the Airforce contingent dwindled but Steve, bossing that before becoming NSO boss, kept it artfully alive.

The outspokenest person in 1977–1978 was Pete Worden, very much Airforce, always scheming, an excellent host<sup>29</sup>, most thoroughly conservative (“nuke them till they glow” re Russians after an Airforce cadre course)<sup>30</sup>, a mean volleyball player (but not as bad as Don Neidig whose serve was a

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<sup>24</sup>Pinky was applying for NASA astronaut selection when we arrived. He worried about not informing them about his once-dislocated shoulder – I guess I can safely spill that secret now.

<sup>25</sup>I collect their ADS files for years already, refreshing them regularly in order to have every abstract of every colleague whose work has ever interested me in my laptop for easy literature search. The collecting engine is a nice script from Alfred de Wijn, with another collecting Hirsch values. The first also collects all the accompanying bibdata specifications from ADS, so that I never have to produce bibfiles for publications but instead let bibtex hunt through this entire collection, a nice trick I highly recommend. My website gives detail and the scripts.

<sup>26</sup>Solar physics is a small field so that generally its Hirsch level is comparatively low. Another aspect of this is the relatively wide spread of open solar data policy, without fierce competition for scarce data between too many researchers as in *e.g.*, cosmology, and with Alan Title’s wonderful example for space missions (including his forcing it for Hinode). I followed it for the DOT (and also for my teaching and research materials). NSO has open data policy for its NISP monitoring; I hope it will also have it for DKIST.

<sup>27</sup>Our year started with a festive Silver Jubilee meeting “Large-Scale Motions of the Sun” including a very posh banquet at the Lodge where Dick Altrock taught us how to sip a margarita.

<sup>28</sup>Early Sac Peak history is described well by Zirker (1998).

<sup>29</sup>His Halloween party was a screamer. He dressed, wigged, and blackened himself into a fat Mississippi lady, screeching all night in a loud falsetto about her basooms hanging in the way. Some much nicer girls came over from Tucson for the event. I got thoroughly drunk but had the Tower next morning and remember getting there in very bad shape but still in time at sunrise – to quickly judge the clouds too thick and go to bed.

<sup>30</sup>The summer students had a good prank while he spent a summer in Cambridge England, posting a letter with his authentic signature to Zirker that he had now seen the lights of peaceful liberal democracy and had chosen to stay where those shone so progressively and socialistically bright, herewith resigning his Airforce position – or maybe Jack put it up himself, I don’t know. The best-ever prank was to paste giant black footprints going up the Tower – which Dick Dunn didn’t appreciate. Later a good one was when Steve Keil returned from a European stay to find his office, *i.e.*, its whole content of cabinets, chairs and desk with all its mess including the stacks of lineprinter output that adorned any desk at

bomb lightspeeding to kill you), and most eager to win any game in the long winter evenings. I had introduced dice poker at Sac Peak, the only game I like (Steve calls it “liar’s dice”), but the highlight that winter became Diplomacy, a board game in which you start having a country in divided Europe in 1914 with an army and/or navy and battle the others in spring and autumn campaigns, with as distinctive feature that in between campaigns you huddle in toilets and bedrooms and outside to make secret deals – and then betray your newly-accorded partner. One game took a week of every night scheming and betraying, if not already negotiated at coffee time in the Mainlab. I had expected to be the second slain after Tim Schneeberger, an easy to slaughter contender in my opinion, but he wasn’t and so I was the very first defeated. I also expected that the final battle would be between Pete and Lawrence Cram and my hope was on Lawrence: also ambitious but more civilized and likable. Not so! Surprise! The final Pete-contestant and eventual winner was Steve Keil. I had never expected such tenacious aggression from this quiet background mumblor, but so I learned that Steve was of eventual director meat and would be good at that job if that would entail political win-or-loose fighting, as of course indeed it did and does.

Then-director Jack Zirker impressed me by his directness, efficiency, quick understanding of anything, and no-nonsense impatience with slow response. But most of all by his American-speak: a natural-sounding fast flow of idioms I mostly had never heard or read before, always very clear and very much to the point to make people wrap up and continue to the next item in our staff meetings. He came from the Boulder Thomas–Athay eclipse school of NLTE chromosphere interpretation – even now an immature subject with considerable misunderstandings. In our time at Sac Peak he was mostly administrator while his real passion was guiding multi-day Sierra Club hikes like the Mount Rainier circuit. Later his science was mostly filaments/prominences triggered by Orrall, with the little mafia of Sara Martin, Oddbjorn Engvold and pals succeeding in having a meeting in a nice faraway place every year. Since then he put his language skills to write very clear and well-organized astronomy and physics popularization books: I have them all thanks to Amazon. A good legacy.

During those staff meetings George Simon was naturally at his most complaintive, but always pleasant and hospitable to us. He made a sport of together walking up the steep little trail from the Mainlab to the Tower maintaining our conversation, so that I would arrive out of breath: though short it is very much a thin-air killer climb. Not him thanks to his yoga he claimed, so we followed Pat’s one evening/week yoga class which usually emptied my mind so well that I couldn’t work afterwards. Much later I took my revenge on George, together climbing the 14 stairs of the ugly Utrecht campus building where we had moved from the beautiful but antique Sonnenborgh observatory, now a museum. I did that on arrival every work day year-in year-out, and that time also made sure he talked but not I, and so got him gasping – but I didn’t boast about my yoga (never since Pat).

By being out in the boondocks Sac Peak had a natural propensity to collect funny characters. Shy types as Ray Smartt and Steve Musman found a good niche there, in later years Larry November. The pivot of good sense was post mistress Marie Cope – only much later did I discover Rebecca stems from her. She was very nice to us, keeping an eye on our kids gamboling in the woods behind her office and home; we had given them freedom to range anywhere within the surrounding roads and they imagined themselves deep in the Amazon wilderness, building lean-to shelters and becoming savage bow-and-arrow Indians<sup>31</sup>. Marie forwarded tidbits as a thick glossy L.L. Bean mail-order catalog (“I

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that time, precisely one-to-one arranged outside in the parking lot with a coke machine and a sofa in the Keil-empty room.

<sup>31</sup>Not hunting lions or bears – but they might have. One summer Rietje was forbidden to take her daily walk along the airstrip because a young lion was spotted there; I then met a young bear on my daily bike ride to Apache Point.

am sure that Jack Zirker doesn't need two of these and I think you may like it") from which we ordered a much-used and beloved hi-tech Moss tent, air mattresses, and outdoors clothes I still use, our first experience in shopping-at-a-distance. Nowadays Amazon, Abebooks etc. serve me well to obtain ancient solar physics and radiative transfer books not on ADS<sup>32</sup>, right on my doorstep to flesh out my private library, usually for just a few dollars plus shipping<sup>33</sup>. I don't know how well the relatively complete Sac Peak library has fared in its move to Boulder; I hope it remains as accessible as it was, the best I have perused. In our year Nancy Carson was the librarian, successfully wooed by Pete Worden (I was surprised at first until I realized that she managed well to prick through his boisterous bolster – "she will make a good general's wife" was the communal opinion). The other wooing was of Jack Zirker's secretary Christy Ott by Tuck Stebbins, also tenacious and also successful. I also suspect that Dick Alrock was already wooing Sally away from Don Neidig (or reversely), also successful. Sac Peak had been infamous for musical chairs but the couples present or paired that year were mostly stable.

Tuck Stebbins and Tim Brown were disciples of Henry Hill who was a coworker of Robert Dicke at Princeton before he set off to build the SCLERA telescope on the Catalina mountains near Tucson to confirm or disprove Dicke's scalar-tensor alternative to general relativity. I knew all about that, having dabbled in pole-equator center-limb temperature differences using the Mg I 4571 LTE line with the Utrecht spectrograph, not knowing that the Dicks (Canfield and Alrock) had already done that at the Big Dome; the intention was also to prove or disprove Dicke's oblateness findings at Princeton. Hill's telescope was meant to measure stellar light bending outside eclipse but I don't think it ever did; instead he did refute the oblateness<sup>34</sup> and detected long-period limb waves that became a saga of controversy on their own<sup>35</sup>. His telescope design was very clever and included Schupmann correctors; when Göran Scharmer put a Schupmann in the SST (after copying Dick Dunn's turret for his preceding SVST) I was about the only one recognizing the design.

A result of following these Dicke affairs was that I had learned to recognize former Dicke pupils as sharing his mold: types who combine cleverness bordering on genius with utter obstinacy in wanting to prove something truly outrageous with unheard-of techniques. They include Jim Brault, Jeff Kuhn, Phil Goode, Ken Libbrecht, and effectively but mellower Tuck and Tim as secondary offspring via Henry Hill.

Jim's FTS at the McMath was genial, although the solar physics appetite for  $10^6$  spectral resolution without spatial resolution declined after Stenflo's fluxtube and second-spectrum interests produced its best results and Livingston, Kurucz and Neckel produced much-used spectrum atlases. Jeff (Sac Peak summer student in 1978) is going strong, now on to exo-civilizations. Phil got the world's largest solar telescope named after himself, even without first becoming a dead senator. Ken revamped

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<sup>32</sup>But you might corner some privately from Andrii Sukhorukov who has scanned the more important ones. I put his scan of John Jefferies' *Spectral Line Formation* integrally on ADS with enthusiastic consent from John, but for other classics getting publisher consent is less trivial.

<sup>33</sup>I am so building one of the better solar physics libraries now that most universities are discarding theirs. My intention is that it eventually ends up in the postdoc room at Oslo, also a former library without any books left on the premises but with suited empty bookshelves. No point in bequeathing them to Utrecht University which scrapped its ApJ and A&A subscriptions the moment Utrecht astronomy was killed.

<sup>34</sup>I believe that the oblateness controversy killed Dicke's much-deserved sharing of the cosmic background microwave radiation Nobel Prize (best ever); it was he who told Penzias and Wilson what they were about.

<sup>35</sup>Like most low-*l* helioseismology. SOHO was put in L1 for this but also without success. When I grow cynic I may write a scathing history.

low-*l* helioseismology but then departed to greener pastures of more esoteric physics. Tuck ended up in LIGO and LISA, humanity's most daring enterprises. Tim designed his "Fourier tachometer" during our year at Sac Peak with help from Jacques Beckers who ran tests on a wide-field Michelson interferometer in his Tower office (the largest there – in the Mainlab he had the smallest). Little did I realize how clever the idea was and how far it would go, nor how far Tim himself would go.

Tuck and Tim were both very nice and helpful<sup>36</sup> colleagues, Tim the more reserved but also the more agile volleyball player, a most important asset in that volleyball-dominated society. Tuck made a winter sport of cross-country skiing the already ancient former logging-railroad routes, nicely well-graded and yet without trees growing in the way; I wish I had followed his example and learned how to ski – probably the best way of enjoying the marvelous grades in their then still pristine state. Much later Steve and Pamela and me mountain-biked a bunch of them from the 64 to Bluff Springs but too rocky and bumpy; in the meantime a number has been hopelessly spoiled by quads following on "rails to trails" motorbikes. More on these grades below.



*Figure 2: Chinese cooking class led by photographer Dick Faller. Left to right: Steve Keil, Betty Derrig, Lorette Zirker, Christy Ott, Rietje Rutten. This photo appeared in the Alamogordo Daily News for which Lorette was Sunspot reporter and was taken during two days preparation for the sumptuous exam supper (jellied lamb – tea leaf eggs – asparagus salad – radish salad – Szechwan bean curd – sweet and sour cabbage – soy sauce chicken – siu may – tangerine chicken – roast pork strips – Szechwan dumplings – sherbet – stir-fried beef and snow peas – steamed chicken and Chinese sausages – hot and sour soup – fruit) for spouses as examiners who happily rotund passed them all. Dick Faller's other passion was classical music, including driving to Santa Fé for string quartet concerts, six hours each way and losing at least one car in deer collision.*

<sup>36</sup>Tuck even taught me how to read octal memory dumps from fatal aborts (computerese of that time), a language I forgot since as completely as classical Greek learned at school.

Franz-Ludwig Deubner was spending a year at Sac Peak when we came and returned to Freiburg around Christmas. In the meantime we made music. I had played flute during high school but discarded it at university; now I had time on my hands and took it up again, buying an old school flute from Karin Mauter and repairing it in the workshop. At Deubner's farewell party at the Zirkers he played one of Bach's cello suites; I played Debussy's *Syrinx*. Before Franz had been playing all six suites throughout an overcast day in the Tower whilst every five minutes monitoring the table rotation precisely in order to find its pivot eccentricity in the "divided circle" calibration that both he and I had been taught as a key effort of classical astrometry. When he and family returned to Freiburg we bought his piano; when we left we sold it to Harry Jones; he still has it. Much later I made Franz give a serious concert with pianist Pierre Mein (both had hesitated between conservatory and astronomy), with as highlight the Debussy cello sonata as a special request of Kees Zwaan in whose honor the concert was held (1993 Soesterberg "Swansong" workshop). Franz left Sac Peak with the understanding that he might return soon as staff member, but instead he became professor at Würzburg and stayed there. He died last October, leaving strong and good memories.

Lawrence Cram was also already there when we came, with Barbara and infant Edward. He was a friend already; shortly before we had hiked the sea floor at low tide from the North Sea coast to an island (German in fact) and back at midnight during the next low tide; the roughest, toughest and perhaps riskiest hike one can do in the low countries. My boasting about these later motivated Bruce Lites to try one too, but then it was already November and although we dressed in wetsuits borrowed from my kayak pals it was bitterly cold to slosh many hours through winter-cold sea water in the mandatory hurry before it would rise over our heads again.

Steve and Alice Keil arrived around Christmas from Australia; they had lived at Sac Peak before and maybe they already had in mind never to leave again. They quickly became good friends and they quickly established themselves as social core at Sunspot – which they also remained ever since.

A very important Sac Peak asset was the large flux of visitors, not only from HAO to develop or observe with David Elmore's Stokes-II at the Big Dome but effectively from all over the US. Probably there were more than I now remember and collected in Table 1, but even this subset illustrates their variety and quality. Sac Peak was an isolated observatory out in the boondocks but a busy crossroad of solar physics. Much later I had similar experience at the SST on La Palma where I spent five summers educating Utrecht and European students and met many more solar colleagues than at Utrecht, even running near-daily seminars featuring SST observers<sup>37</sup>.

A clever organizational trick was that for every visitor Christy would post a sign-up sheet on the main billboard in the Mainlab corridor, listing all lunches and dinners during the visit with the intention that one should enter one's name to host the visitor and that he (I don't remember a she) should be

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<sup>37</sup>This style of tutorial teaching was the best I have experienced. The students would come in pairs and earn five study points by spending a week beforehand to study their topic, two weeks on La Palma starting with them giving a seminar on what they had read, then researching their topic using DOT data, and finally after their return two weeks more to wrap that up and write their report. We sat as a trio at the antique table in the SST library with a whiteboard and projector at hand; at questions as "what are granules?" or "what are  $p$ -modes?" I would give an impromptu lecture from my ever-growing collection of pertinent display material. Some of them remain in solar physics, others are now nighttime but with a high opinion of solar physics, and all those displays still sit in my laptop. It is a shame that the program stopped when Utrecht University stopped its financing together with the DOT financing after first retiring me. In the US it is forbidden to fire people for their age, making me jealous – but of course it became worse when Utrecht subsequently killed all its astronomy, and with it effectively all solar physics in The Netherlands except CME interest per LOFAR. Utrecht University's only remaining astronomy activity is serving my website, still a champion in download volume.

booked completely. An excellent mechanism. It made me invite people I wouldn't have dared to invite otherwise – Grant Athay and wife, Gene Parker and wife, Dick Thomas. Rietje was nervous about the fearsome latter<sup>38</sup> but Lawrence and Barbara gave the recipe (“a coke and a steak and he is done”) and brought the essential desert, apple pie with ice cream.

Some Dutch visitors came for me. First Theo and Hanne van Grunsven from HAO where Theo worked on a PhD thesis with Peter Hoyng<sup>39</sup>. Then at Christmas<sup>40</sup> Henny Lamers with family from JILA and Henk Spruit from HAO for our joint vacationing in Mexico. My mother came in spring. The most unexpected was Aloysio Janner, professor of theoretical physics at Nijmegen University, on what one now calls head hunting to get me to Nijmegen to revive astronomy there. He was first vomited upon by Martijn<sup>41</sup> and reacted graciously with a welcome package of Lego<sup>42</sup>. He was much impressed by the Tower telescope, by the research being done there, and apparently sufficiently by me to offer the professorship. However, when I negotiated at Nijmegen after my return I declined when it became clear that I would only be permitted bachelors students, not masters students – the aim was to attract students initially by offering sexy astronomy but not at all to distract them from serious physics eventually. Decades later Jan Kuijpers, colleague solar physicist at Utrecht, became professor there with wider empowerment and did revive astronomy there, expanding it into a highly successful institute that after Utrecht's demise also accepted most of the Utrecht staff – except ex-NSO Christoph Keller whom I had snared to come to Utrecht as my effective successor, was director at the time of the Utrecht closure<sup>43</sup>, and took his group then to Leiden and into exoplanets, and Alexander Vögler from Göttingen, my nominal successor appointed by Christoph, who became a piano teacher.

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<sup>38</sup>An essay “Epsilon” on fearsome Dick for a memorial book edited by his widow sits under books on my website.

<sup>39</sup>It didn't work out then, but he restarted after his retirement and is now getting close, also being close by living in the village across the river from ours, the same street as Christoph Keller with his family – Holland is small.

<sup>40</sup>I cut our Christmas tree along the Cow Trail and spotted the stump years after – but less intrusive than Micky Mauter's tree gathering who at Traute's pointing to a nice-looking high-up tree top would hear, when he had chain-saw-felled the whole tree and held its top up for inspection: “No, that isn't what I thought; maybe that one up there is better?”

<sup>41</sup>Martijn necessarily shared Rietje's every-day snow-chained drive to Cloudcroft to pick up Katrien after kindergarten and daily vomited in the many curves of the Sac Peak road. Katrien took the school bus in the morning with the Altrock boys but it returned too late; Karin Mauter already drove her own car to school. The road was the second one, not the original one up through Water Canyon that is now favored by long-stay campers in August and was then favored by Jack Zirker for painting landscapes – many SacPeakers painted the forest, Don Neidig and Alice Keil the best (an Alice aspen pair bought for our 25-year marriage adorns our dining room); Christy Ott was into art photography (a canoe triptych adorns my Lingezicht study – known as “the room with the books” by the villagers); earlier there were famous Sunspot pottery classes. Later Scenic Byway 6563 (numbered by George Simon) was mostly laid over our road, doing away with the dangerous cattle guards in bends (including infamous Cathy's for Cathy Gilliam) and the difficult steep Horseshoe Bend. I wonder how many cars suffered animal collisions there; next to Dick Faller also Louis Strous, another Kees Zwaan pupil from Utrecht who was at Big Bear and Lockheed before Sac Peak but then left solar physics to return home and find a wife (he did), not having found one in the Cloudcroft Light Opera Company – maybe because he always acted the villain. He also started an “Ask Mr. Sunspot” site that he continues as “Astronomy Answers” (<http://aa.quae.nl>).

<sup>42</sup>Our children were lonely at Sac Peak. During the winter there were no others of their age but that improved by summer. Katrien quickly learned English (New Mexico style American) at kindergarten and taught Martijn; in spring it became their primary language. At first they used Dutch idioms in English (“No, I don't can play now”), then reversely (“O, ik zie!”). We also learned from Katrien: after a week she asked what a PB&J is that she got offered in breaks – we had to ask the neighbors. She later assisted me in guiding Saturday observatory tours for Texans: “My daddy knows more difficult words than I do, but he has a very bad accent and I will help explain”. It is a pity that we returned home just before she learned to read or her skill might have persisted; instead, they quit speaking English together immediately because the other children in our village school made fun of them. In the meantime Katrien's English again became far better than mine, but King's English now.

<sup>43</sup>See his account of this sad affair in Keller (2013).

**H**ikes. Weekend hikes became an important aspect of our life in Sunspot and a most valued asset of the location. Naturally Dog Canyon became the champion – by now ten times. The first and last were disasters.

The first was soon after we arrived, having Henk Spruit visiting from HAO. Pinky Nelson asked Steve Musman to guide us. We started at the Tower and scrambled straight down the slope avoiding nasty cactus to the West Side Road and got on to the Joplin Ridge Road. When we questioned Steve where we should go left into the canyon that we saw enticingly from above he didn't know, so we again scrambled down the slope with Henk reconnoitering cliffs blocking our way into the canyon and spotting detours around them. There we ate our lunch and drank our water in the shade of the wall, believing we were already at desert level just as Pinky and I had been on an earlier hike down Alamo Canyon with Jack Thomas and family. However, Steve then started muttering about a waterfall. When we got to the top of it I saw our car glinting with my binoculars, far away and far below us, but we saw no way down and then spent much time scrambling around the ledges to find one, losing each other with Steve whistling most confusingly because he wasn't where his echos sounded. We finally bunched up again and went seeking the Eyebrow Trail by going up a northward side gully and west over the adjacent hills. At the second one, just before we would indeed have seen the trail below us, Pinky decided decisively we must stop searching but take the fastest way back up – our water was gone, it was hot, and it was getting late. So we went up the slope, retrieved the Joplin Ridge Road, made the West Side Road at dusk, and then Steve remembered the existence of the Cow Trail. I didn't believe him but he found it and it proved a godsend in the dark, with a roll of Live Saver candies in Pinky's pocket earning their name. We finally stumbled home near midnight, finding Franz Deubner babysitting replacing his daughter whom we had promised to be back at four o'clock.

The next time we checked those hills above the waterfall, establishing what Steve Keil called the "Rotten Rutten Route" ever since – on his yearly "death march" he preferred to rappel summer students down the waterfall. We also followed my route at his 1983 workshop because he was worried about Nigel Weiss who himself was more worried about his son. In the upper canyon we met Bruce Lites and Larry Wilkins going up, having chimneyed up the waterfall after depositing cars at Oliver Lee for our return. I then realized that going up is a much better idea than going down; the next seven times I led the hike doing this along my roundabout but very scenic route: up the Eyebrow Trail, cut right well above Indian Cave and scramble over two wide dry hills after first climbing a scalable ledge, descend into the east-bending side gully seen far below, follow that until its junction marked by house-sized rock pillars, and then at the mouth besides the waterfall follow a narrow ledge and then scramble down into the upper canyon upstream of the waterfall. One time going up with Oskar Steiner there was a strong cat smell in the clump of tall trees there, but we didn't see a lion. Then follow the long upper canyon upstream. Twice its stream was actually running and swimmable in pools (I won't insert my naked-colleagues photo here), the second time even full of mature fish which was puzzling because the creek runs only rarely – until we found that the dam of the new fish pond at the top had been flooded. It belonged to the isolated houses built there in the 1990s that Steve warned must be skirted wide away from the ferocious dogs. The last time there I pulled out the Alamogordo Daily News of that morning with headline "Killing at Dog Canyon" which rather upset my companions until Alfred de Wijn read the article: "Oh, just a man shooting his wife in the housing below that we drove along, that's perfectly normal, no worry, we are OK". As before we then hid ourselves along the dip of the southern creek until we got tree cover to cross over and regain the northern creek. Then follow that up along its many curves, ignore two side roads to the left, continue all the way up

to the West Side Road, from there (unposted but its entrance marked by anti-bike rocks) finally up the ever-steepening Cow Trail – a suited companion contest or killer.

In doing these trips I got into the guide's habit of inspecting my group at the start and wonder who was going to be the problem. Always another one than you think; certainly the last time because then it was me. I barely made it – I lost my step in Dog Canyon (not Nantucket), indeed on the Cow Trail where Andrej Tlatov and Maria Loukitcheva patiently pushed me on to eventually reach the top at dark. Thereafter I could barely climb our home stairs, but presently having two new bionic knees I hope to hike again – although Dog Canyon remains beyond my bucket list.

My largest other hikes during the reminiscence year were from Phantom Ranch up to the South Rim with Henk Spruit after rafting down-river from Page (we couldn't pay for more then, but since my retirement I have done the whole stretch to Diamond Creek four times, ducking all permitted rapids including Hermit), the Barrancas del Cobre in Chihuahua (of similar size as the Grand Canyon but less well known) with Henk and Henny Lamers in our midwinter vacation, and in summer from Three Rivers all the way up Sierra Blanca with Steve Keil and Jeff Kuhn through beautiful unlogged forest, spending the night under the first trees down from the top in my coldest night ever.

In later years our most boring hike was the Rim Trail from Cloudcroft to Sac Peak with Nick Hoekzema<sup>44</sup>, endlessly up and down dark spruce forest along the trailbike-spoiled trail with almost nowhere a view. Amazingly, Matt Penn used to run its full length – speeding may make it less boring.

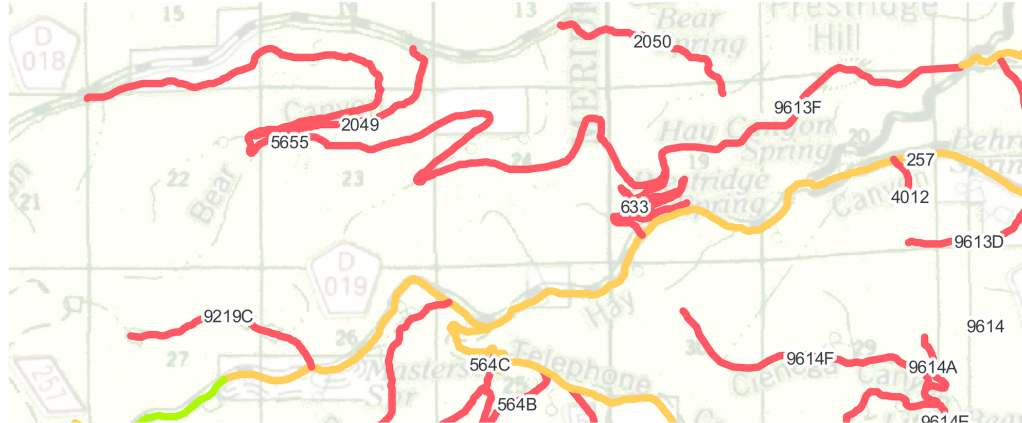
It was much better to discover old railroad grades including the five impressive hidden switchbacks off Hay Canyon with Phil Wiborg, and beautiful San Andres Canyon, the northern fork of the two converging valleys seen below the Tower lookout (with a recent rock slide that Kit Richards dated per Google Earth), but where we always turned around at the waterfall. There is a marvelous meadow with beautiful tall ponderosas at the confluence of the two creeks. We camped there three times, instructed by Larry Wilkins how to make a sizable swimming pool with the plastic sheet he hid there for the purpose by letting it fill a wide rock cleft overnight. He and his boys had a good habit of cleaning the trail with chainsaws, but now there are many newly fallen trees over it and it became harder to find. Larry knew the Sac Peak mountains better than anybody except possibly Micky Mauter. Larry once descended the San Andres waterfall by climbing down a cliff-leaning tree and scrambled around the promontories along the knees and benches halfway up the slopes, always unexpectedly petering out, all the way to Dog Canyon, but taking days longer than he had told Tina and surviving thanks to watering at Frenchy's Cabin – not an example to follow, but I did put San Andres on the agenda for the day after the Farewell Workshop and collected a dozen colleagues daring to get guided by me. Not so, they had to find the waterfall by themselves<sup>45</sup> since I gave up sooner than I had hoped, returning already shortly after the cabin ruin in fear of my not-yet bionic other knee, maybe symbolically fitting the concept of an ultimate farewell hike.

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<sup>44</sup>At the 1998 workshop Nick, my nonconformist pupil, brought his bike and pedaled from El Paso to Sac Peak, "rather boring at first". Going back he went down the hill from Cloudcroft before our car (Sebastian Steffens driving Oskar Steiner and me) at exactly the speed limit, to the Space Hall of Fame where he knew every little detail about any Apollo astronaut. Later he went to Lindau and Mars studies.

<sup>45</sup>It has a nice bathtub-size pool-with-a-view at its very lip from a choke block in the cleft, but my friends found it too muddy from the heavy rains the night before that had also made the West Side road slippery but luckily didn't repeat.





*Figure 3: Logging railroad switchbacks. Extract of a National Forest map showing hiking trails following ancient (1930s) logging railroad grades in red. Long before these trails got numbered I noted the five switchbacks of 633 descending to Hay Canyon on the western slope of Prestidge Hill on an aerial photograph in an excellent railroad history brochure found at a Cloudcroft fair (Fig. 24 in Vernon J. Glover, “Logging railroads of the Lincoln National Forest”, out of print but there is a downloadable scan\*). We retraced it in 1993 on a long hike with Phil Wiborg, down to Wills Canyon from the 64 and then going up along what is now Trail 5655. I got worried when Phil said in Bear Canyon that the big rocks on the trail that looked like have been overturned recently were a sure sign of bear looking for ants, probably just ahead of us. Later we went up the switchbacks (their bottom is or was marked by the remains of a watering structure at the creek on the other side of the road) as family outing, first with Phil’s newly acquired one, then the Uitenbroeks with Kit Richards and later the Reardons, descending along the grade not shown here that branches off at the top (at the red U turn) and goes down to Hay Canyon further west. The last time was with Han Uitenbroek and Ali Tritschler, again coming up 5655 – not seeing bear sign in Bear Canyon but an eaten elk in the next U turn, lion? – and then continuing along 9613F (demolished by quads) to the Prestige Hill Road where we had hidden the beer the three of us enjoyed while Han ran back along the roads to regain his car. Each time it felt like an archaeology expedition – although back in history only to the year I was born; soon after all rail was taken up to become Liberty ships to free Europe including me. It is all gone, one only finds a few leftover bolts and ties, plus some marvelous trestles falling apart.*

(\*) <https://foresthistor.org/wp-content/uploads/2017/01/Logging-Railroads-of-the-Lincoln-National-Forest.pdf>.

**L**incoln forest. Sac Peak is amidst the Lincoln Forest, its major environment definer. From the desert below this forest appears quite unexpected. The Chihuahuan desert is a high dry plain, a former sea floor and therefore as flat as Holland. It was covered by grass prairies around 1900 but those were quickly eaten by cattle barons only slightly hampered by Apaches chasing up their cows along the Eyebrow and Cow Trails to hide them in the forest above and initially successful in stoning the US cavalry coming up Eyebrow from the cliff above – until General Custer (a General Pete type) put an end to their capers. Now the Mescalero’s do well again thanks to having snow for Texans to ski on Sierra Blanca in winter and casino rights for milking Texans in summer. In the meantime the desert got covered by thorny scrubs (creosote bush and mesquite) and became unattractive, as boringly evident on the long drive up from El Paso where the only pastime is to spot antelopes (pronghorns), be the first to spot the Sac Peak tower and nowadays also the telescopes on Apache Point, and to recognize the narrow indistinctive entrance to crooked Dog Canyon behind Oliver Lee visitor center. The only Tularosa basin features of interest now are uniquely splendid White Sands, the adjacent lava flows best seen near Carrizozo, the petroglyphs at Three Rivers, occasionally rockets launched over

White Sands, and weird aircraft stealthily climbing from Holloman.

The secret of the Lincoln forest is watering from catching snow in winter and thunderstorms in August even though most vanishes into the limestone, possibly into undiscovered caverns below. The main runoff is the Penasco River but it is mostly a meager creek, only way down east large enough for Steve to fish and our kids to float, activities we tried combining but they didn't match. Flowers do not come out before summer, spring means just snow evaporation to expose brown muddy earth, a large disappointment to Europeans eagerly expecting a springtime flower carpet. The desert below did better in cactus, especially in the Sonora desert when we drove to Tucson in March.

In Alamogordo the mountains pose a forbidding barrier to the east, but one doesn't appreciate that their tops appear black rather than limestone-white because they are densely forested with "Canadian zone" vegetation. East from the cliffs of the Tularosa fault they descend slowly towards Texas as rolling pine-forested hills that indeed look like Canada. New Mexico mountain tops are "sky islands" of cooler and wetter climate; the Lincoln Forest on the Sacramento Mountains is a prime example. The Guadalupe seen from Apache Point to the southeast, hard to reach from Sac Peak but very worthwhile, are less high so drier but more remote.

Starting to drive up the 82 to the crossing with North Florida Avenue (with its last gasoline station where the very first evening the cashier girl, my second girl encounter in the US, asked: "You have a funny accent! Are you from Oklahoma?") one may first detect (with binoculars) the Sac Peak Tower on the far rim<sup>46</sup> and also the trees there that blacken the upper reaches. On the steepening way up one then passes through dry yucca and agave canyons, after the tunnel<sup>47</sup> one gets into High Rolls oak scrub and fruit trees, and then one drives up along the former water faucet where we used to collect our drinking water, Sac Peak's water from the water tower (never climbed by me but by most summer students although forbidden) being too chlorinated, on the right just before the A-frame still there, and then one ends up in the tall-pine Lincoln forest starting at the railroad-trestle level. A most amazing ride up into an uncommon inverted upside-down treeline (in the Alps one skilifts up to get above trees, here one drives up to get into them excepting the ski lifts on Sierra Blanca). However,

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<sup>46</sup>The Tower even sticks out in the view from Sierra Blanca and also from White Sands and from the Holloman Base sewage lakes off the I-70 where one may spot actual ibis, not an Italian artifact. They glint in the evening seen from Sac Peak. "The officer's lakes" Horst Mauter said when asked what those were, maybe because officers bullshit more, but they are cleaner now and a birdwatcher paradise at migration times although I think ibis are there year-round and breed too but not publications. Take the abrupt binocular-signed turnoff after the last little hill along the I-70 before White Sands and go right after the first deep lake, over the levee to the shallower birding lake. The only location where we saw the Tower sink below the higher Sacramento hills to the east is recommendable Aguirre Spring Campground below the Organ Needles on the way to Las Cruces, up the opposite side of the Tularosa basin. We camped there again the night before the Farewell with Roman and Natasha, our longtime friends from Kiev who had cornered Trump-era visa thanks to a well-phrased invitation letter from Valentin (one Iranian and two Chinese did not get in) and whom we showed the emptiness of New Mexico before the meeting but getting stuck on a dirt road from the VLA to the Gila Cliff Dwellings.

<sup>47</sup>New Mexico's only tunnel became an organizational crisis for the Farewell workshop when it was belatedly discovered that it would close every night that week at eight o'clock for long-overdue repairs. The LOC's preference to lodge participants down in Alamogordo rather than up in Cloudcroft (I contested but it took long before Cloudcroft options appeared on the website) made them suggest to scrap the Tuesday barbecue and traditional Sac Peak volleyball game, the Wednesday White Sands excursion, and that the Thursday banquet should be down in Alamogordo. Luckily Alexei Pevtsov pointed out, his main act as LOC member, that there is a suited alternate road connecting La Luz to High Rolls. I google-mapped it after a helpful hint from Jacques Beckers and saw that it is paved and even has a center stripe for night driving. It did suffer a no-pass flash flood shortly before the workshop but not during it and in the end we did have Tuesday snacks and an impromptu volleyball game, the Wednesday White Sands excursion, and the Thursday banquet at the Cloudcroft Lodge (well, at a dismal shed and Alamogordo fare might have fared better).

the Lincoln forest on top is now largely spoiled, irrevocably so.

We never realized how much until Tower observer and avid naturalist Mike Bradford (deceased 2017) made us hike up San Mateo mountain across the Rio Grande. It also reaches high enough to catch forest-growing snows and thunderstorms, but it was never clean-cut thanks to being small and steep. On that climb, indeed steep, one sees what the Lincoln forest must have looked like before the railroads enabled total-cut logging: magnificent open forest with giant but well-apart ponderosas interspersed by neat and tidy clumps of tall pine and aspen, with saplings everywhere but mostly to be burned in the occasional natural wildfires that remove undergrowth while tall trees survive.

Instead, the clearcut harvesting of most of the former Lincoln forest has now translated into very high danger: the overly dense (orders of magnitude overdense) mono-culture same-age impenetrable extended forests of black spruce one particularly encounters along the former railroad grades (not at Sac Peak itself where the trees were thinned for a fake sense of security) predict far too hot forest fires in which everything burns down completely, causing repeat of this ugly too bare > too dense > too bare cycle, as can be seen already in a tell-tale burn stretch along the 64<sup>48</sup>.

**Returns.** Steve proposed that I should write this reminiscence under the title “Why I keep Coming back”. Simply because I love the place and so does Rietje. Sadly, it will be “Why we kept coming back” from now on. For Steve and Alice this title would simply be: “Why we never left” – but they did eventually, Pamela even to the far side of the world.

I came back alone for the outstanding workshops<sup>49</sup> organized by Steve in 1983 and by Bruce Lites in 1984, the latter followed by a solar-stellar one set up by Stuart Jordan (who joined my first Dog Canyon up and figures on my not-shown naked-colleagues photo). Then with the family in 1991 after the Mexico eclipse<sup>50</sup>, again per sabbatical with Rietje in 1993, then alone for the workshops in 1998 (DST naming) and 2000, in 2003 on another sabbatical with Rietje and also Jorrit Leenaarts as starting graduate student to learn tricks from Han Uitenbroek, in 2005 alone to the Bob Steinfest, and after my mandatory retirement (2007) three months with Rietje in 2008, together to the workshop in 2009, six weeks in late 2013 when at home I became too unhappy being the only active solar physicist in Holland<sup>51</sup>, and finally the 2017 Farewell: my thirteenth time, presumably the last. Clearly, we love the place – as it was.

**Farewell evening.** My last evening at Sac Peak of the reminiscence year became my ignominious claim to local fame. I had booked the Sigma 5 to write a magnetic reel tape with all my

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<sup>48</sup>The same happens with the splendid pine forests covering the volcano top of La Palma where the pines also depend on occasional fires for survival, even for shooting off their seed cones as jet-driven rockets, but now burn all-out thanks to the EU furnishing millions of subsidy for fire-fighting roads, faucets and even sprinklers all over the mountain.

<sup>49</sup>I think that Lawrence Cram proposed in the spring of 1978 to hold yearly Sac Peak workshops in the format of the Silver Jubilee the autumn before. The NSO website serves the proceedings or links to them from 1980 on. That one was Dick Dunn’s “Solar instrumentation: What’s Next?” which sports Hammerschlag’s open DOT tower on the cover, but not yet on La Palma and not yet with a DOT on top – that would take Rob another seventeen years. In the meantime Rob had parked the tower at the Westerbork radio telescope; Henk Spruit and I climbed it in 1977 on the way back from our sea floor hike with Lawrence. Henk was very skeptic of Rob and DOT and later killed the latter in very repugnant manner.

<sup>50</sup>My next eclipse after the 1970 one in the same area on which my thesis was based; I then started viewing eclipses as tourist. By now I have been to 13 with only 1.5 clouded out; the latest the glorious USA eclipse after the farewell.

<sup>51</sup>Not counting Daniel Müller because ESA’s ESTEC is an international non-tax-paying enclave in Holland.

programs and data files residing on its disks, very many kilobytes to take home. When walking up to the Mainlab side door in near dark I saw Christy Ott's black and white cat sitting next to it, as often before. As usual I bended over to stroke, but it jumped on its forelegs and whipped up a huge white tail. I realized it wasn't the cat but a skunk! I jumped back and quickly went to my office to phone Rietje and boast how narrowly I had escaped being skunked – but then I suddenly nearly suffocated: the fluid sprayed on me was evaporating. I could hardly breathe, ran outside to gulp fresh air, and tore off my clothes. But I still absolutely had to fill that tape, so I did that in my underpants and went home in them and buried my clothes in the forest – except for the Zeiss binoculars hanging on my belt all that year<sup>52</sup> and ever since; for years I smelt skunk when birdwatching.

The next morning while I made my farewell round Chuck Bridges asked who had gotten a skunk into the computer room. He had come in after me for his butterflies and concluded from the stench that there was a skunk underneath one of the many cabinets but hadn't been able to find it. I then made the mistake of confessing it had been me.

Many years later somebody asked: “Are you from Holland? Do you know there once was a Dutch guy here who got skunked right in the Mainlab?” – my Sac Peak fame.

**Farewell workshop.** I was SOC co-chair and had proposed to have this workshop during a 2013 dinner in Cloudcroft. Sort of our farewell dinner after an extended stay; we planned the Western Bar but it was closed for the yearly Christmas employee party and so we ended up in a diner to the east with even crummier food and no beer. There I suggested it should be a fancy well-attended farewell and also topic and title. Valentin reacted: “OK, good idea, why don't you do it, but wait a few years until DKIST gets closer to ready”. I first wanted it in 2015 and then again in 2016, fearing that the Sac Peak infrastructure (notably Rex Hunter and Rebecca Coleman) would be gone if we postponed too long, but those years got vetoed by Valentin. In the end we made it just before Sac Peak folded as an NSO site, so perfectly though only just in time – Rex and Rebecca were still there and did their superb usual to my great relief.

Rebecca even got me a hummingbird feeder, standing ready when we arrived, and reminded us to bring a large quantity of sugar. Viewing hummingbird antics at our VOQ window (in 1977 it was the BOQ for Bachelor Officer Quarters) was the highlight of this farewell for me.

At Steve's retirement home in Pagosa Springs (on a muddy dirt road fittingly called “Luxury Place”) I had told him in 2015, visiting on our roundabout way to HAO after once again canoeing the White and Green Rivers (Rangely to Sand Wash, our fourth descent), that I wanted to be SOC boss, a joke alluding to the very many years in which his email address was boss@nso.edu or such. He indeed gracefully gave me free reign in setting up the science part of the program, basically gathering colleagues I like, while taking care of the rest himself: applying for and getting NSF funding, running the historical sessions, and overseeing LOC business.

I did the participant gathering not on my own but with a helpful SOC. The date had been shifted,

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<sup>52</sup>The first rare US bird I saw through them was a whooping crane at Bosque del Apache with Theo van Grunsven, to Jack Evans' dismay because he went there regularly for them but without success. Later that year we learned that the Jornada del Muerto drive to the Bosque can be enriched by turning south at the lonely Bingham rockshop halfway to camp at the scenic and old-timer-stuff-rich Bingham mine up the slope where a sizable fraction of the periodic system sits in the rock pile put up for rock hounds to keep them from venturing into the shafts and tunnels. The mine caused a dip in the White Sands perimeter and so is the closest one can get to Trinity Site outside its visit times.



*Figure 4: Hummers at Rebecca's feeder outside our VOQ window, Broad-tails I think, not Rufous because those are so aggressive there wouldn't be another present. Taken after the Tuesday volleyball game that was on the plan originally but got scratched – and then materialized nevertheless thanks to Steve having a ball. This photograph is nice but I also took videos which are much better, although not as spectacular as the high-speed one that I still have from Kit Richards using a fast AO camera in which you can follow the tumble-over-backwards maneuver by which they roll out of the way of a kamikaze-harpooning Rufous. One summer I stepped in for Tower observer Dick Mann so that he could vacation elsewhere for a week, accepting to daily boil huge amounts of sugar to refill his multiple feeders – he must have multiplied the Sac Peak hummer population at the time. Standing between his feeders was putting yourself straight into Star Wars: they would suddenly materialize out of some other dimension to inspect my nose, then shrilly scream and vanish as instantaneously. I wish we had those critters here in Europe – whoever missed out on them was not an intelligent designer. On Wednesday I didn't join the White Sands excursion but stayed in our apartment to practice my own talk the next day (it included running IDL live which is risky) but instead I just sat glued to the window until dark. The next evening I didn't see any since the Farewell Banquet at the Lodge was on the program – but it wasn't at the Lodge and not at all like any of the previous Workshop banquets but a lousy affair, perhaps fit for a farewell in the sense of never ever again. I should have stayed home to watch more fulfilling hummers instead.*

from an earlier spring date with better weather expectation but discarded due to overlap with the Seattle IRIS workshop, to the week a week before the eclipse in order to permit leisurely travel north to totality. Unfortunately, for quite some European colleagues the eclipse also coincided with the start of the school season, while for some others (notably Serge Koutchmy and Sara Martin) the workshop came too close to their eclipse preparations, but the combination has probably enticed some participants to travel to the US.

In addition to SolarNews announcements by Steve I sent personal notifications to many colleagues



*Figure 5: The NSO ladies behind the Farewell: Rebecca Coleman, Lou Ann Gregory, Jen Ditsler. Taken on the last day but they were still smiling.*

whom the SOC helped define as desirable. Many responded enthusiastically. So many that we feared that we might overrun the Visitor Center seat capacity and therefore installed a pre-registration round with the intention that the SOC should perform attendant selection if necessary, not simply first = in. In the end we did get close to the limit, but then late cancelations (including four unwilling or unable to enter the US due to its new president) outgrew late additions; in the end we managed fine.

The program went fine too, as evident from the talk pdf's on NSO's meeting website; many excellent, only a few not up to par. As to posters: I have to confess I did not see any, using the breaks instead to add 70 colleague portraits to my astronomer mugshot collection (google "Rob Rutten website", descend to "Photos"). Poster attendance is nearly always a problem at conferences; I hope my colleagues did better than I did (while still getting their mug into my camera).

**Farewell ceremony.** I had proposed the following choreography. At the workshop's finish all participants walk up to the Tower and line up along the visitor walkway around the telescope table. Then the three ex-directors present (Leibacher, Beckers, Keil) representing the past spin the telescope up hand over hand, faster and faster – easy to do thanks to Dick Dunn's no-friction mercury float hanging the immense 100-m 300-ton structure; our children and I used to do this for fun on overcast Sundays – and then, pivoting at the center Valentin hands over the ceremonial keys to James, together at the center of this revolving universe and so performing the transition. Applause and cheering from the event-horizon around, and then just as much work to slow the telescope down again because the float is so frictionless that it needs as much effort to spin it down as to spin it up,



*Figure 6: One of the, if not the, last NSO observing runs at the DST in the Sac Peak = NSO era. Left-to-right: Alex Feller, Momchil Molnar, Lily Kromyda, Kevin Reardon, Valentin Martínez Pillet, Francisco Iglesias, Franziska Zeuner. Always during my stays at Sac Peak I would walk up to the Tower in the morning to see what was happening. During the Farewell a trio from MPS Göttingen were running, assisted by Kevin, a program on Sr I polarimetry; they are happy with their data. Here Valentin is touring with the two CU students that were the very last participant additions to the workshop, thanks to being driven by Kevin. I would have welcomed many more: the very low influx of solar physicists coming out of CU (in fact most US universities) has been and still is a severe drawback to solar physics – although fortunate for the many Europeans who found and find jobs in the US. Even the splendid former Sac Peak summer-student program solicited more students from Freiburg than elsewhere. Hopefully, the strengthening of CU solar physics from the NSO relocation to Boulder will remedy this deficiency. But maybe you should regard this statement as frustration of a member of a university, in fact a whole nation, that scrapped solar physics altogether – presently all Dutch solar physicists except me work abroad, the Dutch Open Telescope stands mothballed even though its wide-field Halpha is better than anybody's, there is no hope of reviving Utrecht's former eminence in educating solar physicists. In the 2015 solar publication statistics of [Schrijver \(2016\)](#) Holland ranks only 45th with Uganda, whereas there were more Farewell participants originally stemming from Utrecht than from any other education institute (the one solar physicist stemming from Uganda was Utrecht-educated too: Catherine Fischer now at Freiburg). Sic transit gloria – but the same may hold for this photograph.*

again hand over hand but now by the seven students present representing the future for DKIST and solar physics. Thank-you-all by the NSO director, welcome-you-all by the new site boss, festive toast. It would have made a good YouTube memento – but the two performers vetoed it. Instead, the meeting frazzled out.

**Morals.** I learned many things during this year, in solar physics, about the US, and about myself. In solar physics at that time the highlight was the coming of age of helioseismology. It was a very exciting development and I followed it closely at Utrecht and kept up to date since but never worked in it; nor did I appreciate that Tim Brown’s invention then and there of his Fourier tachometer was going to enable its maturing in the form of GONG, MDI, HMI and local helioseismology.

The rest of solar physics remained pretty much in the infamous stage of dermatology. Space data were virtually non-existent after the so promising Skylab episode. Numerical simulations hadn’t taken off yet – Åke Nordlund’s landmark  $64 \times 64 \times 64$  granulation simulation got public in Steve Keil’s workshop in 1983. The mainstay was still my own field, spectroscopy and line formation. Avrett’s VAL-I (1973) and VAL-II (1976) publications were out and already the summit of numerical atmospheric modeling, but his monumental VAL-III (1981) publication<sup>53</sup> still had to come.

Most observational solar physicists still sat squarely in the photosphere and debated granules (George mesogranules but these seem to have gone away) with fluxtubes on the horizon; only a few dared up into the chromosphere. “What about spicules?” remained the nastiest question one could ask at any solar physics talk (as at that time “What about binaries?” to stellar evolutionaries, “What about magnetic fields?” to galactic types, “What about neutrinos?” to cosmologists. Nowadays “What about dark matter” and “What about dark energy” are too easy since our neighbors ask those; naturally the answer is hydrogen 42, or maybe ice-nine).

The major improvements since then are threefold: the advent of diffraction-limited solar imaging (the SST exemplary), the advent of full-time many-diagnostic monitoring from space (SDO exemplary), the advent of realistic simulation codes (Bifrost exemplary). The first development is essential because the Sun is intrinsically small-scale in feeding mass and energy to its outer atmosphere. The second is essential because (in Alan Title’s words<sup>54</sup>) the Sun is a complicated animal, needing holistic many-diagnostic, high-resolution, large extent (space, time, spectral, Fourier) observation; if you are observational but not co-aligning large-field long-duration SDO, IRIS, Hinode, groundbased (and hopefully ALMA) data sets your work may be besides the point. The third development says it is high time to stop interpretation using static one-dimensional modeling – far too last-century.

Radiative transfer and line formation are still important but no longer the main topic. At present I find myself invited to teach it worldwide because generally it has dropped out of the astronomy curriculum whereas a good grasp is still needed for data interpretation if you are not chianti-thin – not too many colleagues are optically thick these days<sup>55</sup>. But also for me it is now more a topic for teaching than for research per sé. At Sac Peak I learned to ask what solar phenomena one diagnoses with what lines, putting the science questioning and emphasis on the former, knowledge to the latter.

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<sup>53</sup>Vernazza et al. (1981), the classic in describing the solar atmosphere as plane parallel layers in hydrostatic and statistical equilibrium without dynamics or magnetism. I love it deeply for my spectrum-formation teaching because every spectral feature it produces (especially in its wonderful Figure 36) is fully understandable, but nevertheless it is a severe mistake to take it as representative of a mean solar atmosphere – colleagues who write about “the temperature minimum” or “the transition region” are plane-parallel-star physicists instead of solar physicists. Both concepts do hold instantaneously along any microscopic radial column through the solar atmosphere, but that’s all – certainly not plane-parallel layers or quasi-spherical shells in any sort of equilibrium. The Sun is more interesting than that!

<sup>54</sup>In Kiev in May 1989 at the only solar IAU symposium ever in the Soviet Union, held at my instigation and ended by writing Gorbachov and Bush to make them behave (Stenflo & Gurtovenko 1990). Guess what happened that autumn.

<sup>55</sup>All who write that a particular line is thin are thin themselves. The width of a line is measured in Å or Hz or km s<sup>-1</sup>. What they mean is that the feature they study appears transparent in the line.



Lessons about the USA: of course it differed much from what we anticipated. We were never threatened by rednecks at gunpoint but found many people amiable and hospitable. Most we appreciated the hugely wide empty expanses of New Mexico and the spectacular scenery of the western deserts where we returned many times since.

Morals for me: I like writing computer programs but they bear fruit too rarely: too often a wasted effort. Also the ones I developed at Sac Peak or took home (as Bruce Lites' SOSO code which I much expanded but never used in publications, then also an extensive Fourier package, idem). For some decades thereafter I didn't program at all because my students were much better at it: I quit when we stopped having Control Data computers serve whole universities at the time that Han Uitenbroek and Jo Bruls started their PhD research and had to cope with many operating systems in too fast succession. Years later, at Mats Carlsson's prompting<sup>56</sup> I learned Latex (also a computer program and to be treated as such) which served me well to co-write (or write) student publications, but Unix and IDL took me much longer because my students did all the tricks including maintaining my home computer: for a decade an Atari-ST and a beloved ST-book that I took to Sac Peak and La Palma, one of the few hundred ever made; then laptops from Dell and Toshiba running linux, then an unhappy MacBook episode when Alfred de Wijn and Jorrit Leenaarts decided that I should do without further help from them and could do no harm to a Mac – but I went back to linux at my discovery that googling helpful Stackexchange nowadays replaces helpful students. Inventorying colleagues at meetings shows that presently 90% laps a Mac but I proudly do not, instead belonging to the happy-few elite of post-Mac solar scientists. I also slowly stumbled my own way into IDL. Some of my programs actually became productive; my “simple IDL manual” for dummies like myself is now one of my most downloaded documents and I hope that the SDO co-alignment pipeline that I spent much of the past year developing will be useful to others too. I still hesitate re Python, although I have web-found my IDL manual translated line-by-line into a Python manual.

I also liked and still like observing, but my track record in reducing data to get fit for analysis and publication has remained dismal. It turned out much much better to rely on colleagues to get me fully-reduced data to analyze and publish: Bruce Lites, Kevin Reardon, in recent years especially Luc Rouppe van der Voort who is very good at feeding me what I want or should want<sup>57</sup>. This dependence/reliance on others started at Sac Peak.

My best lesson was that I much enjoyed collaborating with colleagues and that such collaborations were and are fruitful because they push me over the psychological barrier to sit down and write.

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<sup>56</sup>Our collaboration is another Sac Peak story. We met at Bruce Lites' 1984 workshop, sharing a relocatable where our conversation naturally turned to ice-skating rivers and lakes and the sea – although all such were there as far away as they can get. End of February 1986 Mats visited Holland for skating, from our house the frozen Linge river (the longest Dutch river originating in Holland, our stretch navigable for barges up to 400 tons) and also part of the route of the 200-km Eleven City Tour held a few days before (and completed incognito by then crown-prince Willem Alexander who also performed the DOT First Light ceremony in 1997), then joined me a day at Sonnenborgh to make the visit chargeable, and told me to learn TeX, emacs, and IDL. I learned all three (LaTeX rather than TeX) from Peppe Severino a year later at Naples during a stay there, and have never left these as my daily workhorses – being very happy that they have been a stable environment throughout the decades since. Later Mats made me visiting professor at Oslo. I went there many times and still visit Oslo regularly with much pleasure. At Utrecht my so-enhanced status helped gain extra years of support for the Dutch Open Telescope and even led to temporary separation between solar physics and astronomy, but I thought that a bad idea and undid it later – not knowing that astronomy would be killed altogether.

<sup>57</sup>Luc is also my first offspring outhirsching me. Sign of a field in good shape: Title/Leighton = 2.2, Linsky/Avrett = 2.1, Schrijver/Zwaan = 2.0, Carlsson/Scharmer = 1.6, Lites/Athay = 1.5, Solanki/Stenflo = 1.5, Schmieder/Mein = 1.4, Nordlund/Gustafsson = 1.2, and other pupil/teacher combos. But this ratio seems declining: is solar physics over the top?

Without some personal obligation I find that hard to do; only recently have I published single-author journal publications since my thesis ones (Gene Parker has hundreds! He must be the champion single-author hirscher). The happy start of my collaborative publishing was also at Sac Peak.

Later having graduate students forced me to come up with viable research suggestions beyond the endless tinkering I tend to get stuck in myself. They were not only useful to my self-esteem by showing myself that I could inspire them and so get results (I am proud of my scientific offspring – five at the Farewell<sup>58</sup>) but also in boosting my own publication production, although it never rose beyond 1-2/year. This phase of tutoring youngsters is now over, much to my regret, but I am grateful to colleagues still willing to share data and research with me and inviting me to teach.

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<sup>58</sup>In PhD date order: Han Uitenbroek, Luc Rouppe van der Voort who wasn't my graduate student but I did tweak his nose forever to La Palma, Alfred de Wijn, Jorrit Leenaarts, Gregal Vissers who got his PhD with Luc but I also tweaked his nose, and additionally Michiel van Noort whose career I tweaked only during minutes but decisively, and Mandy Hagenaar who visited the workshop from her summer cabin in nearby Timberon. All my solar offspring works abroad; in Holland Thijs Krijger runs a satellite-design consultancy, Frans Snik moved with Christoph Keller to exoplanets.