The Station.

Catherine Nisbett

March 2005

"I hope we shall not be arrested for stealing it as well as the southern stars. An old priest, who comes here occasionally, was very much surprised to learn that we sent our plates of stars to the U.S. He said "Aha! Your take our stars and you send them to Cambridge, and they have the use of them there, Aha!" with a very suspicious look."
Solon I. Bailey to Edward C. Pickering, 16 August 1893[1]

In this paper Harvard College Observatory (HCO) plays a colonial power and its Arequipa Station, which it established in the 1890s, plays its mercantile colony. The director of the HCO, Edward Charles Pickering, intended establish a system in which the Observatory in Cambridge would be a clearing house for data brought in by two high-altitude observatories established by the HCO—one on Wilson's Peak in southern California, and the other in the Southern Hemisphere (eventually in Arequipa, Peru). Failures on the part of his right-hand-man in South America to act financially responsible, among other considerations, compelled Pickering to let go of the Wilson's Peak possibility. Harvard's reputation was based on the strength of its photographic program and it was the plates that came from Arequipa that were the basis of its most important projects. Pickering used the station to import raw data to Cambridge, and there turned it into a finished scientific product. His ideal worker in Arequipa was close to his ideal worker in Cambridge (unambitious, dedicated to centrally assigned projects, willing to take direction), but long-distance management produced special problems. And although his intention was to create an insular island, a hermetically sealed machine, a place that provided everything for its workers and produced everything for the home institution, like other colonies it was permeated by its host site.

The organization is thus: a short section on how Harvard came to Arequipa, eliding the most interesting material that will probably go in a preceding chapter; a section on how Pickering's

brother managed to mismanage the director's best laid plans; then a section on each of the two most important projects that came out of the Arequipa Station. The last section will skip over most everything that happened from about 1900 till 1918, including the war, but it will give some indication of where this story ends.

Coming to South America

During the 19th century, astronomers had impressionistic evidence that mountain observing provided better "seeing"[2] than ground observation—the air was clearer above the clouds, there was less atmosphere to get in between astronomers and the stars. Uriah Boyden apparently heard the murmurings and agreed, as he left nearly his entire fortune, $230,000, for the establishment of a high-altitude observatory. The will was contested, but stood. He did not specify an institution to which the money should go, and for a time the Trustees considered giving it to the National Academy of Sciences or Congress to manage. Pickering began angling for the Fund soon after the suit had been settled, but the Trustees moved very slowly and Pickering and Harvard President Charles Eliot did not push, so it took over seven years and some delicate politicking for the fund to be transferred to the Harvard Corporation. Along with two other grants received at about the same time—the Robert Treat Paine bequest and the income from the Henry Draper Memorial—the HCO was rather flush. It was a prime time to begin expanding, which happened both internally (Pickering hired more staff and ordered more equipment) and externally (the plan to establish two remote stations).

---

[1] SI Bailey to EC Pickering, 16 August 1893, Correspondence: Arequipa to Cambridge, 1893-1894, HUA, Records of the Harvard College Observatory, UA V 630.109.2.

[2] "Seeing" is a technical term meaning steadiness and dryness of the air, brightness of the stars, cloudlessness, and lack of wind. "Seeing" actually was impressionistic until the HCO developed a scale of seeing in connection with its search for a high-altitude station.

At the first whispers that the HCO would get the Fund, Pickering made plans to begin testing high-altitude conditions and toward that end chose two sites relatively close to Cambridge that seemed promising—Pike's Peak in Colorado and Wilson's Peak in southern California. As he explained to President Eliot, he would have to have an assistant to oversee the work of the Boyden Department, and appointed his brother, William. William and Edward Pickering traveled together to Colorado, but were disappointed with the conditions at Pike's Peak. William went on to Wilson's Peak, which expedition had been arranged through an agreement with M. M. Bovard, President of the University of Southern California. The construction of the Lick telescope was looming in Bovard's imagination, and in order to stay competitive with northern California, he was thinking of establishing an observatory on Wilson's Peak. He agreed to finance a road to the summit, structures for telescopes, shelters for observers, and part of their salaries in return for meteorological data, staff, and instruments from Harvard that would help him eventually to establish a permanent USC observatory. Upon William's arrival, he found none of these things completed and no prospect of them being done. Bovard accused Harvard of acting in bad faith, of trying to set up a permanent HCO station and withdrew support. He was not as paranoid as it may seem on first blush. William used his position in the Boyden Department and the offer of a permanent directorship at the new USC observatory (which was most likely not actually offered) to bargain for a higher salary at the HCO. After William left Wilson's Peak, the remaining Harvard observers were plagued by prying tourists and bad relations with Pasadena. Pickering was never able to get a clear title to the land, and after William's financial extravagance (later) in Arequipa, he could not have financed the project if he had wanted to. Still, the prospect of having a California observatory under quasi-HCO leadership was very exciting to him. He said, "Wilson would be the observing station of Harvard, and Harvard the computing station of Wilson."[3]

[3] Howard Plotkin, "Harvard College Observatory's Boyden Station in Peru: Origin and Formative Years, 1879-1898", in

While William wrangled on Wilson's Peak, Pickering sent Solon I. Bailey, an up-and-coming assistant, to test sites for a possible southern observatory in Peru or Chile. He quickly found a site for his temporary observing station near Lima, Peru, about 8 miles up a mountain by mule path from Chosica. Here he, his brother, his wife and son, a Peruvian assistant and two servants spent nearly a year. Daily they waited for the *portador* to bring their water up the mountain, lived in a paper house on a barren landscape, and observed an exceptionally clear sky for four months until the rainy season came. At that point, Bailey took the opportunity to leave his wife and son in Lima and scout other areas along the west coast of South America with his brother. Peru and Chile were desirable locations because they had a reputation for being dry, the Andes offered the elevation that the Fund required, and they were on about the same meridian as Cambridge, which was important for some types of work. Because he spent relatively little time in each place, Bailey got much of his information from foreign (American and European) gentlemen, and often bemoaned the state of Peruvian and Chilean meteorology and astronomy. He would eventually narrow the choices to Pampa Central, Chile—which had a better sky, but absurdly difficult conditions for living, which would mean much more expense—and Arequipa, Peru—a slightly worse sky, but a city accessible by train to the Pacific. Pickering and Eliot agreed on Arequipa, and Bailey brought his family there to conduct some photographic investigation and wait for William to take charge.

William the Conqueror.

William operated under the assumption that he had won a prize. Before he left he had been authorized to rent land, or buy it if necessary, at a price not exceeding $500. He spent twice that much buying an 2-acre plot of land, and took advantage of the 6-week mail delay to begin building an estate that he estimated would cost $7000, but ended up costing about $13500. He exceeded the

income of the Boyden Fund for the year in a few months and told his brother matter-of-factly that he would just have to borrow from the principal. Then he continued to live large on borrowed money, making plans for his second term after he had had a short break in Cambridge to publish his results.

Pickering may have been cheerier about his financial disaster if William had carried out the photographic program that he had assigned the station. But William had his own program of visual work that he would not give up. He completed almost none of the assigned work and brought deep embarrassment to the HCO by releasing spurious conclusions about Mars and Jupiter's satellites straight to the press. Admonishment from his older brother would not stem the tide of press releases or spending, and Pickering recalled his brother halfway through his term. William's temper-tantrum at the news was only the last gasp of his odd sense of entitlement.

Solon Bailey was sent again to take his place, and Bailey was really the only director of the Arequipa station that Pickering ever felt completely comfortable with. He allowed his to choose his own projects because they never interfered with the routine work that was the raison d'etre for the station. Pickering would later tell Eliot that in the event of his death, Bailey was the only man competent to carry on the work of the HCO.

Mercantilism.

How was it that William was such a disaster, and Bailey so successful? Besides the obvious, my argument is that the station was set up according to Pickering's formulation for the relationship between Cambridge and Wilson's Peak, and indeed was an extension of the model that governed the observatory itself. The HCO built its reputation on huge works of data—catalogues mostly—centrally assigned and delegated to a large staff, a production line. Plates came off the telescopes at

---

A. Elena, and M.L. Ortega (eds.). 1991, p. 695.

night, were developed, and were handed over to a corps of women assistants for analysis. The foundation of the Arequipa station extended this process abroad, expensively. The station was not meant to be a source of great work, but rather a source of raw material for projects in Cambridge. Two projects and one conflict will illustrate my point. The two projects that the HCO is most famous for during this period were the *Henry Draper Memorial Catalogue of Stellar Spectra*, and the classification system that came from that work, and the catalogues of variable stars (which was a photometry project). Neither of these would have looked the way they did without the Arequipa plates, but both placed the emphasis on the Cambridge women's analysis.

In commencing work on stellar spectra, Pickering decided to join the debate on stellar classification systems, and soon the HCO was producing hundreds of plates with hundreds of stars on each. The task was formidable, and so the project was divided into the northern and southern hemispheres—difficult Antonia Maury was assigned the northern stars, and easy-going Annie Jump Cannon the southern. It was partly chance—Maury was there first, and the northern stars were photographed first, from Cambridge. Cannon, who arrived later, was given what was available. Nevertheless, Maury's classification was 2-dimensional, bulky, and too theoretically complicated to use on mass scale. It took her nearly nine years to complete her two year project. Cannon's classification, on the other hand, was one-dimensional (Maury's second dimension was reduced to a series of footnotes), easy to use, and was quickly used on a mass scale. Later, it would be adopted as the international standard and by that time many observatories already used it. Interestingly, the volume of the *Harvard Annals* which contains their two papers explaining their two schemes bears their names. It was the first time women had gotten credit for their work in this way (it had been known before but never written), and happened because Maury was irritatingly insistent that Pickering leave her alone and credit her work. She, like William, was unwilling to be part of Pickering's productive machine, the difference being that after her project was done she found

herself unemployed while William was shipped off to Jamaica. It was important that Cannon used southern stars to create her classification, because there is more variety among spectral type in the bright southern stars than in the northern, and so Cannon had the advantage of diversity.[4] Some of her stars to illustrate typical spectra to northern astronomers were actually southern stars. In addition, the Arequipan sky, during the clear season was exceptionally clear, and the plates were exceptionally good in comparison to Cambridge plates.

The second project was variable star research mainly carried out by Henrietta Swan Leavitt. Her work would eventually produce the period-luminosity relation that linked variable star period and apparent magnitude to distance and became a means of finding distances to stars too far for parallactic study. Leavitt was mainly interested in the Magellanic Clouds, quintessentially southern objects and "happy hunting grounds" for variable stars of all types of periods. The quality of the photographs was important, since the main method to find a period was to lay a negative over a positive taken a few days later—if the star was variable it would show a white ring which was the difference in magnitude between the two dates. That simple explanation became much more difficult in practice, and usually 20-40 plates were required to determine a period.

The arrangement was thus: Bailey and two assistants worked every clear night making plates to fill out the lists of the regions they regularly received from Pickering. When they had a box worth of plates, they sent these back to Cambridge, where they would be unpacked and sent to the Brick building to be attended to by the women assistants. When they had compiled enough data for a volume, Williamina Fleming (Pickering's right-hand woman) would oversee the editing, and then Pickering would have it published. They began to talk about "the new astronomy" which was not only astrophysics, but observational work done during the day on photographic plates—by women.

---

[4] Owen Gingerich, "Two Astronomical Jewels from Peru, 1889-1927", in *Mundalización de la ciencia y cultura nacional. Actas del Congreso Internacional «Ciencia, descubrimiento y mundo colonial»* A. Lafuente, A. Elena, and M.L. Ortega (eds.). 1991, p. 709.

Everyone was still an astronomer, but the priority became clear when Bailey began encouraging his assistants to examine the plates before they were boxed, circling objects that they thought were curious. Fleming bristled, complaining to Pickering that it gave the men in Arequipa the credit for new discoveries and her and her team all the work of discovering. Pickering raised the issue in a letter to Bailey, and Bailey flared (which is the only time I have known him to do so):

> I have assumed and until recently I think it has been true that the person who made the necessary preliminary examination of the plates would occasionally see an object of interest and record it thus receiving from you, as has been your custom, certain public recognition. Personally I think that the ability to make first class plates is greater than that required in the mere picking of new objects by certain well known characteristics, as it has been done generally by the assistants here. But as the latter has been publicly recognized and the former seldom or never, it is perhaps not strange that an ambitious assistant should desire to try also the latter. I have encouraged a certain amount of such work, without intending to conflict with any one, but simply because in practice I find that men do much better and more regular work when they have some interest in some practical results obtained from the plates which they make. The observatory certainly gains. This has been specially true of Mr. Stewart who since he has been given some independence in his work here and has received some recognition from you has done his regular work with very much more enthusiasm. … As I look at it, his fault has been great inconsideration for others, a desire to gather in every thing possible without regard for other. Mrs. Fleming is not the only one who has felt vexed at times.[5]

But Bailey left the station soon after that as his term was coming to an end, and by the time he left the matter was somewhat unresolved.[6] Pickering, though, took the women's side—after Bailey left, Pickering informed the Arequipa assistants that all of their work should be for the good of the observatory, that their own good *was* the good of the observatory, and that he would be glad to assign them special projects if they wished. Cannon went on to receive credit for the classification system, Leavitt for finding variables and finding relationships between them, and even Fleming for finding more novae (using mainly Arequipa plates) than any other astronomer and increasing the

[5] SI Bailey to EC Pickering, 2 November 1897, HUA, Records of the Harvard College Observatory, UA V 630.109.2.

[6] It should be said that Bailey's irritation at the devaluation of the station's work may have had something to do with the unfamiliar, often primitive by Boston's standards, and politically unstable situation in which he found himself. This letter was sent in 1897, only four years after revolutionaries marched through town, forcing the Observatory staff and a few townspeople to bunker down in the station complex, waiting to be dragged into the street and beaten to death like

number of known novae many times over. Bailey developed an interest in variable stars in globular clusters and made it his specialty, but even as he resumed direction of the Arequipa station, he never allowed his own work to interfere with the output of the station. Pickering's and his first priority with regard to the station was to develop a humane working schedule for assistants that would keep the telescopes working all of every clear night.

The Arequipa Effect.

It is clear that Arequipa's precious natural resource, its clear sky, changed the work that came out of the HCO. Once mined, it could be continually re-mined and formed a permanent record of the sky. It is also clear to me that its position on the periphery led to certain arrangements in labor, credit or acknowledgement and the value placed on certain kinds of work in relation to others. Where I struggle is to find what difference it made that the astronomers were in Arequipa, as opposed to anywhere else in the southern hemisphere. (The Boyden station was eventually moved to South Africa in 1927.) I will spend the last part of this paper suggesting ways that I might find Arequipa in Harvard. I am, however, convinced that I need not go the road of Lewis Pyenson, holding "the exact sciences" above all manner of context. And I do not want to segregate the process from the science, especially since the photographic process and the data process *were* the science at Harvard.

The first direction is old-fashioned "interaction". Arequipans were excited at the prospect of an astronomical observatory. The local papers reported the comings and goings of astronomers as they would celebrities. The astronomers often wrote short popular pieces for the papers and gave lectures to general audiences and at the university. They gave their publications to the university at Arequipa and the one at Lima, and shared meteorological data with the government. They threw an

---

other well-to-do men in town. The tight budget did not allow much space to make their lives very comfortable, despite

annual party for the town's elite, letting them see the moon or mars though the large telescopes. They used trustworthy and interested amateurs to take meteorological data and report it back to the station from meteorological stations all over the country. Arequipans called the station their observatory and it was a standard stop for socialites and tourists visiting the city. They did not, however, give financial support, which was how the Boston elite generally interacted with the HCO. The Harvard Astronomers thought of Arequipans as uncultured and low-class, even when they were elites. The married men of the station generally liked to be left alone, the unmarried men fraternized with señoritas. The astronomers were dragged into law suits for cheating natives that they believed to be shams of justice born of bribery. The astronomers complained of slow work by carpenters and built walls around the compound to keep out wandering animals, children and thieves. There was much personal interaction between astronomers and the townspeople, and it tended to reinforce the Americans' quasi-colonial attitudes—it's just so difficult to get good help.

They also employed Arequipans as assistants—to observe, develop plates, make repairs to buildings and equipment. One such assistant, Mr. Muñiz, stayed with the station through nearly every administration. New directors found him irritating and inefficient, but each soon realized that they could find no better mechanic in Arequipa, nor could they find one as loyal. Inevitably they would seek him out, and Muñiz would return. Once Bailey built a small cottage on the property for Muñiz and his family to live in, so that he would not have to walk the miles from town. Later, the house was occupied by observers irritated by their close-quartered comrades. Throughout these phases of irritation and need, Muñiz remained connected to the observatory, longer than any other person. Ultimately, in 1918, the lone observer, Mr. Blanchard, who had been left in Arequipa to do what he could as wartime concerns had almost shut down communication between Cambridge and Arequipa, decided he had to leave to join the army, cabled his decision to Pickering, and left the

---

William's best efforts. It is understandable if Fleming's complaint added insult to injury.

station in charge of Muñiz, the one man in Arequipa who knew it better than any other. He wrote to Pickering in Spanish, though he understood English and wrote it well, but he continued the policy of giving a weekly status report. It was not until after the war was over that Pickering was able to send anyone else down.

Conclusions.

This short version leaves out much of what is really fascinating about Arequipa—the adventure of climbing mountains, discord over living in close quarters, the character of the men who were sent, and the character of their wives and children, thievery, intrigue, revolution. What I intend to do with what I intend to become a chapter, is to tell a transnational story which had been American alone. My trouble right now is in finding the right questions to ask of this material in order to get answers that are interesting. Ultimately, I want it to be about science.