

Early Days of the Radio Astronomy Laboratory and the Hat Creek Radio Observatory

Harold F. Weaver

Astronomy Department and Radio Astronomy Laboratory
University of California, Berkeley

Abstract. A brief history of the start of the UC Berkeley Radio Astronomy Laboratory and its remote facility, the Hat Creek Radio Observatory is presented.

Radio astronomy of today, like many features of the modern world, can be traced to technological advances made during World War II. At the end of the war, some electrical engineers and a few physicists who had worked on radar saw radio astronomy as an exciting field ready to be developed. Australia in particular had a large and active group working in radio astronomy. In England, research groups at Cambridge and Manchester were active in the field as were groups in a number of other countries. The US was generally slow to become involved. Traditional astronomers showed little interest in radio astronomy.

When Jan Oort saw a radio map of the sky that Grote Reber had published in the *Astrophysical Journal*, he began to wonder if there were spectral lines in the radio band. He asked Henk van de Hulst to investigate the question. In 1944 van de Hulst predicted the λ 21cm line of neutral hydrogen (HI); in 1951 Harold Ewen and Ed Purcell at Harvard observed the predicted line. At about that same time W. Baade and R. Minkowski at Mt. Wilson and Palomar were cross-identifying the optical counterparts of radio sources—identifications that raised important questions about the physical mechanisms involved in the radiation.

At the 1952 IAU meeting Oort presented an early Leiden HI map of the spiral structure of the Galaxy. It was remarkable! Radio astronomy began to be an important topic in the astronomical community. Astronomy departments began to establish radio observatories. In the Spring of 1952 Harvard installed a 24-ft radio telescope at the Agassiz Station and began observations of HI. Four years later they inaugurated a 60-ft dish. In 1954 Caltech established their radio astronomy group under John Bolton, and by 1959 the group was making observations at the Owens Valley Radio Observatory.

1. Berkeley Radio Astronomy

At Berkeley, Otto Struve invited Ron Bracewell (the Pawsey & Bracewell textbook on radio astronomy was about to come out) to come to Berkeley from Australia and to give a course on radio astronomy during the 1954/55 academic year. He also asked the Dean of the College to appoint a faculty committee to determine how Berkeley should enter the field of radio astronomy. Members of the committee were Sam Silver of the Electrical Engineering Department (an

expert on antenna theory), Luis Alvarez of the Physics Department and me; I was the chair of the group. Our final report in 1955 urged the Dean to create a new faculty position in radio astronomy for Bracewell, and to establish a solar radio observatory for research and teaching. The report was very favorably received, and the proposed plan was going to be implemented. However, as it turned out, the plan was not feasible as there were related solar interests in other departments of the University.

Meanwhile, my own research interests were turning more and more to λ 21cm work on the Galaxy. In early 1956 Struve asked me to take on the task of establishing the new radio observatory. I finally agreed to do the job, but with two provisos: (a) the new radio observatory would specialize in Galactic studies; and (b) it would be a first class research establishment with a large radio telescope and an adequate staff. All parties involved agreed to the proposal and the work started.

The next two years were devoted to searching for funding, writing reports, searching for funding, meeting with university administrators, searching for funding... But there was a happy and pleasant interlude. I had a sabbatical during the 1956/57 academic year that I spent at Harvard with Bart Bok's radio astronomy group, which allowed me to see at first hand the operation of a radio observatory and to learn how it all worked. The graduate students working with Bart Bok were a remarkable group of pioneers. Among them were Dave Heesch, Frank Drake, Kochu Menon, Bill Howard, Nan Dieter, Ed Lilley and many more. It was a pleasure to get to know them. I spent some time in Washington at the Department of Terrestrial Magnetism where λ 21cm work was also being done. (And of course while in Washington I could work at fund raising.) I also took the opportunity to visit other U.S. radio observatories and to learn what they were doing.

The search for funding seemed endless. The Berkeley project was well received, but other radio astronomy projects that had started earlier were being sponsored, and therefore not enough money remained to fund the Berkeley request. Unknowingly, our Russian colleagues came to the rescue. In 1957 October the Russians launched Sputnik. The U.S. Government sprang into action. Research money flowed. The Berkeley project was funded by the Office of Naval Research (ONR) in early 1958. The funding atmosphere was unique. At one point ONR called and asked if we could use more money!! Of course we could—whenever they wanted to send it!

With funding assured, the Radio Astronomy Laboratory (RAL) was established by the Regents in 1958 July. A small staff was hired and we started to assemble equipment to test potential sites for radio noise. The first employee was Tap Lum, a student in the Astronomy Department, and an experienced master of all trades; the second was David Williams, a real radio astronomer with a PhD degree from Manchester. Tap and David became an outstanding team in the design of low-noise amplifiers. The mechanical engineer in the group, Temple Larabee, came from Caltech, where he had been a member of their radio astronomy group.

2. Hat Creek Radio Observatory

The scheme for finding an observatory site was simple. I would get contour maps from the library, and search for out-of-the-way flat valleys that were not on air routes between cities and hopefully not too far from Berkeley. Once a potential site was located, my wife and I would visit the area, meet local people, investigate the annual weather pattern, and get acquainted with the area. If the area still seemed promising, we would go to the County Seat and look up the property owners. The team from Berkeley would then come and make a 24-hour, radio noise test. If the results looked good, additional tests would be made later.

The areas examined ranged from Mono Lake in the south to north of Redding, with the majority of sites being in the northern area. Hat Creek, north of Lassen National Park, was the winner. It had a large generally flat area that would allow the development of interferometry in the future, had a very low noise level, and did not seem likely to grow in population or through commercial development. The land chosen for the observatory was owned by the Forest Service and by a local rancher, Mac Bidwell. I met with both the Forest Service and Bidwell and discussed a use permit with the former and a long term rental agreement with the latter. The University administration was to make the final arrangements.

Word of what we planned to do quickly spread among the local ranchers. They were suspicious and worried. They thought that the equipment we were going to install would cause their cattle to go sterile and put them out of business. I spoke to as many clubs and local groups as I could find to tell them about radio astronomy and to assure them that we were harmless.

The University was very slow in getting to the task of making the Hat Creek land arrangements. In the case of the Bidwell rental, the University wanted to condemn the land and buy it. That would have utterly ruined our reputation with the local ranchers! Finally, in desperation, I wrote and negotiated a twenty-year lease with Bidwell and a land use permit with the Forest Service and presented them to the University. The University Administration didn't like what I had done, but they accepted the documents.

At long last the REAL work could begin—establishing a site plan, building roads, installing power, putting in wells, drawing up plans for the housing area: a dormitory for six transient personnel, three houses for employees who would live on site (the site superintendent, a maintenance man, an electronics technician). In addition there was an ample shop building. At some distance from the living area there were two lab buildings for the telescopes we planned to build.

There are many memories of that first building period, which went on right through the winter. We learned that the Hat Creek night air seemed to have special properties. Any tools left out simply evaporated into thin air, never to be seen again. It was a relief when the shop was completed and everything could be safely locked up. Communication between the site and Berkeley was difficult. There was a single telephone line that connected all the ranchers and the site with the outside world. Sometimes you had to wait for an hour just to get on the line. That was finally changed when the telephone company put in modern equipment. That was done, I always thought, after some pressure was brought to bear by the Office of Naval Research.

The ONR was a wonderful sponsor. Not only did they supply funds, they also gave us equipment. Among other items, they supplied a crane, a bulldozer, jeeps, and whatever they had that we needed. Arnold Shostak of the ONR was very helpful. I always think of him as the patron saint of the Hat Creek Radio Observatory.¹

Our first instrument was a 33-ft antenna designed and built by lab personnel. (The dish itself was built by an outside firm.) We wanted to gain experience and to test the design of the controls since the plan for the future 85-ft telescope called for the Radio Astronomy Lab to design and install the controls and electronics. The 33-ft telescope was put in operation in 1960 July, just two years after the Radio Astronomy Lab was established. Building the 33-foot ourselves and associated “Lab 1” turned out to be a wise policy as the controls on the 85-foot were quite different in design from those on the 33-foot. We learned a lot from that first telescope. The 33-ft telescope was donated in the 1980s to Professor Sam Okoye at the University of Nigeria at Nsukka.

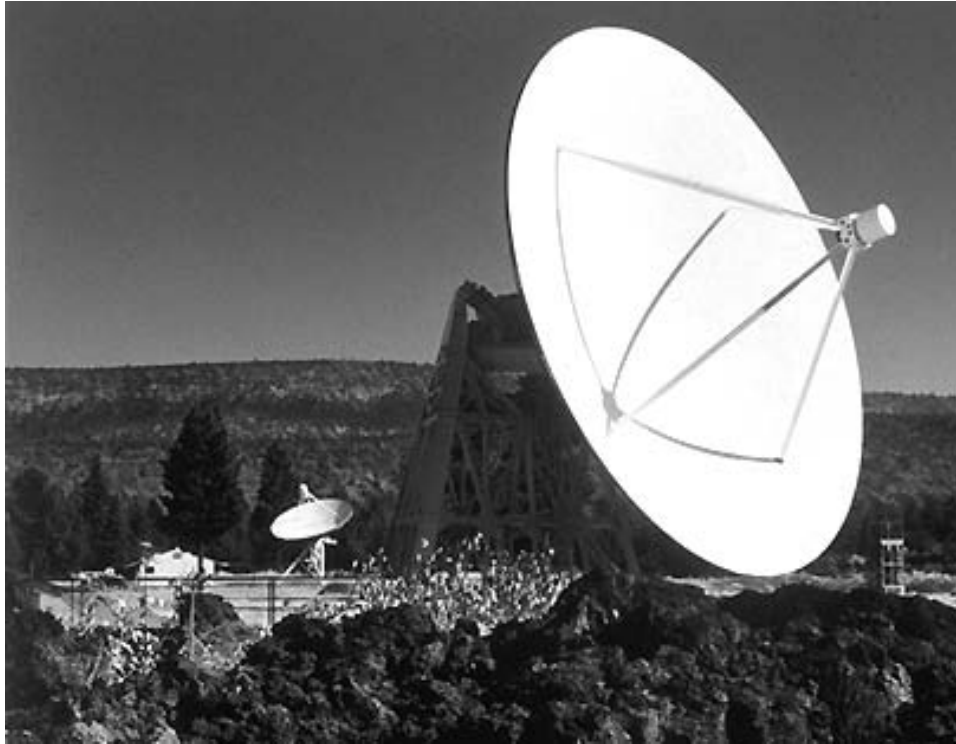


Figure 1. The 33-ft (in rear) and the 85-ft (in front) telescopes viewed from a lava bed to the west at the Hat Creek Radio Observatory in Lassen County, CA (a cropped portion of a 1964 Ansel Adams photo).

¹Ed. note: Arnold's son Seth is a primary participant at the SETI Institute and in the Allen Telescope Array project; see contributions by J. Tarter and J. Dreher, resp.

3. The 85-ft Telescope

The contract for the 85-ft antenna was signed with Philco, Inc in 1960 January after a long hassle with the University administration about boiler plate in the contract document. Work started immediately. By late summer of 1960 the major parts of the 85-ft structure were complete—the mount and the fork that would carry the dish. The dish had been started. In the last stage of its construction the entire dish was housed in a large airhouse for final testing and surfacing. But then... in October there was a long weekend holiday. All the workmen left. A sudden windy snow storm occurred; there was a power failure. The airhouse deflated, and sagged onto the dish. The sharp edges of the partially mounted surface sheets cut the airhouse to shreds—shreds that flapped in the wind and even tore off parts of the dish surface. Testing and surfacing of the dish had to be completely redone in a new airhouse. For years thereafter one could drive in the Hat Creek area and see pieces of the original airhouse covering stacks of hay. The ranchers never wasted anything.

The antenna was completed by Philco and turned over to the Radio Astronomy Lab in 1961 April. We then started tests and installation of controls and electronics in “Lab 2”. The first regular observations were made in 1962 June. I have a strong memory from that time: we had difficulty adjusting the antenna to the celestial pole. The antenna seemed to move around during both day and night. It wouldn’t stay pointed to the pole. It turned out that the mount had been painted a ‘bad’ color—a dark green chosen to ‘paint it out of sight’, but not chosen to avoid solar heating. I learned of a special white paint developed for spacecraft that provided strong protection from heating by the sun. We repainted the telescope with the special paint, and the pointing problem went away.

The first observing program was a study of neutral hydrogen absorption lines. The observations were made with a single-channel receiver and a strip chart recorder. It was clear that we would not get very far with that equipment. We began to think of a multichannel system and digital recording. Early in 1965 a 100-channel receiver was built in the RAL shops and put into service on the 85-ft telescope. Extensive observing programs were then possible. In the same period the staff was increasing. Nan Dieter joined the group in 1965; Carl Heiles became a member of the Berkeley faculty in 1966. The 85-foot with its new equipment (including digital recording on punched cards) would be kept very busy; see the Heiles contribution in these proceedings.

4. Enter Jack...

In 1965 another important event occurred: Jack Welch, a member of both the Electrical Engineering faculty and the scientific staff of the Radio Astronomy Laboratory, moved Sam Silver’s 10-ft dish from the top of Cory Hall to Hat Creek, and developed a third observing site, “Lab 3.” Jack and Doug Thornton (who was traveling abroad and could not attend the Jackfest) had been using the dish in Berkeley for planetary observations, but they needed the far better observing conditions that existed at Hat Creek. The third observing site continued to develop over the next few years. The 10-ft dish was replaced with a

20-ft dish. The 10-ft dish was remounted (Fig. 2), and the two dishes began to be used in the first millimeter-wavelength interferometer experiments.



Figure 2. The 10-ft telescope on the Stanford mount near Lab 3.

The association with Jack has been very fruitful for the Radio Astronomy Laboratory. Jack's work at higher frequencies and his interest in high angular resolution provided a new outlook and a new direction for the Lab. He was the clear choice for Director when that position became vacant in 1972.²

References

Shields, J. 1993, *Harold F. Weaver: California Astronomer*, available in the Bancroft Library, UC Berkeley; see also, Shields, J. 1993, *Bulletin of the AAS*, 25, p. 923.

²For further perspectives regarding Harold Weaver and the founding of the Radio Astronomy Laboratory and the Hat Creek Radio Observatory, see oral interview conducted by Joe Shields in 1991 (Shields 1993).