The Bevatron

Edward Lofgren

Antiproton Symposium
October 28, 2005

The Radiation Laboratory and the Bevatron as I knew them.
Edward J. Lofgren
October 28th 2005

My first contact with the Radiation Laboratory, as the organization which later became the Lawrence Berkeley National Laboratory was then known, was in May 1938. After graduating from Berkeley that year I got a summer job on the crew of the 37 inch cyclotron. The laboratory consisted of the 37 inch cyclotron, located in an old, once condemned, wooden building on the campus, and the 60 inch cyclotron under construction in the new Crocker Laboratory building nearby.

The slender financial support the laboratory had with which to pay a few of us our $75 per month for the summer came from medical foundations which were interested in evaluating neutron therapy for cancer treatment and producing radioactive sodium and other isotopes for medical and biological research. There was no public support for science at that time.

Two years later, in the fall of 1940 I was a third year graduate student, busy with the usual courses, exams, teaching duties and trying to get a start in Cosmic-Ray research. Professor Lawrence one afternoon stopped me in the Hall and said 'I have a job for you.' I was stunned, here out of the blue I was about to be offered what to me at the time would no doubt be the most attractive opportunity I could conceive, but I was completely enmeshed in obligations and duties that would seem to make it impossible for me. Somewhat hesitatingly I told Professor Lawrence these impediments. In a positive manner that I would learn was characteristic of him he brushed them aside as not important and easily solved. He also gave a hint that national need was involved. (War, for the US, was then 13 months away.)

I succumbed to Lawrence's argument, was hired on the spot, and within a few days found myself at work and with serious responsibilities in the Radiation Laboratory. The Laboratory then consisted of the 37 inch cyclotron running mostly with deuterium for various biomedical programs and the 60 inch cyclotron just struggling into operation. There also was construction activity here on the hill behind the campus.

We few new crew members had to learn fast and were given important responsibilities because the experienced people, Ed McMillan, Luis Alvarez, Dave Sloan and others were disappearing to a new secret laboratory, also called the Radiation Laboratory, but located across the Continent at the Massachusetts Institute of Technology. The focus of our work at Berkeley also changed. While the new 60 inch cyclotron went into around the clock operation, mostly on biomedical programs, an entirely different program was introduced at the 37 inch cyclotron. The cyclotron was dismantled as such and the main elements, magnet, vacuum system, power supplies and other components were incorporated into new devices to develop an electromagnetic method of Uranium isotope separation. This program grew and later dominated the laboratory until the last wartime year when the program was turned over to industry. Many of the scientific and engineering staff went to other locations. I went to Los Alamos where I remained until the end of the war.

With the end of the war I returned to Berkeley to complete the final year of my degree program, then to the University of Minnesota. There Frank Oppenheimer, Ed Ney and I joined in a program of high altitude Cosmic-Ray research. We had the good luck to discover, and identify, the heavy component of primary Cosmic Radiation.

However, I found an invitation from Lawrence to return to Berkeley and join the very active accelerator program there to be too attractive to pass up.

Returning to Berkeley in the Summer of 1948 I found it to be a real Santa's Workshop of accelerator activity. In some stage of design, construction or operations there were all of these:
Alvarez and the proton linear accelerator, but also a state of the art pressure Van de Graff.
McMillan struggling with the very difficult problems connected with bringing the newly invented electron synchrotron to operation.
The 184 inch cyclotron being readied for its first run as a 100 million electron volt synchrocyclotron. It was originally intended to be a standard cyclotron with 1 million volts on the dees. This would have been a monument of trouble!
Off at one side was a routinely running 60 inch cyclotron.

Of greatest interest to me was to hear the outcome of a meeting that had been held on March 8th, 1948 at Berkeley. The occasion for the meeting was the submission, to the Atomic Energy Commission (AEC) on February 5th, 1948, of a letter proposal to "construct a proton synchrotron of 1.8 BeV (the Bevatron) with provisions for expansion to 2.8 BeV, then to 6.5 BeV". The letter was signed by Lawrence, McMillan and Brobeck. In attendance at the meeting were AEC officials and the top management of the recently organized Brookhaven Laboratory.

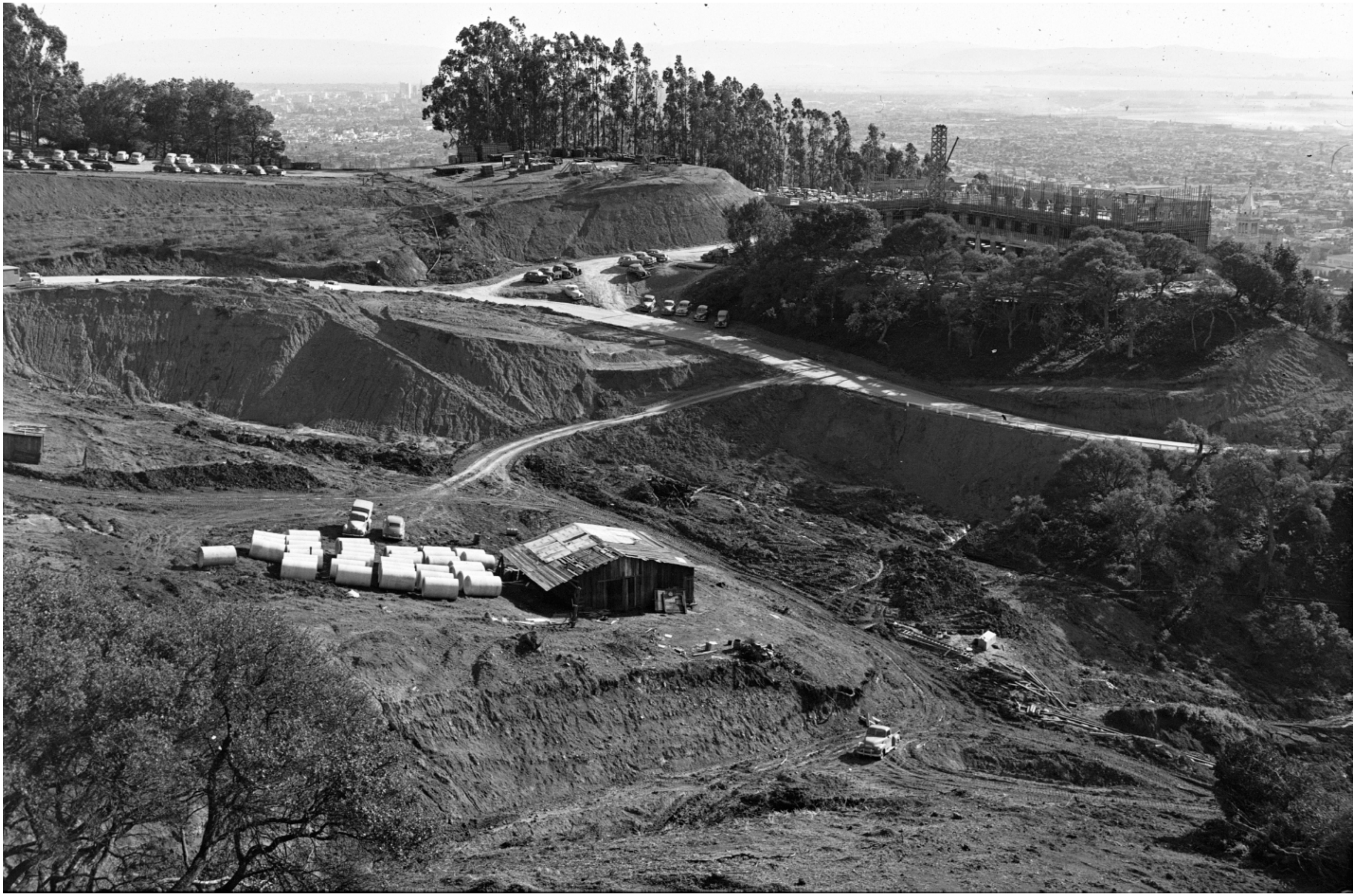
Approval of the Berkeley plan was given by the AEC on May 20th, 1948 as part of an overall national plan for three accelerators, ones of 3 and 6 Bev to be followed by one of greater energy. Brookhaven agreed to accept the lowest energy accelerator for now, as part of an understanding that they were to have priority when the highest energy accelerator was considered. The remarkable thing about this plan was that it was carried out.

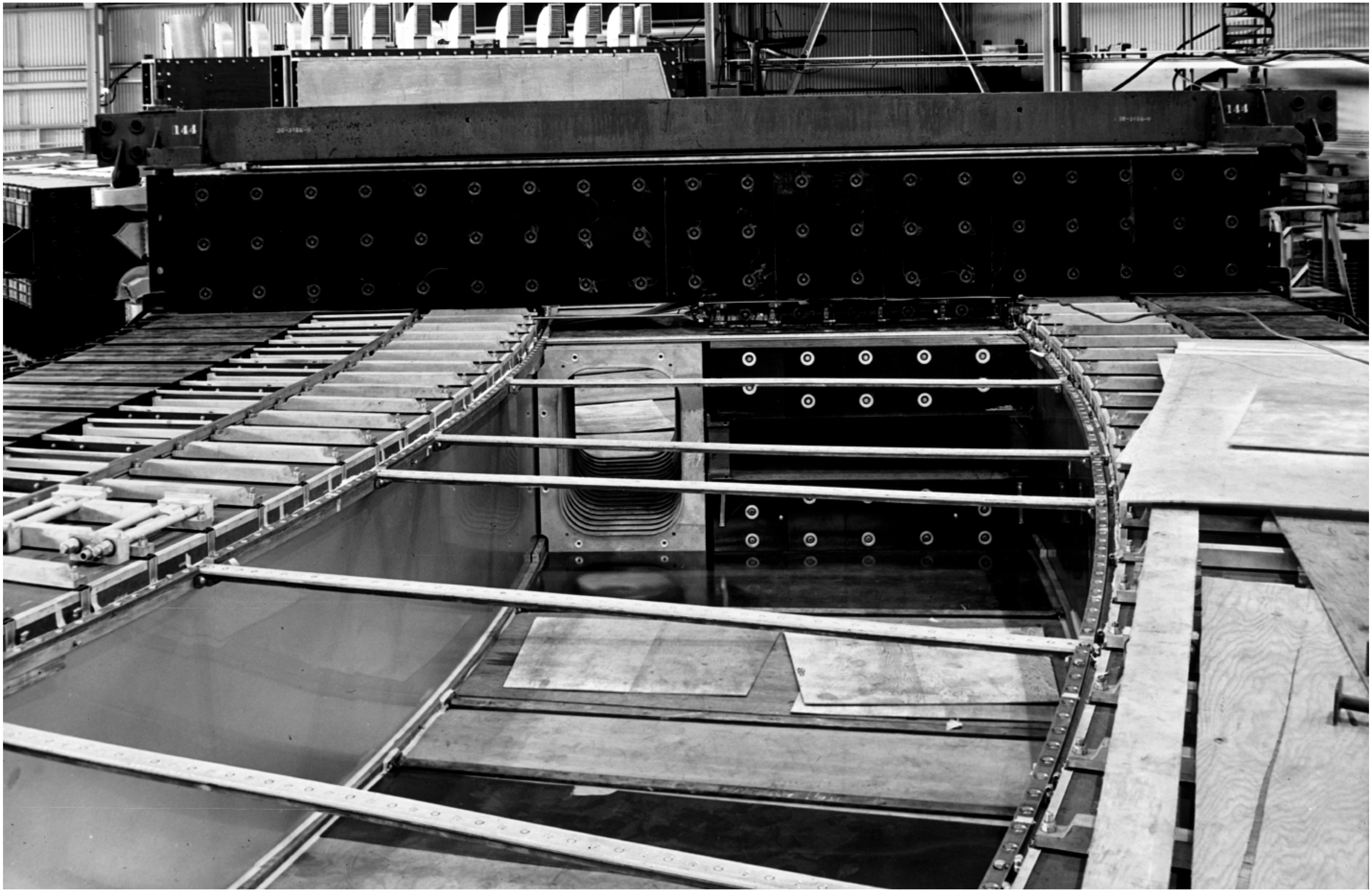
At this point there was the feeling let's go! But in the face of many choices, just how? A schedule of monthly meetings to make decisions was instituted. Here I should like to state that as I see it all the major design choices derived from admirable characteristics of two persons (the statements are mine):
Lawrence: Take chances, if necessary, but always have a way out.
Brobeck: Don't fear to make it big or novel, but provide a way to fix it.
By midsummer I began to attend these meetings regularly. The most urgent decision was the aperture. It was decided after much discussion that a 1/4 scale working model should be built and that I, not yet hired, would be in charge of operating it to settle the aperture and other questions. Here it is interesting to note the schedule. It was decided to build the model on July 20th, 1948. It was designed and built in five months. It was then operated for seven months providing quick answers to the aperture and a number of other questions. It was quickly established that the largest aperture, 4 feet by 14 feet, would never be needed, 2 feet by 6 feet was the new design maximum. As finally built the maximum aperture was further reduced to 1 foot by 4 feet.

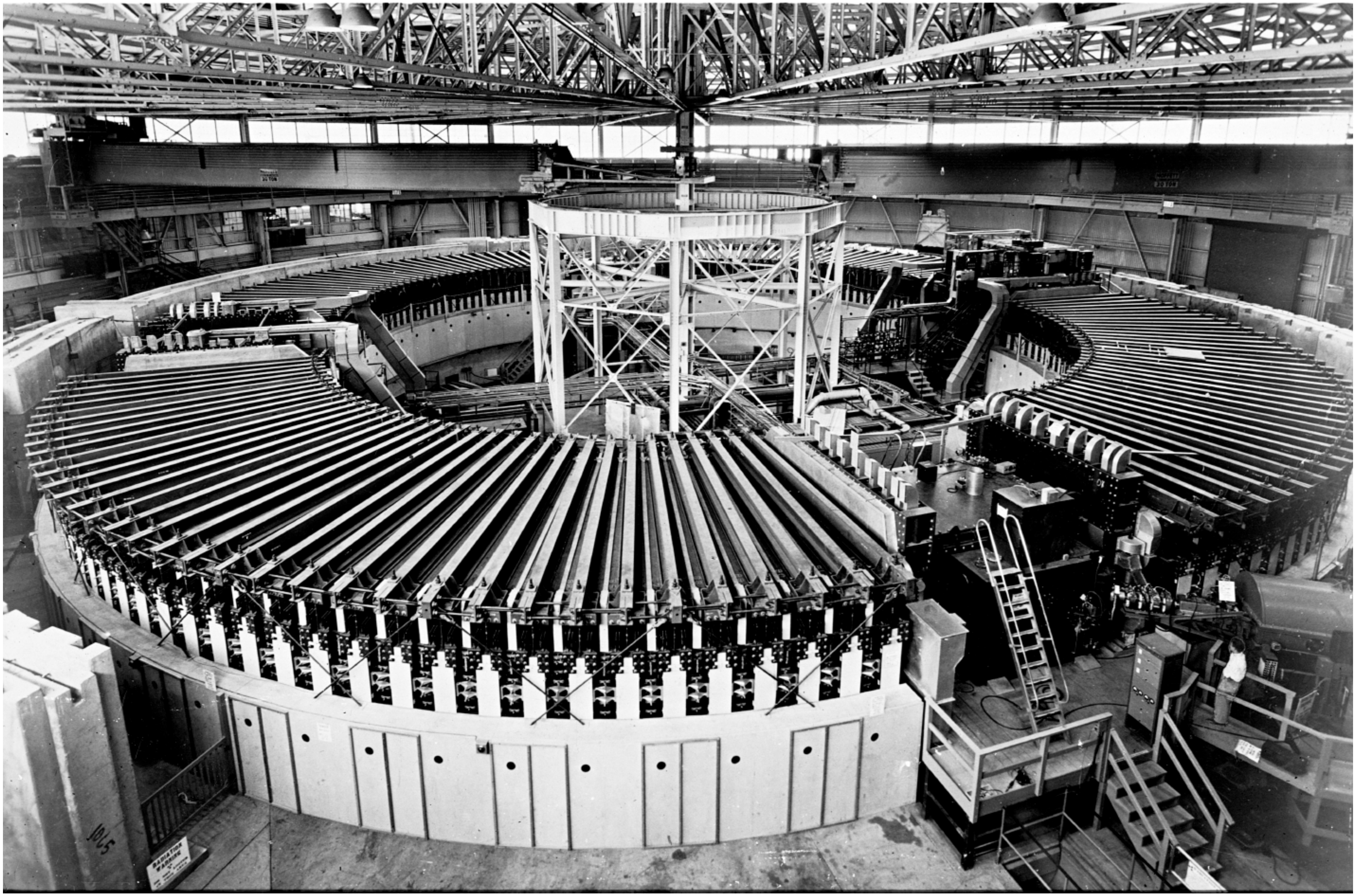
At this point further design refinement and construction came very close to a complete halt because of a diversion of nearly all of the engineering and physics staff to another project at Livermore, believed to be more urgent.

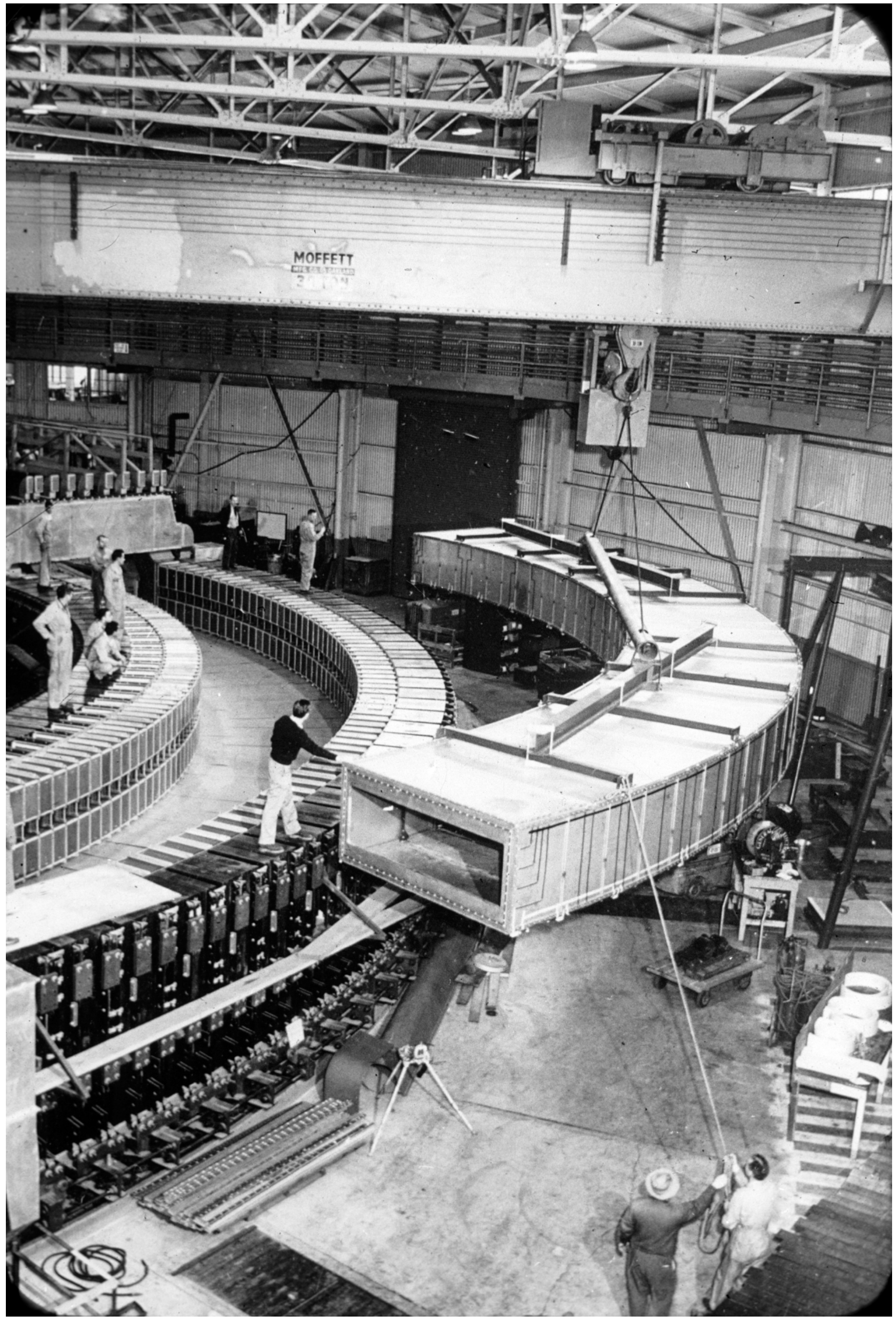
About two years time was lost on this, but eventually it too came to an end and full scale work on the Bevatron resumed. On April 1st. 1954 the Bevatron was declared complete and responsibility for it was handed over from Brobeck to me. The turn-on process began, far too long and detailed a story to tell except to mention a few notable events. The beam was first detected with scintillators borrowed from the experimenters and used to track the beam around, pulse by pulse, 1/4 turn by 1/4 turn, until there was enough to detect electrically.

The people in our operating group who were fully trained physicists were very few in number and badly overloaded. Of the physicists from outside the operating group who were most helpful I think that Sulamith and Gerson Goldhaber deserve mention. They were very helpful in dealing with the very large number of physicists from all over the world who needed a few photographic plates, or a large stack of plates, exposed to our beams, which were copious by cosmic ray standards.




144
144




MOFFETT