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For President Kerr

From: Dan Wilkes

Re: Transfer of Crocker Lab Name to Davis: Regents' Presentation.

I should like to have you join me for a moment in an imaginary journey back to the year 1936. Our nation was struggling out of a great depression. Dictators were strutting in Europe, and war was in the making. In a handful of scientific laboratories of the world a few scientists were busily exploring the atomic nucleus. These scientists were exhilarated by the knowledge they were gaining with new tools. They were unaware, at the time that they were shaping a new era for mankind -- the Atomic Age.

Nowhere was the pace of this work faster or more extensive that what is now the Lawrence Radiation Laboratory on the Berkeley campus of the University of California. In 1928 ~~a brilliant,~~ the late Ernest Orlando Lawrence, a brilliant young physicist had joined the faculty at Berkeley. At the time physicists were trying, with only limited success, to devise machines for accelerating nuclear particles to high energy -- in this way to explore more fully the still-mysterious atom. In 1929 the exuberant, tousle-haired Lawrence conceived the principle of the cyclotron. A year later he demonstrated that it would work, and he gegan to build successively more powerful machines. By 1936 his 85-ton 37 inch cyclotron -- the most powerful atom-smasher in the world--was accelerating deuteron particles to the fantastic energy of 8 million electron volts. New information about the atom was pouring out of experiments. Radioisotopes were being discovered at a rapid rate. Tracer techniques were being pioneered in biology, medicine, agriculture, and other fields. It was noticed that the neutron beam from the cyclotron dramatically destroyed living cells. Were cancer cells more vulnerable to neutrons than X-rays?

Berkeley had become the most exciting center of physics in the world. Brilliant young men in physics, chemistry and biology had been attracted to the Berkeley departments and to the Laboratory.

Lawrence, with characteristic vision, looked to the future. If so much could be done with this machine, how much more could be achieved with a bigger cyclotron! It would be possible to transmute and to disintegrate heavy nuclei whose repulsive electrical forces could not be overcome by the particles from the 37-inch cyclotron. A wider range of radioisotopes could be made for use in biology and medicine. A more energetic and intense neutron beam could be generated for experiments in cancer--a field of continuing interest to Lawrence. More important than anything, he felt, would be the discovery of phenomena either he nor anyone could predict.

So in 1936 Lawrence set out to build a more powerful cyclotron. It would be, by the standards of the day, breathtaking in size and power. A magnet weighing some 220 tons would have to be built. New engineering problems must be solved. When finished, the monster 60-inch cyclotron would accelerate particles to twice the energy of the 37-inch cyclotron, 16 million electron volts, 32 million electron volts for alpha particles.

The problem of financing was a difficult one. Government funds for such purposes were non-existent in those days. There was no AEC--indeed, work with the 60-inch cyclotron played a big part in the subsequent establishment of that agency. The sum needed for Lawrence's monster machine would come to $150,000 to $200,000 -- certainly a fortune in those days. Where could the funds be obtained?

Former President Sproul set out to help the impatient young scientist raise the money. From the Rockefeller Foundation came $32,000 toward construction of the machine; the Chemical Foundation gave $20,000, the Research Corporation $10,000 and the Josiah Macy Foundation, $7,000. Miscellaneous contributions were made by the University and other sources.

A building was needed to house the machine and associated research facilities. President Sproul approached his good friend, the late William H.

Crocker, San Francisco banker, philanthropist, and for 29 years a Regent and dedicated patron of the University. Mr. Crocker was particularly interested in the promise of the machine in medicine, especially the treatment of cancer, with neutrons. He generously donated $75,000 and the great project became a reality. In his honor, the laboratory was named "The William H. Crocker Laboratory."

By 1939, the massive new machine was finished and "on" June 30 of that year the first target was exposed to a beam. By fall, treatment of deep-seated cancer with neutrons was started under the direction of Dr. Robert S. Stone, chairman of the Department of Radiology on the San Francisco campus. The experiment did not prove to be superior to other methods of treatment.

The immediate goal, in which Mr. Crocker was deeply interested, was not reached. But the ways of science are not always direct; the unpreditable often turns out to be more fruitful than the prdictable. And there are few more spectucular examples of this axiom than we find in the work of the 60-inch cyclotron.

As we look forward to the last experiment with this machine at Berkeley, on June 30 -- coincidentally just 23 years to the day after the first target was exposed to its beam -- let us look at a few items in the roll call of achievement with what has been the most productive atom-smasher in history.

Discovery of Radioisotopes. Dozens of new radioisotopes were discovered with the 60-inch cyclotron. Perhaps the most famous example is carbon 14, now used all over the world in research which has immeasurably enhanced our understanding of the earth and living systems. Other examples are hygrogen 3, tritium, now renowned as one of the ingredients of thermonuclear reactions, and helium 3, widely used in low temperature research.

Production and distribution of radioisotopes. To the delighted surprise of

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Lawrence and his colleagues, the 60-inch cyclotron produced even larger quantities of radioisotopes than they had expected. For example, in a given time it could produce 20 times greater quqntities of radioiodine, and, similarly, larger quantities of other isotopes. For some time after its completion, the 60-inch cyclotron was virtually the world's sole producer of radioisotopes. So Ernest and John Lawrence, eager to have as much work done as possible, pioneered on a small scale the distribution of radioisotopes in the U.S. and abroad -- a function now performed on a world-wide industrial scale by the Atomic Energy Commission. In 1941, distribution - all free of charge - was divided roughly as follows: 30 per cent for the Radiation Laboratory; 40 per cent to other departments of the University; and 30 per cent to other institutuions in this country and abroad. Several hundred doctors and 40 universities, medical schools, commercial companies, and government laboratories received isotopes. Isotopes were sent to Argentina, Belgium, Italy, Paraguay, Peru, and other foreign countries.

Even after the giant reactors of the Atomic Energy Commission took over, the 60-inch cyclotron continued to be a producer, for the AEC and others, of important isotopes that cannot be made in reactors; for example, sodium 24, potassium 45 and calcium 45 and 47.

Tracer studies. The Crocker Laboratory permitted an acceleration and expansion of tracer studies of both normal and diseased processes in humans, animals, and in physics, chemistry, agriculture and industry. Knowledge was gathered that could not be obtained by any other means. The astonishing and unexpected speed of body metabolism was revealed. Understanding of the mineral metabolism of the body was greatly improved. Study of the throid gland with radioiodine yielded promising avenues for diagnosing and treating pathological conditions. Radioiron began to revolutionize concepts of the blood and blood cells. In Crocker, the first experiments on the metabolism of the fission products were conducted during World War II, showing the biological significance of these products of nuclear reactors and explosions. The first experiments with astatine, element 85, which is similar to iodine, were conducted.

Biological effects of radiation. Studies of the biological effects of radiation have continued at Crocker since the machine was first operated in 1939. Exploration of the severe effects of neutrons on living cells, noted with the 37-inch cyclotron, were intensified with the 60-inch instrument. Such research - with neutrons, alpha particles, and radioisotopes -- had much to do with the safety regulations established during World War II for the Atomic bomb project and continued during the post-war period, and led to the broad studies of radiation effects, including those now being conducted on space radiation with several accelerators.

Diagnosis and Treatment of Disease. If the results of the most immediate use of the 60-inch cyclotron were disappointing, the value of work with the machine in laying a foundation for treating cancer and other diseases in other ways has turned out to be immeasurably greater than anyone could have foreseen in 1936. Analysis of neutron treatment showed the particles did not yield a significant advantage. But the knowledge gained provided the foundation for the present successful and highly promising treatment of cancer being carried on by Dr. John Lawrence with the much more energetic alpha particles accelerated in the 184-inch cyclotron at Berkeley.

Even more widespread has been the use of radioisotopes in the diagnosis and treatment of disease. The promise of these uses, indicated with isotopes produced in the 37-inch cyclotron, was greatly expanded, in the Crocker Laboratory. The treatment of polycythemia vera started by Dr. John Lawrence in 1938, has now been established by Dr. John Lawrence's work as the first disease to be controlled by radioisotopes, and is now widely used. Radiophosphorus treatment of some kinds of leukemia is helpful, as is radiogold treatment of some cancers.
Diagnosis and treatment of thyroid disease was initiated in 1940 at Crocker by the late Drs. Joseph Hamilton and Mayo Soley, and is now common.

Today, virtually every major medical center and hospital in the nation and in many foreign countries has a radioisotopes laboratory -- and a large part of the foundation was laid for this benefit to mankind by the pioneering work at Crocker Laboratory.

Even more far-reaching may be the new ways of diagnosis and treatment that have been developed as a result of new knowledge of health and disease gained through tracer studies with radioisotopes.

It is noteworthy and symbolic that the first target bombarded at Crocker was iron phosphate -- which yielded radioactive phosphorus and radioactive iron. The bombardment was carried out by Dr. Paul Aebersold, who for some years was in charge of the operation of the 60-inch cyclotron and who is now head of the huge radioisotopes program for the Atomic Energy Commission. Radioactive iron and phosphorous are now workhouses of nuclear medicine.

Establishment of Donner Laboratory. The firm establishment of the broad potential of radioisotopes and particle beams of accelerators in medical and biological research led to the founding of the Donner Laboratory in 1942, a gift of the late William H. Donner. In this laboratory, headed by Dr. John Lawrence, the work started in the Crocker Laboratory has been continued and expanded.

Discovery of New Elements. An epic chapter in the history of science has been the discovery of new elements, especially those heavier than uranium. This episode began in 1940 with the brilliant discovery, using the 60-inch cyclotron, of element 93, neptunium, by Dr. Edwin M. McMillan and Dr. P. H. Abelson. The discovery ended years of frustration by scientists in several countries who had been seeking to create this element. There followed in 1940-41 the discovery of plutonium by Dr. Glenn T. Seaborg, the late Dr. Joseph Kennedy, Dr. A. C. Wahl, and Dr. McMillan. Later the 60-inch cyclotron was the instrument for the discovery of elements 96 (curium), 97 (berkelium), 98 (californium), and 101 (mendelevium). In addition, this cyclotron first produced elements 99 and 100 after University of California and other scientists jointly discovered them in the debris of the first hydrogen bomb explosion. Element 85 (astatine), similar to iodine, was also created and identified at Crocker. In all, 7 elements and many isotopes of each of these and other elements were discovered with this machine. A whole new body of scientific knowledge was erected by this work.

National Defense. The discovery of plutonium in 1940-41 greatly stimulated America's wartime project to develop nuclear weapons. It significantly quickened the development of the nuclear reactor -- for it was with reactors that plutonium could be produced in quantities sufficient for a nuclear weapon. The 60-inch cyclotron could produce only tiny amounts of the element; but the quantities it did produce in 1942 were used in the dramatic initial work to develop a process for purifying the plutonium that was to be manufactured in the reactors later. Plutonium turned out to be the nation's chief atomic weapons ingredient -- the key material for the defense of the free world.

Nuclear Power. Plutonium significantly expanded the potential of nuclear energy for power. Moreover, U-233, a uranium isotope made from thorium was discovered in the Crocker Laboratory, and again immensely expanded the world's nuclear energy resources.

Nobel Prizes. Work with the 60-inch cyclotron was directly or indirectly responsible for the Nobel Prize going to four members of the faculty; to Edwin M. McMillan, present director of the Laboratory, for his work in the discovery of elements 93 and 94; to Glenn T. Seaborg, now Chairman of the Atomic Energy Commission, for his research in the discovery of element 94, plutonium, and other transuranium elements; to Melvin Calvin, for his elucidation of the chemical processes of photosynthesis with carbon 14; and to William Libby, of the Los Angeles campus, for his technique of dating, with carbon 14, fossils and other materials.

Training of nuclear scientists. The Crocker Laboratory has been the training ground of several hundred nuclear scientists. Some are on various campuses of the University. Others have taken Crocker know-how to laboratories all over the world. In many instances they have established new programs of research and teaching, and so multiplied the bounty of the late Mr. Crocker's gift.

Mr. Crocker did not live to see the Crocker Laboratory built. A few months after he made his gift, he passed away. Soon after, President Sproul paid tribute to Mr. Crocker at a meeting attended by 7000 students. President Sproul said of Mr. Crocker: "He entered with understanding into the life of the institution, and gave freely of his time and substance to the up-building of its facilities and the promotion of its welfare. These things he did generously and unselfishly because he believed that the University renders an invaluable human service."

At the time no man could foresee the import of Mr. Crocker's gift -- one of many to the University -- for the Laboratory bearing his name. The world in the year 1962 is far different from the world of 1936. It was made so in significant ways as a result of Mr. Crocker's timely generosity.

Science itself reflects important changes. The "big laboratory", pioneered by Lawrence to a large extent at Crocker, is a fixture of modern scientific research. Group research, also pioneered at Berkeley, is an essential order of the day in many fields. Today's accelerators dwarf the 60-inch machine, even as it dwarfed its predecessors. Private donors seldom can afford the huge outlays required for the equipment and the programs.

The "payoff" from the research at Crocker was in no small measure responsible for recognition by the Federal Government of the necessity of Federal investment in basic research in the interest of the national welfare. Today, in the atomic field, the Atomic Energy Commission expends hundreds of millions of dollars annually to insure the continued flow of basic knowledge similar to that which began to emanate from Crocker in 1939. Included in these outlays has been the major part of the support of the Crocker Laboratory program since World War II°

Several years ago it became clear that the Crocker Laboratory was nearing the end of its brilliant service. First of all, rapid advances in science and technology made it desirable for the Lawrence Radiation Laboratory to construct a somewhat larger and more flexible cyclotron, incorporating new principles, to replace the 60-inch machine. Such a cyclotron, the 88-inch instrument, was recently completed on "The Hill", with AEC funds. Second, the Crocker Laboratory itself would have to be razed to make way for Berkeley campus development. But the old machine will continue to serve science. Before his death in 1958, Ernest Lawrence started the transfer of the 60-inch cyclotron to Davis, where it could be used to great advantage in the budding physics program of this expanding campus. You will recall similar measures by Lawrence to build up physics programs on other University campuses: the 37-inch cyclotron was moved to the Los Angeles campus in 1947; and the 32 million electron volt proton linear accelerator was transferred to the University of Southern California in 1958.

After the cyclotron is dismantled in July, the magnet will be moved to the Davis campus. Remodeled, as a 72-inch machine and incorporating the new principles of the 88-inch spiral ridge cyclotron, it will stimulate the nuclear physics program on that campus. The remodeling will be financed by the AEC.

We are mindful of, and grateful for, the contributions of all of the original donors to Crocker Laboratory, and to the AEC for its generous support in the post-war period. While we have no fear that the Crocker name will be lost