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Conceming Raymond George Herb on the Occasion of the Dedication of the First Herb Pelletron Tandem Accelerator

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Nuclear physicists throughout the world owe an enormous debt of gratitude to Raymond George Herb. His own research has established a a standard of experimental quality and precision towards which others can usually only aspire; his inventive genius has enabled him, perhaps more than any one other man, to give nuclear scientists everywhere the tools and the techniques which have been essential *to* major progress in the field; his personal qualities and leadership have been dominant factors in establishing his University as one of the international centers in nuclear physics – a center whose graduates have spread the Wisconsin tradition of experimental excellence throughout the world.

Wisconsin can truly look on Ray Herb as a native son. He was bom on a farm near Navarino, Wisconsin, on a frigid January 22 morning in 1908. the son of Joseph and Annie Herb. Educated in Wisconsin he received that strange Wisconsin degree Ph. B. in 1931 and his Ph. D. degree four years later in 1935.

It was in 1931 that Ray read Robert Van de Graafs first paper describing the electrostatic generator which was to become known as the Van de Graaff accelerator. It was Ray Herb who contributed many of the vital concepts and ideas which have made these electrostatic accelerators the work horses of nuclear science. A spot check in 1969 showed that 87% of all the new results on the nucleus presented at American Physical Society Meetings had been obtained with them.

Ray's doctoral dissertation was performed on his first accelerator built jointly with Bill Parkinson and Don Kerst; construction had been initiated in 1933 and this first machine was already pioneering – it was the first to use high pressure gas insulation. This was only the first of a long line of new and powerful inventions and innovations which have culminated in the magnificent system in whose dedication we have the privilege of participating in this Symposium.

Arriving in Wisconsin during this last year of Ray's graduate program, Gregory Breit immediately initiated construction of a Cockcroft-Walton accelerator so that he could tackle the nucleon-nucleon problem; Gregory recognized an experimental genius immediately. It may be too that he recognized someone who was just as strong – just as hard working as he was. Ray's students treasure the spectacle of his appearance at a Madison sporting goods store where he became interested in an archery display. Selecting what appeared to him as an adequately sturdy bow, Ray presented it to the salesclerk who said "No, no, sir! You see, sir, that is a 70 pound bow and without years of experience you couldn't begin to pull it." Whereupon, without comment, Ray took the bow in one hand and the string in the other and briskly pulled them *sideways* in front of him. It was well known, too, that in Wisconsin laboratories a supply of large wrenches were always on hand for use by lesser mortals in removing nuts which Ray reported he had only made "finger tight".

In any case, the summer of 1935 found Ray driving to Washington with Gregory and Marjorie Breit where Gregory had arranged for him to spend a few months at the Carnegie Institution with Tuve, Hafstad, Dahl, and Breit who were working on their first Van de Graaff accelerator. This began a long and enormously important series of experimental studies on the nucleon-nucleon problem which Ray Herb has taken to a degree of elegance and precision which have never been matched.

Returning to Wisconsin in 1935, Herb, Parkinson, and Kerst plunged into an ambitious program which led to electrostatic gradient control and a 2.5 MV accelerator in 1937 and much new data on proton-proton scattering.

By the late 1930's this was replaced by a new machine which operated up to 4.5 MV, a record held for over a decade. This was the machine which was spirited away to los Alamos in the early days of the war and which, operating 24 hours per day for years, produced most of the precise nuclear cross section data required in the Manhattan Project. Ray himself went east to the Radiation Laboratory at MIT where he was very much involved in the development of microwave early warning radar.

Having used his accelerator to demonstrate the sharp resonant character of low energy proton reactions before the war and, incidentally, to eam the comment in Eugene Wigner's Nobel Laureate address in Stockholm, "In leadership, a young man at the time, Ray Herb was my tutor", he returned to Wisconsin after the war and working with Snowden and a new student from Brazil, Oscar Sala, Ray built the first cylindrical elec-

trostatic analyzer, an instrument which for years constituted the absolute standard in nuclear measurements. I need hardly tell you that Ray's students are well trained, not only in careful experimental techniques but as gentlemen and scholars.

Ray's work, with his students, was fundamental to all subsequent study of the nucleon-nucleon force; it also underlies the famous Breit-Wigner resonance theories. Pushing always toward higher quality measurements, he has invented a whole array of new devices and techniques. Best known, until recently, have been his dry vacuum pumps employing both gettering and ion pumping and his work on ultra high vacuum acceleration tubes and systems. His Orbitron ultra high vacuum gauge marks a quantum jump in sensitivity.

Less well known is the fact that Ray and his students, in the mid 1950's, developed the first intense source of negative hydrogen ions, a source that made the tandem electrostatic accelerator feasible. More recently, as the laboratory here in São Paulo makes spectacularly obvious, Ray has developed a whole new breed of tandem accelerators. These are indelibly marked by his fondness for elegant simplicity and precision of operation. The special new Pelletron charging principle has grown out of a long careful series of experiments which Ray and his students have carried out over the last decade. The new high gradient acceleration tubes are able to eliminate troublesome magnets and non-axial electrostatic fields again because Ray and his students had found that by going to much higher vacua than had ever been used in electrostatic accelerators it was possible to suppress the secondary electron problems which have always plagued large electrostatic accelerators in the often cursed "long-tube" effect. Gradient control with self-healing devices also goes back to Ray's second machine in the late 1930's. So, in a very real way, here in São Paulo Ray has brought it all together from many years of patient, careful and meticulous study and innovation. But more than this, and typical of Ray's approach, is the fact that he has also developed a completely new and delightfully simple method of fabricating electrostatic components; even more delightful is the fact that while elegant, Ray's new process is very much less costly than those used previously. These new machines show every promise of opening up whole new frontiers in nuclear science. Oscar Sala, Ross Douglas and their colleagues here at São Paulo are indeed fortunate in having the first of these superb instruments.

Ray has been active in many areas of science. He chaired a recent blue ribbon panel charged with examining and making recommendation con-

cerning plasma physics research in the United States. His many contributions to science have been recognized by his election to the U. S. National Academy of Sciences and by honorary doctorates from this University and the University of Basel.

Ray Herb wears his two hats, the one as Charles Mendenhall- Distinguished Professor of Physics at the University of Wisconsin and the other as President and Founder of The National Electrostatic Company, with characteristic modesty and distinction. When the American Physical Society chose, in 1968, to make its most cherished award, in nuclear physics, The Tom W. Bonner Prize, to Raymond George Herb the citation read

"for his pioneering development of high precision equipment for nuclear physics research and for a series of experiments each setting a new standard of quality which profoundly affected the whole course of nuclear physics research.

There is little that I can add to that.

On behalf of all of us here assembled it gives me the greatest pleasure to express our sincere congratulations on this happy occasion, our warmest best wishes, and our confident expectation that we will continue for many years to look to Ray Herb for leadership in precise nuclear studies and for those marvelous devices which all of us wish we could only have been smart enough to think of first.