OPENING REMARKS

A. M. Weinberg
Oak Ridge National Laboratory

It is indeed a very great privilege to welcome you to Gatlinburg on behalf of the United States Atomic Energy Commission, the Union Carbide Corporation, and the Oak Ridge National Laboratory. This International Conference on Isochronous Cyclotrons is the fourth in which this exciting new cyclotron technology is being explored, and ideas are being exchanged between workers in the field from many lands.

Some of you may know that I am a reactor man, not a cyclotron man. Perhaps it might be worthwhile to tell you how the development of isochronous cyclotrons looks to a reactor man. To what extent will cyclotrons of this ingenious type supplement, to what extent might they even replace reactors, as research tools, as sources of isotopes, possibly even as breeders of fissile material?

Now, with respect to the use of intermediate energy high intensity accelerators in the greater than 100 MeV range, this conference comes at a very timely moment. The recently issued Pake Committee Report, which surveyed the status of physics in the United States, devoted an entire subsection to a newly emerging specialty in nuclear physics – what is now called intermediate energy nuclear physics by the Atomic Energy Commission, as well as by the Pake Committee. The Pake Committee Report urged that this field be pursued vigorously; those of you who have read the report may recall that it suggested that new cyclic accelerators, such as the separated-orbit cyclotron, be investigated further.

In the field of heavy-ion acceleration there seems to be a happy marriage in the offing between reactor people and isochronous cyclotron people. No fewer than four high flux reactors, capable of producing sizable quantities of transuranic elements, such as ^{252}Cf, are now either in operation, under construction, or being planned throughout the world. These reactors include: the oldest of this type, the great SM Reactor in the Soviet Union, which achieves a thermal neutron flux considerably in excess of 10^{15}; the HFIR Isotope Reactor here in Oak Ridge, which is now beginning operation; the A^2R^2 being planned at Argonne; and the projected Franco-German Reactor at Strasbourg, which will also move comfortably into the several times 10^{15} neutron flux region. In addition there is the beam reactor at Brookhaven, and a reactor at Savannah River that has achieved a flux well above 10^{15}.

When the heavy elements, especially ^{252}Cf, from these reactors are bombarded with heavy ions in, say, isochronous cyclotrons, many rare and interesting species will be formed. Perhaps the most exciting possibility is the doubly-magic element of mass 310, with 126 protons and 184 neutrons. (It's very easy for a cyclotron expert to remember this next magic number of neutrons because it is also the size of the Berkeley 184-Inch Cyclotron – 184 neutrons.) Recent calculations by Wong, which extend the calculations of Swiatecki and Myers at Berkeley, suggest that element 310 may actually be an island of stability, way out beyond the existing elements; it may have a lifetime against spontaneous fission of several days, as well as having an appreciable lifetime against alpha and beta decay. These are speculative matters, but the existence of the HFIR and the isochronous cyclotrons, as well as the high-energy Van de Graaffs, suggests that within the next half-dozen years or so there will be attempts to look at the stability of element 310.

Indeed, the reactor, as the producer of most of the scientifically and medically important isotopes, may find the new cyclotron producing competitive products. Beta-emitting – that is, neutron-rich – isotopes have become enormously important only because reactors were invented. Before reactors, isotopes were too expensive to be used very widely. By contrast, the positron emitters of the sort produced in cyclotrons have always been little used, because they have been so difficult to produce; people have therefore had little opportunity to examine their potentialities. The isochronous cyclotron, with its inherent capacity to go to high current, especially in the SOC embodiment, might, I would suspect, mean as much for positron-emitting isotopes as reactors have meant for negatron emitters.

And finally, there are the extraordinary technological possibilities which will be reported by the people from Chalk River, as well as Oak Ridge and England, the huge super cyclotrons that pour 75 megawatts of 1000-MeV protons on targets and produce fluxes of thermal neutrons of the order of 10^{16}, at least as high as the highest achieved in a reactor of very high power. Where such a development will finally lead, none can say. Certainly, the experiments carried on by the joint Oak Ridge—Chalk River group a couple of years ago at Brookhaven on the multiplicity of neutron production by 1—3 GeV protons on various targets suggest that this multiplicty is as high as the optimists had suspected it would be, and that one may, therefore, have here an efficient way to convert electrical energy into neutrons. The possibility of the electrical breeder of fissile material thus raises its head. Though, as a long-term proponent of the power breeder based on the chain reaction, I tend to dismiss such a competitive idea; I must say that the idea of an electrical breeder that looked completely uneconomical 15 years ago now begins to look considerably less unattractive.

The moral of this is clear. Cyclotron building in the very early days was a black art, practiced successfully only at Berkeley under E. O. Lawrence, but over the years it has come of age. It is now a full fledged technology, and, as is so often the case, as it is pushed in many places new and unexpected ideas come up. The isochronous cyclotron, with its spiral ridges, is only a beginning. Many of us are convinced that newer versions, like the SOC's and others, will be developed, and that the overall result will always be to reduce the costs per unit of energy and current. I stress that the technology progresses best when it is pursued independently in many places by many people. Many of us, for example, were particularly pleased that the two inventors of the principle of phase stabilization, Vecksler in the USSR and McMillan in the USA, jointly shared the Atoms for Peace Award a couple of years ago. And so, we can expect that from meetings like this, where independent workers from all over the world gather and exchange novel ideas, will come not only bigger and better isochronous cyclotrons, but also increased understanding among scientists, and therefore among people of every country and every political belief.

Once again, then, I welcome you to the hills of Tennessee. I am sorry the weather is typically rainy, I hope it will be sunshiny for your outing to the mountains. I offer my very best wishes for a most successful conference and, as we hillbillies say in East Tennessee, "You-all hurry back."