Some elementary general facts were recognized at that time: That deuterium gas could react[1] above an ignition point of approximately 35 kilovolts; that deuterium-tritium mixtures could react[2] at a considerably lower temperature of a few kilovolts; that the gas should be introduced at an exceedingly low density of approximately 10^{14} to 10^{15} particles/cubic centimeter in order to make the reaction rates sufficiently slow and in order to avoid excessively high pressures; that at these high temperatures the gas will be completely ionized (such an ionized gas is called plasma); that with the help of magnetic fields the ions in this plasma can be forced onto spiral paths and that by appropriate arrangement of the magnetic fields the losses to the walls can be reduced; that the pressure of the plasma on the field leads to a thermal expansion of the plasma which tends to stabilize the reaction; that equilibrium with radiation is not established and that the energy emitted as bremsstrahlung should be treated as a loss; that for this reason atoms other than hydrogen isotopes must be eliminated as completely as possible; and that even the equilibrium between electron and positive ion energies will not be complete at the highest temperatures. Very particularly it was also noticed that in a simple closed field distribution along a torus the particles will not continue indefinitely to spiral around the same magnetic line of force but that they will drift in a direction perpendicular to the magnetic lines and to the gradient of the magnetic lines. This leads to smaller but nevertheless prohibitive wall losses. For the time being, no experimental work was undertaken for the specific purpose of carrying the theoretical considerations into practice.

In 1952 and 1953 under the stimulus of a successful man-made release of thermonuclear energy such an experimental approach was started. To a very great extent this was due to the initiative and confidence of the chairman of the Atomic Energy Commission, Lewis L. Strauss. It was recognized that the problems of heating and containing the plasma would be extremely difficult. For this reason several parallel approaches were undertaken which between them amounted to an attack on plasma research on a broad front.

THE PRESENT APPROACHES

Two of these approaches, the pinch and the stellarator, were based on the idea of containing the plasma in an annular region. The main difference between these two approaches is that in the pinch an axial current is established with magnetic lines of force encircling the current while in the stellarator the roles of current and magnetic lines are reversed with the principal currents established outside the reacting region. In the United States the work on the pinch effect has been started by James Tuck in Los Alamos. Later, similar work was undertaken in the University of California Radiation Laboratory by Baker and Colgate, and still later at other sites. Nicholas C. Christofilos proposed an ingenious steady-state arrangement, the Astron, which bears some similarity to the pinch effect.

At the very beginning of the thermonuclear program, the stellarator was proposed by Lyman Spitzer and work on it was carried out in Princeton.

Taking an entirely different approach, the advantages of a confinement geometry based on externally generated, cylindrically symmetric magnetic fields were recognized by Richard Post and Herbert York. Starting with these

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