In this way important features of plasma theory have been experimentally verified. The interaction between magnetic pressure and hydrodynamic motions have been observed. Transport phenonema in the plasma have been investigated. These are greatly complicated by the effects of collective motions but when properly attacked have yielded satisfactory verification of our expectations.

Hydromagnetic motions have been extensively studied, most particularly in observing how a pinch is formed. In connection with the same experiment the evolution of instabilities has been studied.

In the stellarator, the mirror machine, and the pinch effect, the importance of impurities has been proved by studies of the influence that the wall materials have on the observed phenonema. In the case of the stellarator a very ingenious device, the divertor, has been developed which harmlessly dumps that part of the plasma which otherwise would get in touch with the wall and would give rise to the emission of disturbing atomic species. The use of this divertor has greatly improved the operation of the machine.

After proper precautions, temperatures of 100 electron volts or more have been reached in the various machines. This should be compared with a few thousand electron volts needed for the effective burning of a deuterium-tritium mixture. More than a hundred electron volts have been reached in the stellarator and still higher temperatures in the mirror machine. Proved temperatures in the pinch effect are a little lower but, on the other hand, greater densities have been obtained.

Perhaps the most important observable variable is the time of containment. In the pinch effect the time during which a high density prevails is only a few tens of microseconds. On the other hand, the working of this machine is in least need of protracted confinement times. In the stellarator, confinement times of a millisecond or more have been established. In the mirror machine, confinement times of several milliseconds are not unusual. This is particularly pleasing because of the small size (a few cm) and high electron temperature (more than 10 kev) of the plasma. Furthermore, in this machine no difficulties have arisen in connection with instability or disorderly motion. These times have to be compared with a period of approximately one second in which a successful thermonuclear reaction would double the original input energy.

NEUTRONS

Throughout the development it has been believed that production of true thermonuclear neutrons would be a milestone in the development toward controlled thermonuclear reactions. Such neutrons would not be merely encouraging but would at the same time give us a sensitive method of measuring temperature distributions within the machine.

In thermonuclear machines neutrons have been repeatedly observed. Unfortunately these neutrons may be due to some form of organized motion rather than to the random agitation of temperature. This shows in a most direct manner that we are still very far from a successful thermonuclear