waters, the geochemistry of deep flow systems and fluid mixing systems, and effects of deep disposal on the hydrodynamics of saline water systems, would improve prediction of long range effects of deep disposal, particularly in the general area of adverse effects on water and other mineral resources of possible future importance.

### INJECTION OF GASES INTO THE GROUND

The storage of natural gas in man-made or natural subsurface reservoirs is an established practice. The methodology developed, as well as the scientific principles learned from research on the behavior of gases in porous media, indicate that major breakthroughs in reducing air pollution at some localities might be possible by injection of low volume waste gas streams into the ground. Disposal might be at shallow depth into unsaturated void space (principally in arid regions of the west) or at greater depth into reservoirs that would depend on creation of a gasbubble.

Shallow disposal into air-filled void space between the land surface and the zone of saturation would depend not only on the presence of an impermeable layer near or at the surface, below which gases could be injected, but would also require detailed analysis of gas migration rates in the permeable reservoir rock as well as through the confining layer. The attractiveness of the method stems principally from the fact that rates of transport of gases injected into the ground are much lower than rates of transport in the air and that decontamination may result from adsorption of gaseous contaminants on the solid matrix of the disposal reservoir or by filtration of particulate matter.

Deep disposal would be closely analogous to methods for storing natural gas, using a depleted structural or stratigraphic natural gas reservoir or locating a barren structure by drilling and testing, which could be used as a disposal reservoir.

The energy requirements for such a system are high, but for gases that present problems of cleanup by filtration or other conventional treatment, and that can be segregated into a concentrated low-volume stream, the method has great potential for alleviating critical air pollution problems.

A great deal of research is necessary in order to develop the method, particularly on the interaction of waste-gas materials and earth materials (including water) and detailed information on any proposed site is necessary to determine feasibility. Current research on the physics of flow of gases and liquids in the unsaturated zone above the water table will contribute to an understanding of the problems underlying shallow disposal. The research areas that are important to deep disposal of liquids are also important to gas disposal.

### OCEAN DISPOSAL OF WASTES

Our knowledge of ocean circulation is far from complete. Yet we know enough to say that under present circumstances the open ocean is a much more suitable waste treatment basin than the rivers and estuaries. However, costs are higher, and we should not repeat past mistakes by assuming that indisicriminate dispoal of wastes in the open sea is a final answer. If it is necessary to continue to view wastes in the negative sense, as useless material which must be discarded, then the ocean can be used safely to dump large amounts of wastes provided that this is done under adequate control. Eventually, it seems that we must find imaginative new ways of waste treatment based as far as possible on the concept of recycling and re-use.

Mr. DADDARIO. Our next witness is Mr. Henry W. Riecken of the Social Science Research Council.

## STATEMENT OF MR. HENRY W. RIECKEN OF THE SOCIAL SCIENCE RESEARCH COUNCIL

Mr. RIECKEN. Thank you, Mr. Chairman. It is a pleasure to have a chance to talk to the committee. I speak for myself as a social scientist rather than as the Vice President of the Social Science Research Council making an official statement. I'm glad to speak to