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The Department of State, on March 28, 1946, made public a publication entitled "A Report on the International Control of Atomic Energy". In the public discussion of the Report questions have arisen with respect to the denaturing of materials utilized in atomic explosives.

After consultation with the Department of State, Maj. Gen. L. R. Groves called together a group, representative of the outstanding scientists connected with the Manhattan Project during the development of the atomic bomb and all of whom are still connected with the project either on a full-time or consulting basis. This group has met and has just completed a conference in which the measure of safety afforded by the use of denaturants was discussed. They prepared among other papers a report which can be released without jeopardizing security. Their report is as follows:

"The possibility of denaturing atomic explosives has been brought to public attention in a recent Report released by the State Department on the international control of atomic energy. Because, for security reasons, the technical facts could not be made public, there has been some public misunderstanding of what denaturing is, and of the degree of safety that it could afford. We have thought it desirable to add a few comments on these points.

"The Report released by the State Department proposes that all dangerous activities in the field of atomic energy be carried out by an international authority, and that operations which by the nature of the plant, the materials, the ease of inspection and control, are safe, be licensed for private or national exploitation. The Report points out that the possibility of denaturing explosive materials so that they 'do not readily lend themselves to the making of atomic explosives' may contribute to the range of licensable activities, and to the overall flexibility of the proposed controls. The Report does not contend nor is it in fact true, that a system of control based solely on denaturing could provide adequate safety.

"As the Report states, all atomic explosives are based on the raw materials uranium and thorium. In every case the usefulness of the material as an atomic explosive depends to some extent on different

properties than those which determine its usefulness for peacetime application. The existence of these differences makes denaturing possible. In every case denaturing is accomplished by adding to the explosive an isotope, which has the same chemical properties. These isotopes cannot be separated by ordinary chemical means. The separation requires plants of the same general type as our plants at Oak Ridge, though not of the same magnitude. The construction of such plants and the use of such plants to process enough material for a significant number of atomic bombs would probably require not less than one nor more than three years. Even if such plants are in existence and ready to operate some months must elapse before bomb production is significant. But unless there is reasonable assurance that such plants do not exist it would be unwise to rely on denaturing to insure an interval of as much as a year.

"For the various atomic explosives the denaturant has a different effect on the explosive properties of the materials. In some cases denaturing will not completely preclude making atomic weapons, but will reduce their effectiveness by a large factor. The effect of the denaturant is also different in the peaceful application of the materials. Further technical information will be required, as will also a much more complete experience of the peacetime uses of atomic energy and its economics, before precise estimates of the value of denaturing can be formulated. But it seems to us most probable that within the framework of the proposals advanced in the State Department Report denaturing will play a helpful part.

"In conclusion we desire to emphasize two points, both of which have been challenged in public discussion. (1) Without uranium as a raw material there is no foreseeable method of releasing atomic energy. With uranium, thorium can also be used. (2) Denaturing, though valuable in adding to the flexibility of a system of controls, cannot of itself eliminate the dangers of atomic warfare.

"L. W. ALVAREZ

R. F. BACHER

M. BENEDICT

H. A. BETHE

A. H. COMPTON

FARRINGTON DANIELS

J. R. OPPENHEIMER

J. R. RUHOFF

G. T. SEABORG

F. H. SPEDDING

C. A. THOMAS

W. H. ZINN"

The background of the individuals who have signed this report follows below:

Dr. L. W. Alvarez worked for the Manhattan Project on the development of the bomb, first at the Metallurgical Laboratory at Chicago and then as group leader at the Los Alamos Laboratory. He is now a professor of physics at the University of California Radiation Labo-

ratory, where under the direction of Professor Ernest O. Lawrence he is engaged on full-time work for the Manhattan Project.

Dr. R. F. Bacher, during the development of the atomic bomb, was chief of the physics division at the Los Alamos Laboratory of the Manhattan District. He has returned to his professorship of physics at Cornell University and still is a consultant to the Manhattan Project.

Dr. M. Benedict is head of an important division of the Kellogg Corporation which designed the gaseous diffusion plant built at the Clinton Engineer Works for the Manhattan Project. He was formerly research chemist with the M. W. Kellogg Company and is now a consultant to the Manhattan Project.

Dr. H. A. Bethe, during the development of the atomic bomb, was chief of the Theoretical Physics Division of the Los Alamos Laboratory of the Manhattan District. He has returned to his professorship of physics at Cornell University and still is a consultant to the Manhattan Project.

Dr. A. H. Compton, now as chancellor, is the head of the Washington University of St. Louis; formerly the director of the Metallurgical Laboratory of the Manhattan District and still a consultant to the project. It was the Metallurgical Laboratory at Chicago which developed the scientific basis for the plutonium process.

Dr. Farrington Daniels is director of the Metallurgical Laboratory of the Manhattan Project. This laboratory is operated by the University of Chicago and is continuing research and development work on atomic energy. He is on leave of absence from the University of Wisconsin where he is professor of chemistry.

Dr. J. R. Oppenheimer is former director of the Los Alamos Laboratory of the Manhattan District. It was at this laboratory that the atomic bomb itself was developed. He remains a consultant to the project, although he has returned to his professorship of physics at the University of California at Berkeley and at the California Institute of Technology at Pasadena. Dr. Oppenheimer was a member of the Board of Consultants which prepared *A Report on the International Control of Atomic Energy* for the Secretary of State's Committee on Atomic Energy.

Lt. Col. John R. Ruhoff, prior to the organization of the Manhattan District, was director of inorganic research and development at Mallinckrodt Chemical Works, and an important officer in the Manhattan Project from the start, first in the development of processes and the procurement of raw materials, then as unit chief of the electromagnetic plant; presently heads the group handling declassification.

Dr. G. T. Seaborg, co-discoverer of plutonium, supervised for the Manhattan Project the general program on the basic chemistry of

the heavy elements, especially plutonium. At present he is engaged full-time on further work of this nature for the Manhattan Project. He is on leave of absence from the University of California where he is professor of chemistry.

Dr. F. H. Spedding is director of the Iowa State College Laboratory, which, among other things, developed the successful method for the production of uranium metal for the Manhattan Project and which is continuing work for the project. Dr. Spedding is also professor of chemistry at Iowa State College.

Dr. C. A. Thomas is vice president of the Monsanto Chemical Company, general over-all chemical adviser for the Manhattan Project in the development of the atomic bomb. He also had complete charge of all phases of Monsanto's work in connection with the project and is still in complete charge of their continuing work for the Manhattan Project in research and development of atomic energy for peacetime applications. Dr. Thomas was a member of the Board of Consultants which prepared *A Report on the International Control of Atomic Energy* for the Secretary of State's Committee on Atomic Energy.

Dr. W. H. Zinn was a project leader at the Metallurgical Laboratory of the Manhattan Project during the early days of pile development. He is now director of the Argonne Laboratory which is operated by the University of Chicago for the Manhattan Project. Experimental pile work is conducted in this laboratory. He was former assistant professor of physics at the City College of New York.