in the attainment of liquid helium temperature level on each attempt.

Figure 2 gives the time rate of cooling. Note that approximately two hours are required to reach the liquid air level (80°K), three hours for liquid hydrogen (20°K) and four hours for liquid helium (4°K). In going from 20°K to 4.2°, the boiling point of helium, a large quantity of gaseous helium accumulates in the experimental chamber. Since the gas must be cooled from room temperature it represents a sizable refrigerative effort on the part of the unit.

* W33-038ac-13866.

Proceedings of the American Physical Society

Minutes of the Meeting at Chicago, June 20–22, 1946

THE 272nd meeting of the American Physical Society was held at Chicago in the buildings of the University of Chicago on Thursday, Friday, and Saturday, June 20–22, 1946. There were 585 registrants, and about a thousand people present in Mandel Hall at the session of Thursday morning. While the registration did not match the two previous meetings nor the largest of the Washington meetings of old, this was by far the largest meeting ever held away from the Atlantic seaboard, and its disadvantage with respect to the few just mentioned is fully explicable by the greater spacing of the centers of physics in the Midwest. Incidentally it was much the largest summer meeting of our history. The Secretary thanks A. J. Dempster, A. E. Shaw, Miss Alberta Jeffrey (secretary of the Department of Physics), and her colleagues for their assistance with the local arrangements.

This will be long remembered as the great nuclear-physics meeting at which a large amount of the work done under the famed "Manhattan Project" was finally brought to light. It is understood that the clearance authorities were laudably assiduous in carrying through with great dispatch the complicated process in the short available time—too short indeed for many who for one good reason or another were unable to prepare in time, and whose contributions may appear at later meetings. A certain number of nuclear-physics papers also came from other than Project sources, and three and a half of the sessions were filled with contributed papers from other fields of physics. There were 97 contributed papers altogether: the abstracts follow.

The programme was enriched with eight invited papers mostly from the Project: the titles and the speakers are given hereinafter. Even the speech of Mr. Seaborg was well attended, though an emergency required it to be given on short notice twenty-four hours before the time allotted. Attention is drawn to the list of scientists on whose work was based the survey by H. H. Goldsmith: this list, not available when the Bulletin was issued, is printed *infra* after the title of the paper.

The dinner of the Society was held on Thursday evening at the Hotel Shoreland, with an attendance of 300. The after-dinner programme consisted almost wholly of the address by A. H. Compton "Physics Research and the Release of Nuclear Energy."

The Council met on Friday afternoon, and elected nine candidates to Fellowship and one hundred and sixteen to Membership: their names are appended.

Elected to Fellowship: W. N. Arnquist, T. B. Brown, H. H. Goldsmith, Victor Hicks, P. E. Lloyd, W. H. Pielemeier, D. H. Rank, M. M. Shapiro, and O. C. Simpson.

Elected to Membership: Edward F. Allen, Frank L. Allen, Mark E. Amdursky, Lowell O. Anderson, Alan Andrew, Joseph Ballam, E. Bleuler, J. W. Bond, William Brauner, Willard E. Buck, William Irving Burg, Alan C. Byers, Paul A. Caldwell, Hans M. Cassel, T. S. Chambers, Richard S. Christian, James Stacy Coles, Kenneth C. Crumrine, Robert B. Duffield, Edgar Everhart, Hubert H. Evinger, Arnold Feldman, Rogers B. Finch, Sister Germaine Fogarty, S.L., Judson Cull French, Ernesto E. Galloni, Clifford S. Garner, Norman E. Gibbs, Homer T. Gittings, Jr., Donald Arthur Glaser, Harold Goldberg, Nicholas E. Golovin, Eugene Paul Gross, P. C. Gugelot, Anatole M. Gurewitsch, Edwin E. Hahn, Jr., Norman S. Hall, Jr., Martin D. Herbst, Melvin A. Herlin, O. Huber, George Gaynor Hyde, Jack Howard Irving, Julius L. Jackson, Nithipat Jalichandra, Sidney Kaufman, George P. Kerr, Jr., George P. Kirkpatrick, Wilfred Konneker, John Herbert Ladd, Arthur E. Laemmel, Simon Larach, Albert H. Lasday, James L. Lauer, Norman T. Lavoo, Lawrence Lee, Sam Legvold, John J. Lentz, Abraham Sidney Levenson, Paul Luger, Paul Thomas Masley, James J. McGlynn, John Armin McIntyre, Howard Oldford McMahon, W. Lathrop Meaker, H. Medicus, William Ralph Mercer, R. C. Meyer, Louis Milgrom, Carlton W. Miller, Herbert I. Miller, Horace L. Newkirk, Robert H. Noble, Arthur S. Nowick, Russell S. Ohl, Benjamin J. Patton, Martin A. Paul, William Perl, Melvin A. Preston, Samuel J. Raff, Milton A. Rothman, Sylvan Rubin, Matthew Sands, Marcello Damy de Souza Santos, Arthur

R. Sayer, Carl Wilhelm Scheerer, Carleton H. Schlesman, Boyd J. Sevold, G. B. Shook, Edmund G. Shower, Sheldon I. Sixfin, Jack H. Smith, Stanley C. Snowden, Bernard I. Spinrad, R. Steffen, Wilbur A. Strauser, Murray Strasberg, Gustaf Strömberg, Nathan Sugarman, M. A. Treuhaft, F. Villars, Hermann Waffler, Robert M. Walker, Roger W. Wallace, Robert L. Wathen, H. R. Wei, David West, Roy V. Wiegand, William Leslie Wilcock, Alfred Wiora, Carl S. Woodward, Harvey Robert Worthington, Jr., Louis F. Wouters, Arianna Wright, J. R. Wright, Greta Yee-Tak Yu, and W. Zunti.

The Council approved changes in the By-Laws of the Division of High Polymer Physics desired by the Division: (the text of these will be made known by the Division). K. K. Darrow and L. N. Ridenour were appointed representatives of the Society on the Council of the A.A.A.S.

The following Resolution had been submitted to the Council by mail ballot:

"The Council of the American Physical Society, being convinced that the national welfare and even the national security depend on the progress and diffusion of scientific knowledge, go on record as affirming that the restoration of freedom of scientific research and publication as it existed before the war is an urgent national necessity. The healthy condition of our science and technology, which was such a great national asset during the war years, will be greatly impaired if the freedom of science is not restored in the immediate future."

Favorable ballots were received from a large majority of the Council, and no unfavorable ballot from any member. This resolution is accordingly to be taken as expressing the sentiment of the Council of the American Physical Society on the important issue involved.

Four alterations in the By-Laws of the Society had likewise been submitted to the Council by a mail ballot, and commanded a large majority. These alterations were submitted to a Business Meeting of the Society convoked on Thursday for the purpose, and were adopted. The By-Laws as hereby amended will be printed in the next Membership List of the Society.

By action of the membership and of the Nominating Committee, the following people were nominated as candidates for the offices and terms which are indicated: *President* 1947, L. A. DuBridge; *Vice President* 1947, G. P. Harnwell, F. W. Loomis, J. R. Oppenheimer, I. I. Rabi; *Secretary* 1947, K. K. Darrow; *Treasurer* 1947, G. B. Pegram; *Editor* 1947–49, J. T. Tate; *Councillors* 1947–1950, D. W. Kerst, P. M. Morse, J. R. Oppenheimer, W. Shockley; *Members of Board of Editors* 1947–49, H. A. Bethe, L. N. Ridenour, W. H. Zachariasen.

The Society has lost through death the following Members: Malcolm C. Hylan (University of Colorado), Howard C. Latham (Navy, lost in action), J. F. Thovert (died in "Resistance" in France some time ago), Max Wehrli (University of Basel); also Louis Slotin (Los Alamos), a candidate for Fellowship.

KARL K. DARROW, *Secretary*
American Physical Society
Columbia University
New York 27, New York

Invited Papers

Elementary Pile Theory. E. FERMI, *University of Chicago.*

The Small Enriched Reactor at Los Alamos. R. R. CHRISTY, *University of Chicago.*

Theory of Nuclear Reactions. GREGORY BREIT, *University of Wisconsin.*

A Critical Survey of Neutron Cross Sections. H. H. GOLDSMITH, *Metallurgical Laboratory:* reporting and collating the work of the following: *from the Metallurgical-Argonne Laboratories:* Messrs. H. L. Anderson, Dancoff, Dempster, Feld, Fermi, Hughes, Langsdorf, Lichtenberger, J. Marshall, L. Marshall, Seren, Snell, Sturm, Szilard, Wattenberg, Weil, and Zinn; *from the Clinton Laboratories:* Messrs. Bernstein, Borst, Sawyer, and Wollan; *from the Los Alamos Laboratory:* Messrs. Barschall, Frisch, Linenberger, Manley, Segré, Taschek, Williams, and R. R. Wilson; *from Cornell-Los Alamos:* Messrs. E. E. Anderson, Bacher, Baker, Holloway, Lavatelli, McDaniel, and Sutton; *from Columbia:* Messrs. Dunning, Havens, Rainwater, and Wu; and *from Illinois:* Messrs. Coltman, Goldhaber, and Muehlhause.

Problems and Plans of Nucleonics Research. FARRINGTON DANIELS, *Metallurgical Laboratory.*

Neutron Spectroscopy. J. R. DUNNING, *Columbia University.*

The Transuranium Elements. G. T. SEABORG, *University of California.*

Introduction to the Theoretical Papers from Princeton. E. P. WIGNER, *Princeton University.*

Physics Research and Release of Nuclear Energy. A. H. COMPTON, *Washington University.*

ABSTRACTS OF CONTRIBUTED PAPERS

A1. Nomographic Charts for Nuclear Reactions. J. L. McKibben, *Los Alamos Laboratory.*—Use of artificial neutron sources made it convenient to have charts as described and displayed here. In the general reaction with energy Q, mass M_1 with kinetic energy E_1 strikes M_2 at rest producing M_3 at laboratory angle θ with kinetic energy $E_3 \equiv C^2$. The vectoral velocity of M_3 in the laboratory system $[C(2/M)^{\frac{1}{2}}]$ is equal to the vectoral velocity of M_3 in the c.g. system $[B(2/M)^{\frac{1}{2}}]$ plus the vectoral velocity of the c.g. system $[A(2/M)^{\frac{1}{2}}]$. As B/A and B depend only upon M_1, M_2, M_3, M_4, E_1, and Q and not upon the angles, a series of semicircles are drawn with radii B and whose centers are displaced from the origin by distance A. About the origin a series of semicircles of radii C are drawn and through the origin a set of radial lines are drawn to demark angles. The two sets of semicircles are labeled with the appropriate energies. A triple intersection designates a set of values.

$$A=\left[\frac{M_1M_3}{(M_1+M_2)^2}\right]^{\frac{1}{2}}(E_1)^{\frac{1}{2}};$$

$$B=\left[\frac{M_2M_4}{(M_1+M_2)(M_3+M_4)}\right]^{\frac{1}{2}}\left[E_1+\frac{M_1+M_2}{M_2}Q\right]^{\frac{1}{2}}.$$

A2. Thick Target Yields with Deuteron-Proton Reactions. Edgar C. Barker,* *Metallurgical Laboratory.*—A study of the thick target yields for the deuteron-proton reactions of 29 isotopes of elements from sodium to bismuth was made with 6.7-Mev deuterons from the Chicago cyclotron. These yields were examined as a function of the atomic number of the parent nucleus so that yields for other isotopes could be predicted without actual bombardment. After normalizing the experimental yields to a parent abundance of 100 percent and a half-life of one hour, the data were empirically linearized. The yields were thus found to have a trend-like variation with atomic number, expressible as

$$Y=\frac{41IZ^{-0.726Z^{1/3}}}{t_h},$$

where Y is the yield in millicuries per microampere-hour bombardment, I is the abundance of the parent isotope in percent, Z is the atomic number of the parent nucleus, and t_h is the half-life of the product isotope in hours. The total variation in Y extends over a factor of 10^6 from Na to Bi; individual yields depart from the trend by as much as a factor of eight.

* Now at Clinton Laboratories.

A3. Cross Section of $D(d,n)$ He^3 Reaction.[1] J. H. Manley, J. H. Coon, and E. R. Graves, *Los Alamos Laboratory.*—The total neutron yield from a thick heavy ice target has been measured at four bombarding energies from 100 to 300 kev by comparison of the activity induced in a large tank of $MnSO_4$ solution surrounding the source with the activity induced by a standard Ra–Be source. The results are summarized in Table I.

Table I.

Neutron energy (kev)	Thick target yield neutrons/deuteron	Cross section (10^{-26} cm^2)
119	1.1×10^{-7}	2.5
171	2.3×10^{-7}	3.7
220	3.6×10^{-7}	5.1
294	7.1×10^{-7}	8.4

[1] Work done at Metallurgical Laboratory.

A4. Cross section of $D(d,p)$ H^3 Reaction.[1] A. C. Graves, E. R. Graves, J. H. Coon, and J. H. Manley, *Los Alamos Laboratory.*—The total proton yield from a thick heavy ice target has been measured for four bombarding voltages between 100 and 300 kev by counting protons emerging from the target chamber at three angles. The results are summarized in Table I.

Table I.

Neutron energy kev	Thick target yield protons/deuterons $\times10^7$	Cross section (10^{-26} cm^2)
122	0.78	2.6
171	1.7	3.3
219	3.0	3.9
300	5.5	5.2

[1] Work done at the Metallurgical Laboratory.

A5. The Yield Function and Angular Distribution of the D+D Neutrons. W. E. Bennett, C. E. Mandeville, and H. T. Richards,* *Rice Institute.*—The thin target yield of neutrons from the D+D reaction has been measured for deuteron energies 0.5 to 1.8 mv. The neutron yield in the forward direction increases smoothly throughout this interval, but the yield at 80° to the bombarding beam remains almost level. Values of A in the expression $(1+A\cos^2\theta)$ representing the angular distribution of the neutrons in the c.g. system are calculated from the yield data and plotted as a function of voltage. A is found to increase from 1.8 at 0.5 mv deuteron energy to 3.4 at 1.8 mv.

* Now at the University of Wisconsin.

A6. Disintegrations of Neon and Argon by *d-d* Neutrons. E. R. Graves and J. H. Coon, *Los Alamos Laboratory.*—An investigation has been made of reactions in argon, krypton, and neon induced by 2.5-Mev neutrons from a *d-d* source. Pulses from a gas filled ionization chamber passed through a linear amplifier into an oscilloscope and were recorded photographically. A calibration of pulse height *vs.* energy was made using recoils from a thin heavy paraffin radiator which was removable. The neutron flux from the *d-d* source was known from previous work so that cross sections could be determined. An n, α reaction occurred in spectroscopic argon with a cross section of about 10^{-28} cm^2. The Q value for the reaction was measured to be +1.8 Mev. An upper limit of $(1/30)\times10^{-28}$ cm^2 may be placed on the cross section for any exoergic reaction in Kr. Measurements of the $Ne^{20}(n,\alpha)O^{17}$ gave $Q=-0.6$ Mev and $\sigma\approx.005\times10^{-24}$ cm^2.