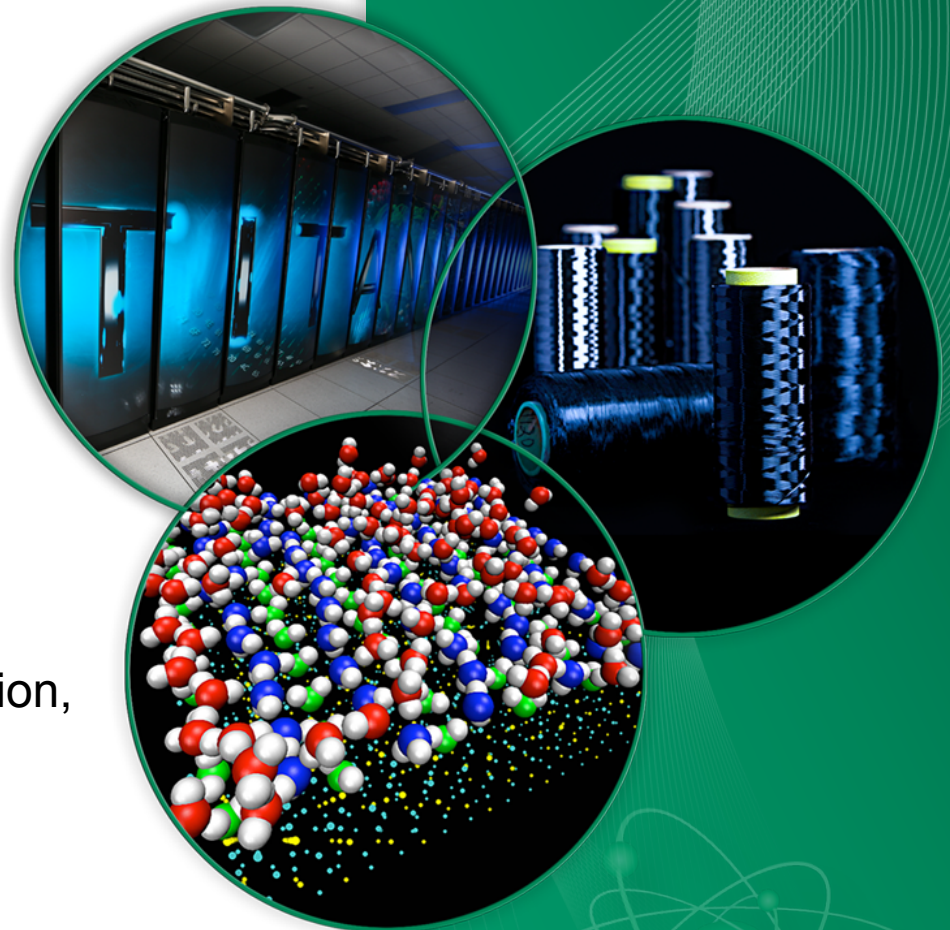


# E. P. Wigner and the Shaping of a National Laboratory: From the Manhattan Project to the Present

Presented to  
**Wigner 111—Colourful & Deep**

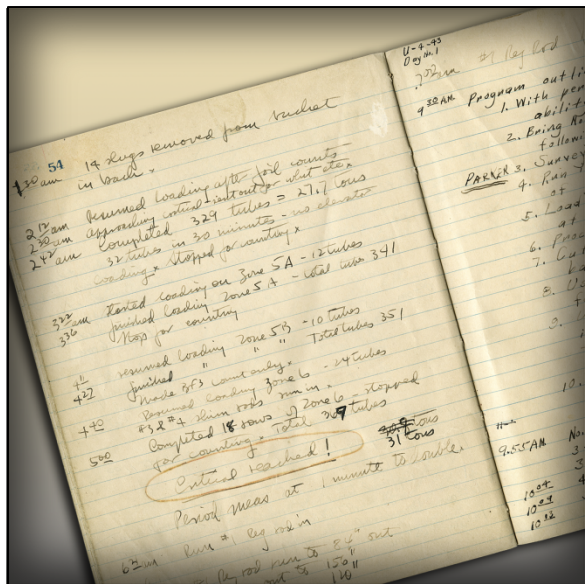
**G. Malcolm Stocks**  
Materials Science and Technology Division,  
Oak Ridge National Laboratory

Budapest, Hungary  
November 13, 2013



# Eugene P. Wigner and Oak Ridge National Laboratory

November 4, 1943



X-10 pile:  
"Critical reached!"

November 4, 1963



Graphite Reactor:  
Final shutdown

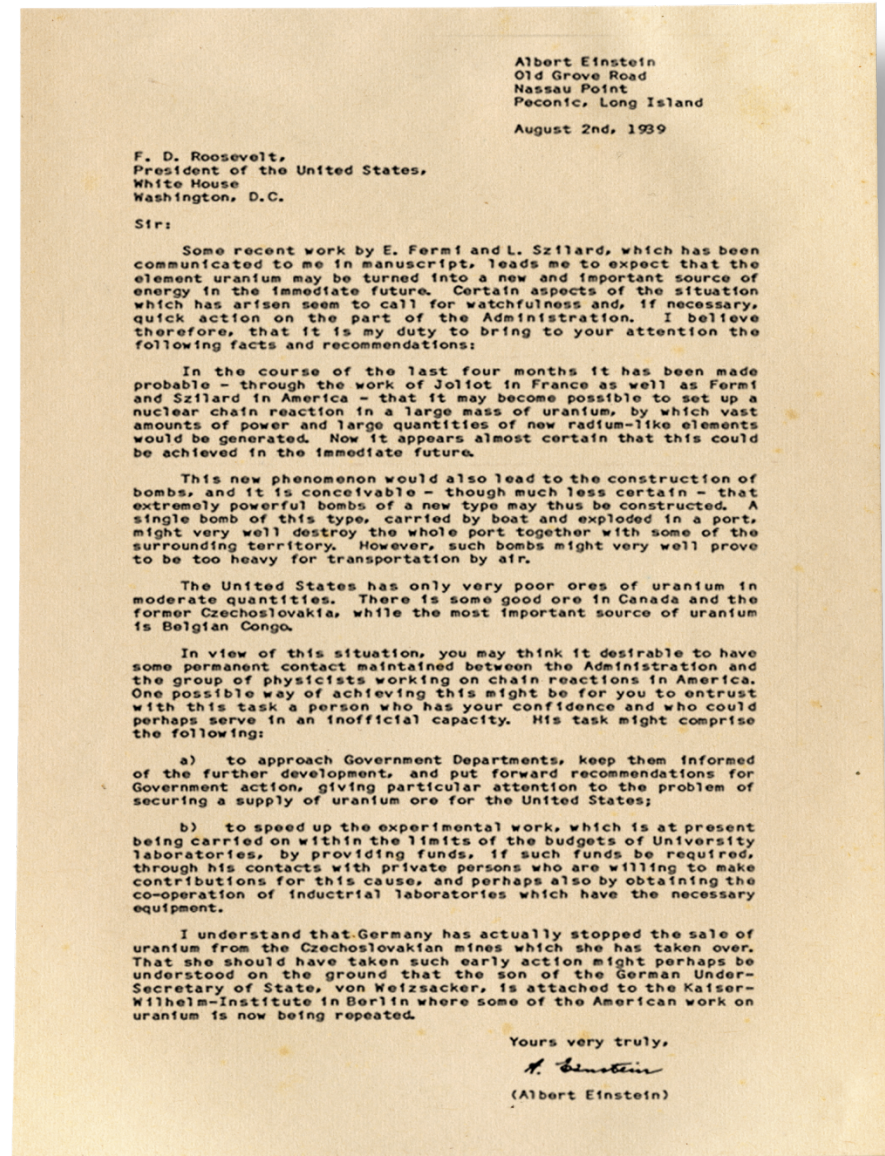
November 4, 2013



Eugene P. Wigner  
Distinguished Lecture

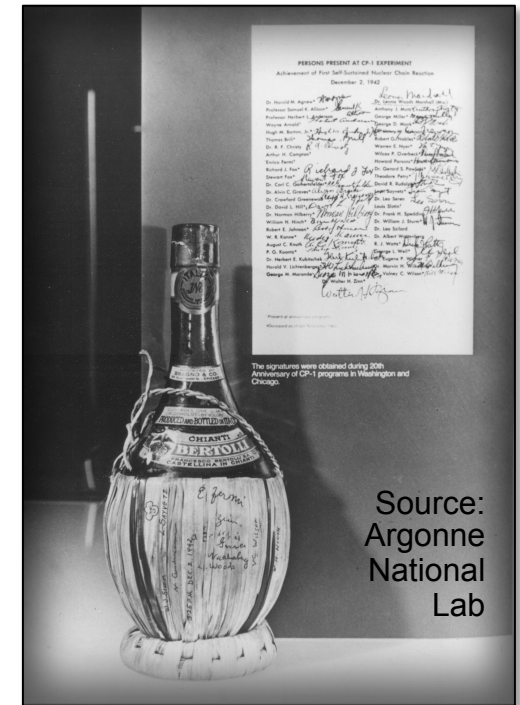
# Princeton, 1939–1942: “Swimming in syrup”

- August 1939: Prompted by Szilard and Wigner, Einstein writes a letter to Roosevelt
  - Possibility of nuclear chain reaction in uranium, in the immediate future
  - Potential for construction of bombs
  - Warning about German research
- October 1939: Roosevelt appoints an Advisory Committee on Uranium, with Wigner as a member
- December 1941: Metallurgical Laboratory established in Chicago
  - Consolidation of work at Berkeley, Columbia, and Princeton
  - Directed by Arthur Holly Compton



# Chicago Metallurgical Laboratory, 1942–1945

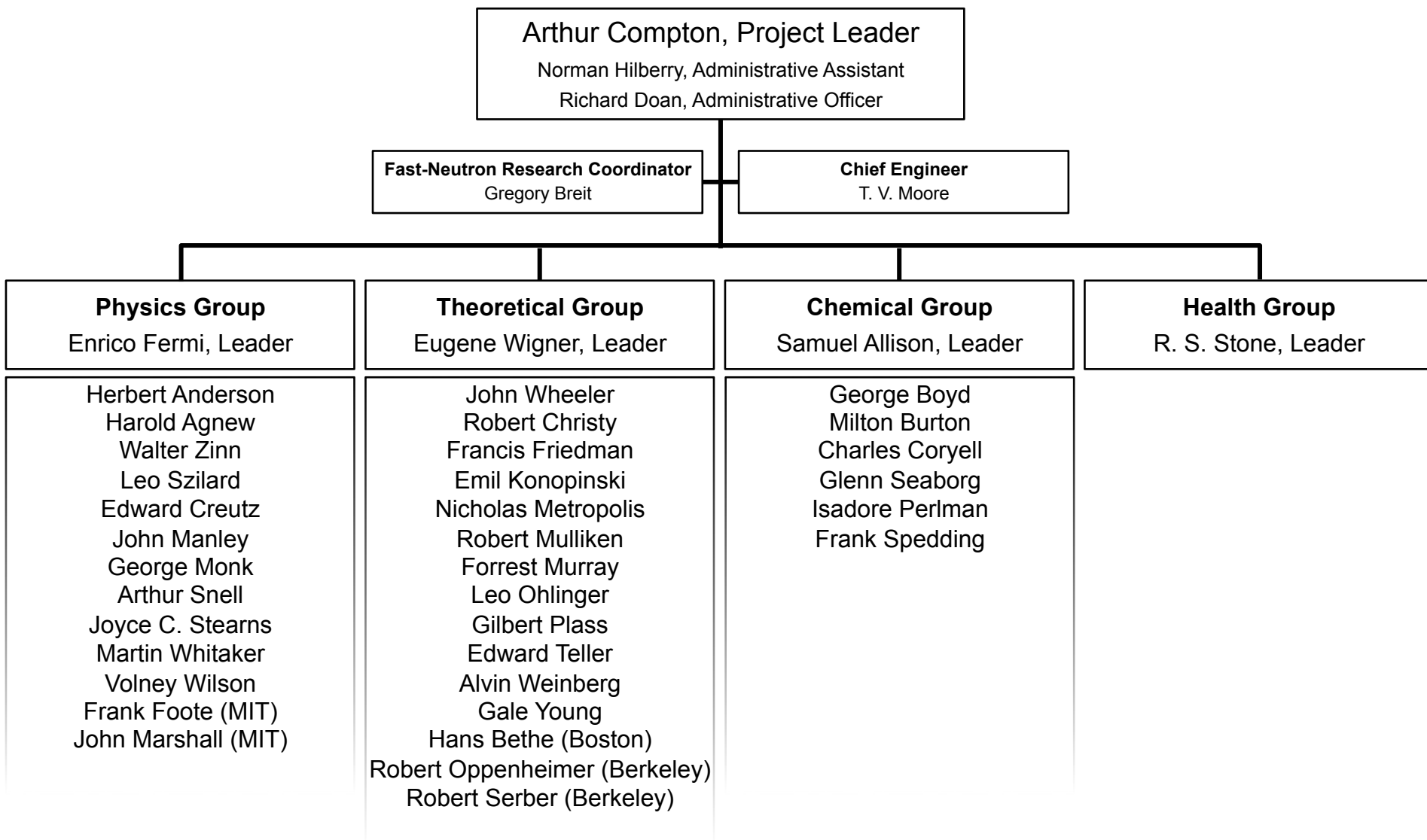
- Supervised theoretical physics and reactor development
- Supplied Chianti for celebration of first controlled nuclear chain reaction at CP-1
- Responsible for design of Hanford production reactors
- Member, New Piles Committee
  - April–July 1944: Identification, evaluation, and discussion of possible reactor types



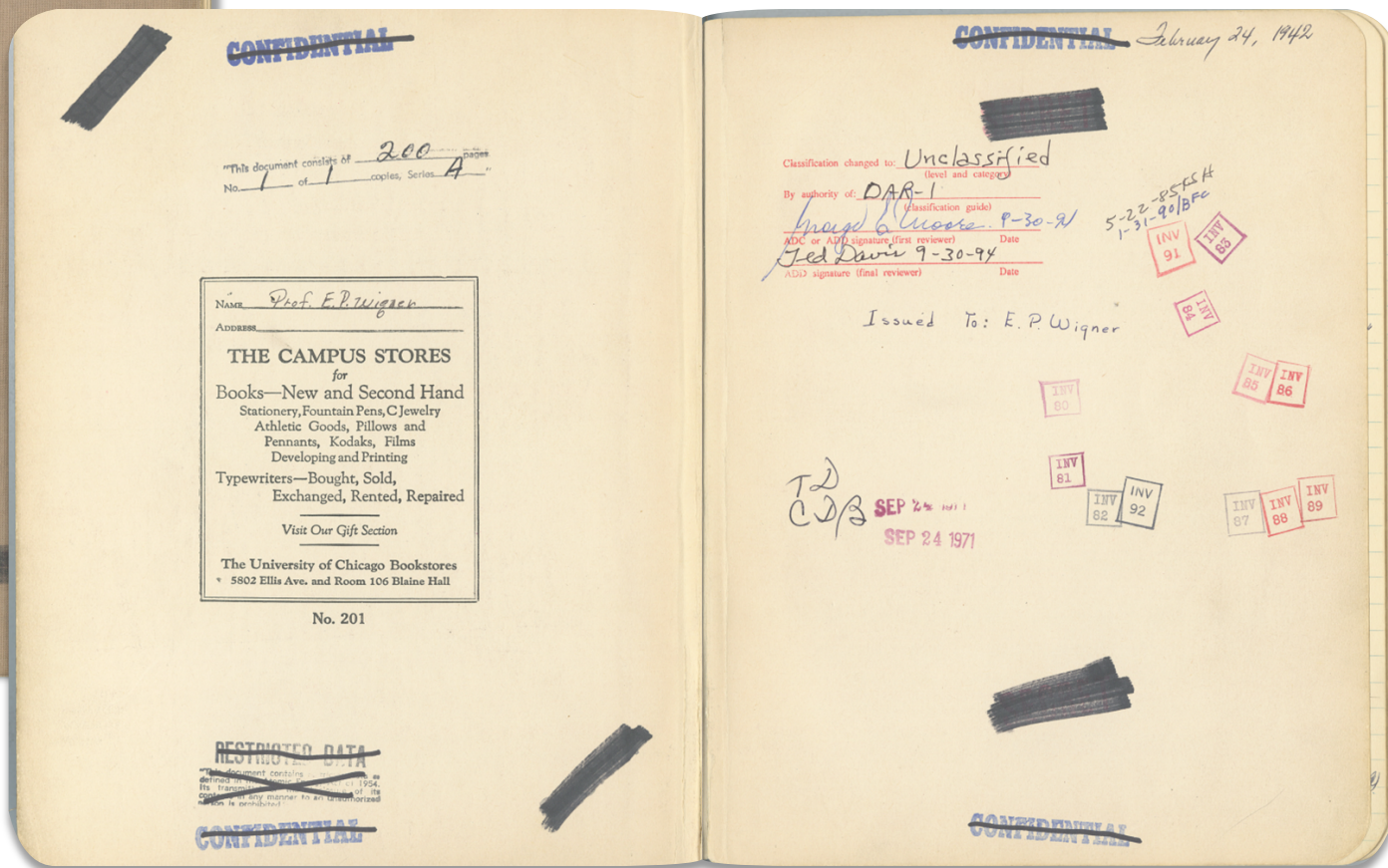
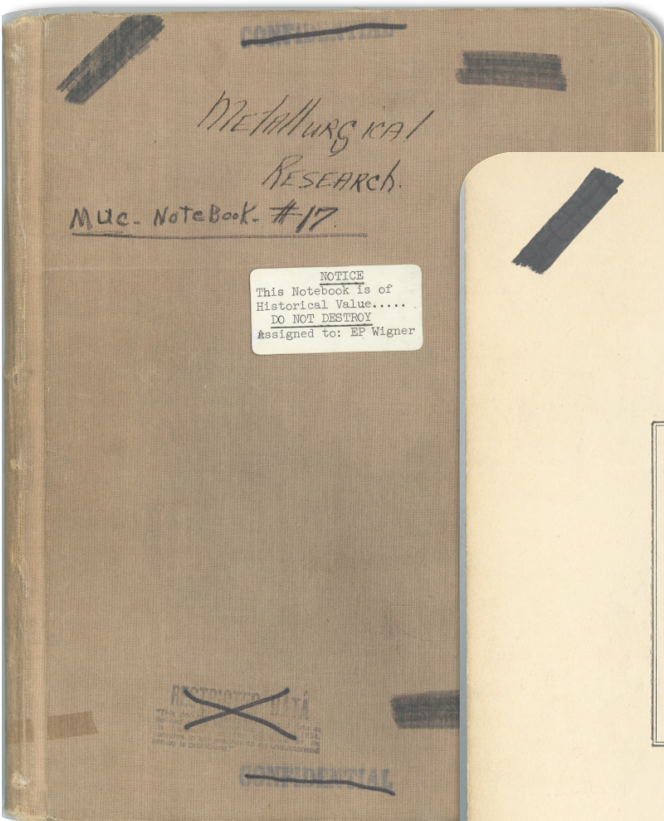
“... of all the people assembled, Wigner was unique in possessing a complete command of nuclear physics, immense mathematical power, an aptitude and liking for detail engineering, a powerful grasp of chemistry, and, perhaps most important of all, an unmatched zeal and sense of responsibility”

– Alvin Weinberg

# Metallurgical Laboratory organization



# Wigner's notebook provides a closer look at many project details



# 24 February 1942

## Problem identification

1

Feb 24, 1942, AHC, Fermi, Allison, Seland, Wigner.

Intermediate Expt. "Problem 2" felt

- Calculation of intermediate expt. See Wheeler about Wien
- What kind of dies? big

March 27. Measurements completed under Mitchell.

New pile to be built by Whitaker.

Absorption of Bi "Problem 2"

~~Proposed~~ Fermi in charge, Snell to work

March 27. Assigned to Mitchell. To be made by the radioactivity produced.

Delayed Neutrons "Problem 3"

Preliminary Result: altogether 29%, life time at end 40"

Snell in charge, Fermi responsible.

March 27. Assigned to Mitchell. Snell + Metzger work, Ibsen analyzes.

$\gamma$ -rays from irradiated U. "Problem 4"

$\beta$ -rays " " " " " "

Fermi in charge. Borst to work on it.

March 27. Assigned to Mitchell. Borst + Sayvitz work. Report next week.

- AH: Arthur Holly Compton
- Problem 2:  
Absorption of Bi
  - Fermi in charge, Snell to work
  - March 27: Assigned to Mitchell.
- Problem 4:  $\gamma$ -rays and  $\beta$ -rays from irradiated U
  - Fermi in charge. Borst to work on it
  - March 27: Assigned to Mitchell. Borst and Sayvitz work. Report next week.

# 25 February 1942

## Searching for a theorist

51

A.H., Van Vleck, Breit, Seiard, Wigner  
Christy Were discussed as candidates as  
Snyder for an additional theoretical man.  
Kripp Possibly two men needed, one to  
Schwinger make more elaborate calculations  
Ingles on exponential pile, the other for  
Hurwitz general purposes.

February 25, 1942

(Christy is Canadian.)  
Saw Christy among about. Makes good impression,  
quiet. Worked on cosmic rays; understands that  
subject well. Also worked on X-ray line  
energies though kept far from experiments. Now  
somewhat interested in a.c. electron multipliers,  
for Copeland. Not too exciting man but seems  
to be able to make calculations independently.

Made extremely rough estimate of number of  
counts of  $C^{14}$  after 1 mo irradiation under con-  
ditions similar to those at Princeton. Result about  
1 count/min.

Wheeler thought that Weinberg is not suited  
for calculations on exponential pile as we want  
them to be made. Mentioned Critchfield, was  
quite enthusiastic for Schwinger. Made some  
additions to his early report on resonance  
absorption in library.

- “Probably two men needed”
  - One to make more elaborate calculations on an exponential pile
  - One for general purposes
- Wheeler’s opinions:
  - Weinberg is “not suited for calculations on exponential pile as we want them to be made”
  - Mentioned Critchfield
  - Was quite enthusiastic for Schwinger



# 8 June 1942

## Organizational changes

- Hilberry says:  
New operating committee
  - Briggs, Bush, Conant, Compton, Murphree, Lawrence, Urey
  - An Army general, Steyr?
- New chemistry organization
  - Ames Project: Chemistry and Metallurgy of 92 and 94
  - Princeton Project: Analytical Methods
  - California Project: Properties of 24, Search for 49

32

Spedding + Hilberry on analysis. The pure oxide does not attack the porcelain and can be reduced to  $UO_2$  in porcelain crucibles.

$Bi$  and  $U$  form  $UBi_2$  forms at higher temperatures. The cooling cracks in fused  $UO_2$  are quite serious.

~~Two~~ grove

Chemistry Organization Chart

S.K. Allison

Allison, Seaborg, Spedding, Teller, Wheeler, Compton, Dean, Fermi, Moore; Turman, Latimer; Rodden, Spiland, Thiele, Urey.

Spedding

CI Materials Research and Testing — G.E. Boyd

CI Effects of Radioactive Emanations on Materials

M. Barton

CIII. Preparation of Compounds

H. N. McCoy

CIIV. Chemistry of fission products

E.D. Coryell

Ames Project; Chemistry and Metallurgy of 92 and 94

Wilhelm

CI V. Chemistry of 49

S.T. Seaborg

Princeton Project Analytical Methods

H. H. Turman

California Project Properties of 24, Search for 49

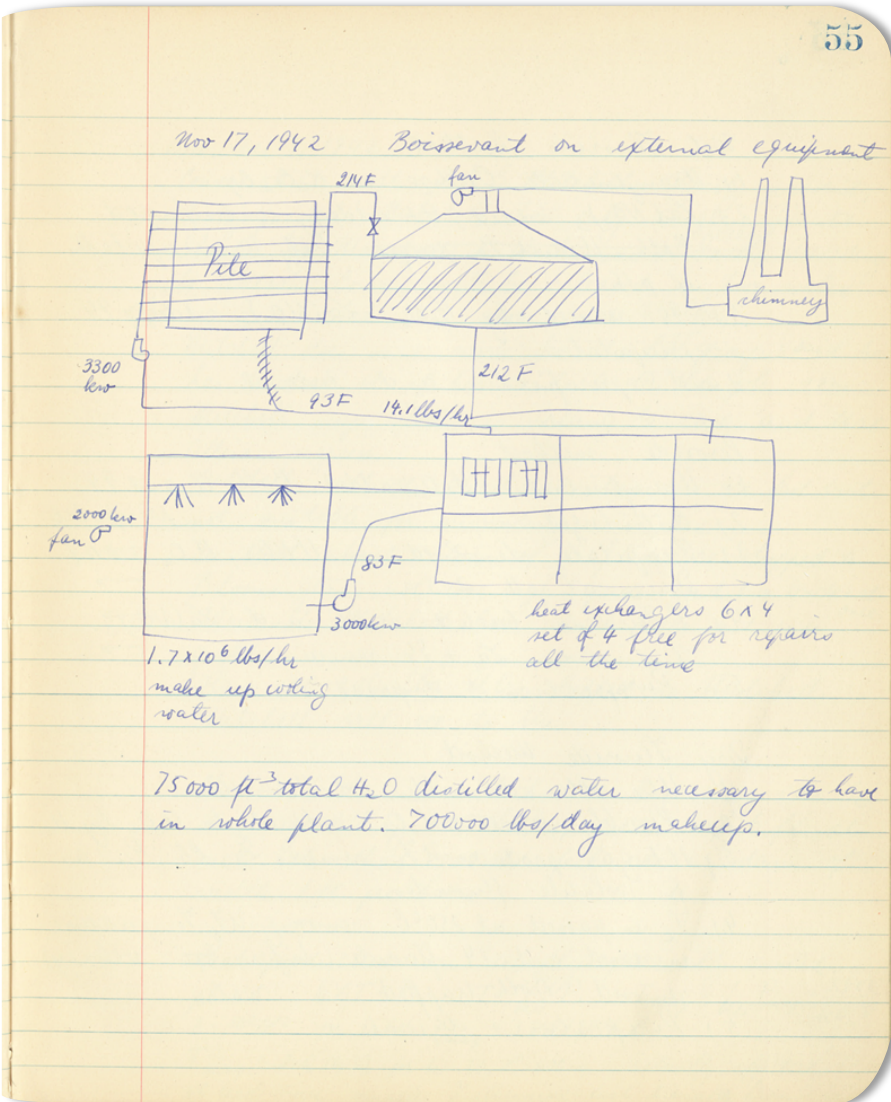
J. Latimer

CI VI. Neutron absorption of impurities in  $U$

H. L. Anderson

Dean about desirability and undesirability of patents.

# 17 November 1942 Sketch of Hanford reactor



75,000 ft<sup>3</sup> total H<sub>2</sub>O distilled water necessary to have in whole plant. 700000 lbs/day makeup.

B Reactor site, 1944



# Wigner's notebook does not mention first criticality at Clinton in 1943



# 29 April 1944

## Notes on "Snell experiment"

102

Analysis of ~~concrete~~ cement. Cf also LM 136, CP-718  
 SiO<sub>2</sub> Al<sub>2</sub>O<sub>3</sub> Fe<sub>2</sub>O<sub>3</sub> CaO MgO SO<sub>3</sub> alk  
 22% 7 3 63 2.5 1.7 .8% 1<sup>st</sup> anal  
 21% 6 6 5 2% 2<sup>nd</sup> regulat<sup>ion</sup>?

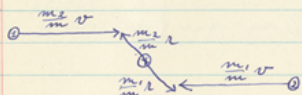
Ignition loss insoluble  
 1.5% .2% 1<sup>st</sup> anal.

### Coulomb Scattering Formulae.

1. Center of mass system.

$$m_1 + m_2 = m$$

$$\frac{m_1 m_2}{m} = \mu$$



$v$  total relative velocity

$r$  " distance.

$\frac{m_2}{m} v$  velocity of particle 1 with respect to center of mass

$\frac{m_1}{m} v$  " " " 2 " " " " "

$\frac{m_2}{m} r$  distance " " 1 from center of mass

$\frac{m_1}{m} r$  " " " 2 " " " " "

$v_r$  projection of velocity  $v$  in direction of other particle

$v_\phi$  " of velocity  $v$  perpendicular to  $v_r$ .

$E_c$  energy in center of mass system.

$M_c$  angular momentum in center of mass system.

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$$\frac{1}{2} \mu (v_\phi^2 + v_r^2) + \frac{e^2}{r} = E_c; \quad \mu r v_\phi = M_c$$

$$v_r = dr/dt \quad v_\phi = r d\phi/dt; \quad s = \frac{1}{r}$$

$$\frac{M_c^2}{\mu^2} s^2 + \frac{M_c^2}{\mu^2} \left(\frac{ds}{d\phi}\right)^2 = \frac{2E_c}{\mu} - \frac{2e^2}{\mu} s$$

$$\phi = \int^s \frac{ds}{\sqrt{2E_c \mu / M_c^2 - 2e^2 \mu s / M_c^2 - s^2}} \quad (1)$$

$$\phi = \arcsin \frac{e^2 \mu + s M_c^2}{\sqrt{2E_c \mu M_c^2 + e^4 \mu^2}} + \text{Const.} \quad (2)$$

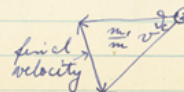
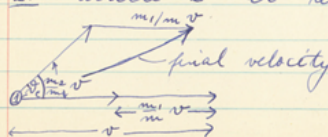
For the half angle of deflection,  $\frac{1}{2} D_c$ , the above integral has to be taken from  $s=0$  if the particles come from infinity, to the value of  $s$  which makes the denominator zero. This gives

$$\text{Arc} \frac{1}{2} D_c = \frac{\pi}{2} - \arcsin \frac{1}{\sqrt{1 + 2E_c \mu M_c^2 / e^4 \mu^2}}$$

$$\text{ctg} \frac{1}{2} D_c = \sqrt{\frac{2E_c M_c^2}{e^4 \mu}} = \frac{\mu v^2 R}{e^2} \quad (3)$$

$R$  is the <sup>smallest</sup> distance between the particles if they were moving without interaction.

2. Particle 2 at rest, particle 1 approaching it.



# April 1946: Why Wigner accepted a position at Clinton

- Clinton Laboratories will be important “in the life of the whole nation”:
  - One of three or four well equipped nuclear research laboratories in the world
  - One of two which carry out work on chain reacting piles
- “It seems to me that the importance of these laboratories can hardly be over estimated”

Palmer Physical Laboratory  
Princeton University  
April 26, 1946

G.M.W.

G. M. Weinberg:

Many people, particularly here in Princeton, have asked me what I had in mind when I accepted a position at Clinton Laboratories and asked for a leave of absence from Princeton. Of course, all such decisions have many components and it is probably impossible to give an entirely fair account of them. I will try to do the best though on these pages.

The principal consideration which was in my mind concerned the extreme importance which Clinton Laboratories are playing now and will have to play for some time in the life of the whole nation. It is one of three or four well equipped nuclear research laboratories in this country and one of two which carry out work on chain reacting piles. It seems to me that the importance of these laboratories can hardly be over estimated. It must be assessed not only from the point of view of the work they carry out themselves but also from the point of view of the help which they give other laboratories with which they should form a community of research institutions later.

This at once brings me to the first point in which I will try to exert some influence. The relation of the nuclear physics laboratories, which are now in full operation, to each other and to the other research institutions, particularly to the universities, should be made closer and more cordial. We must not refuse to make sacrifices to further this purpose. There is evidently no single measure which can achieve this, but there are probably a great many ways which can contribute toward it. The first one which we will attempt is connected with the training program which Dr. Seitz is going to start in the fall. He gave a talk to you about this program so that I need not go into details about it. As matters now stand, it is likely that industrial institutions will participate in the training program perhaps even more intensely than universities although there is considerable interest on the part of universities also. The second way which I have in mind is to foster personal contacts between Clinton Laboratories and the outside world. Invitations to speakers from other institutions, more lively participation in meetings, publication of publishable declassified material - all fall into this category. Perhaps even more important than these is a concrete help on the part of Oak Ridge to get the nuclear laboratories at universities, etc. going. The most direct single step that we can take in this direction is to design a useful neutron source for them which can be installed at not too high a cost and in the not too distant future.

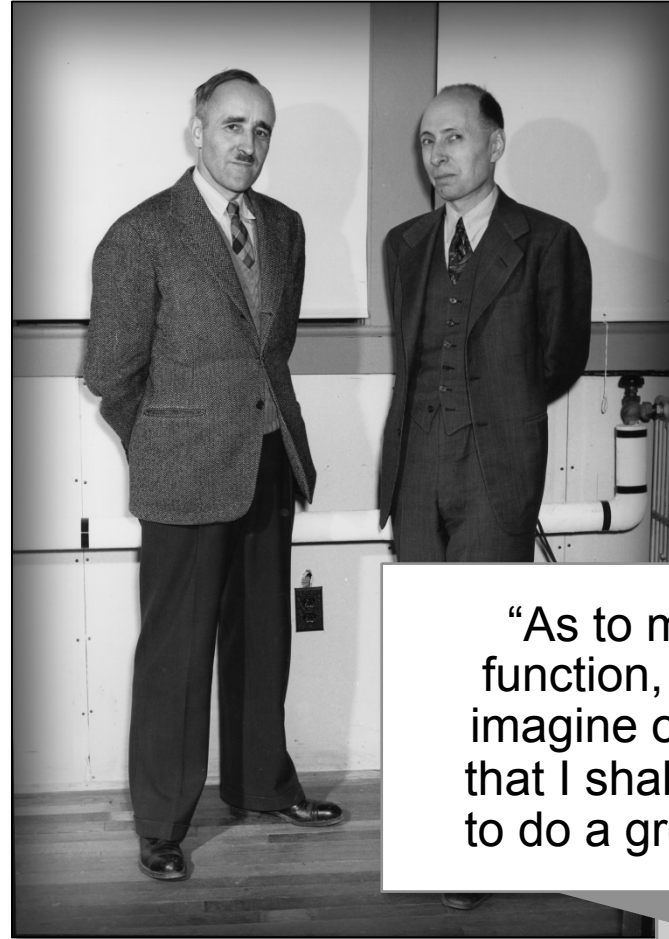
These were some measures by which we may contribute to the revival of nuclear physics throughout the country. I believe that Oak Ridge will also strongly profit from these measures through the contacts which it will make. We must not forget, however, that at least until the other laboratories start

# Where Wigner hoped “to exert some influence”

- Establishing relationships with other institutions  
“to revive nuclear physics in this country”
  - Training program
  - Outreach: Invited speakers, conference presentations, publications
  - Concrete help to universities in setting up nuclear laboratories, including design of “a useful neutron source for them”
- Keeping Oak Ridge alive as a strong research center:
  - Only too much have both Chicago and Oak Ridge lived in the past on fundamental knowledge that has been acquired either before the war or at one of the other government research centers.
  - As these wells begin to run dry, this situation becomes increasingly unhealthy and we must try our best to contribute to the foundations of our knowledge.”

# Wigner's plan for laboratory administration

- Monday: Official duties
- Tuesday: “Do technical work and keep my knowledge alive”
- Wednesday–Friday:
  - I hope to be one of you with whom you discuss your scientific problems if you think that I can help
  - I will see you if I need help from you

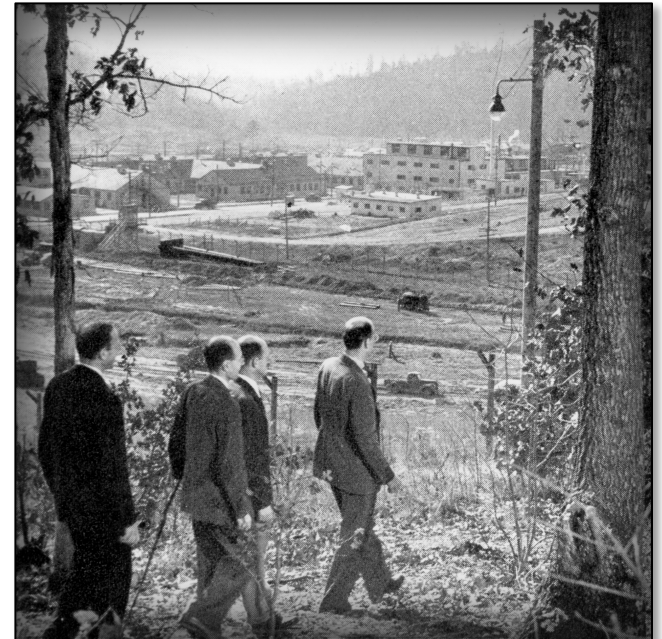


“As to my own function, I do not imagine of course that I shall be able to do a great deal”

# Monsanto Chemical Company

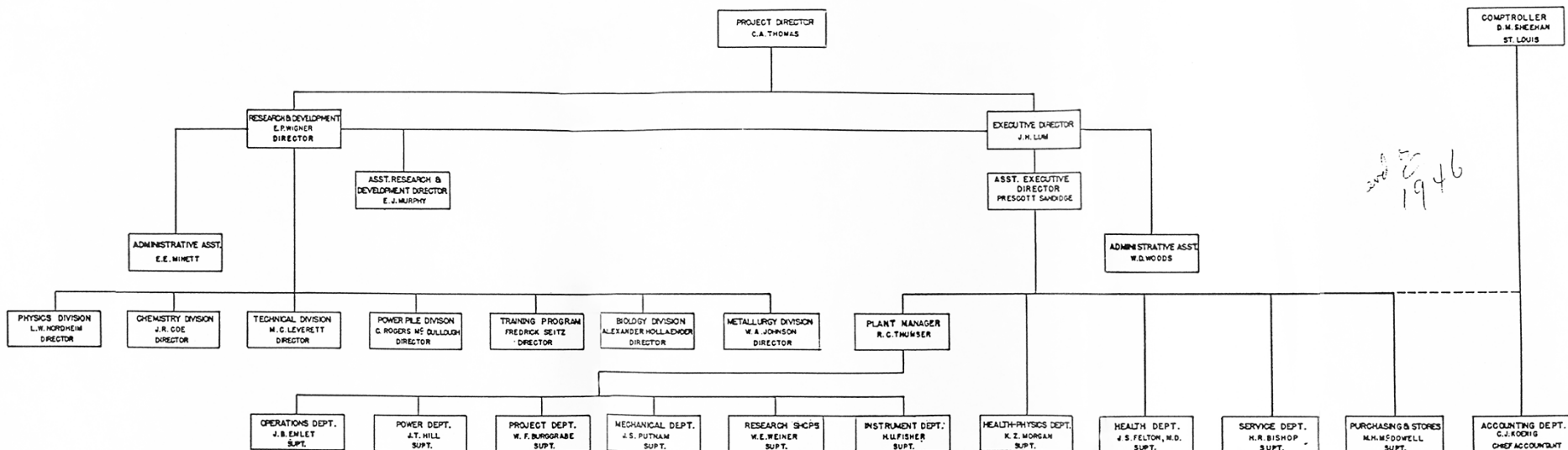
- Manhattan Project role: Chemical separation of polonium from bismuth irradiated at Clinton Laboratories
- At Clinton Laboratories: Succeeded University of Chicago as operating contractor on July 1, 1945
  - Expected a substantial role in nuclear power development
  - Contract expired after AEC decided against building a high-flux reactor at Clinton

Clinton Labs, 1946: Frederick Seitz, program director; James H. Lum, executive director; Eugene Wigner, research director; Alexander Hollaender, recruited as director of new Biology Division





# Monsanto at Dogpatch



200 50  
1946



Al Capp

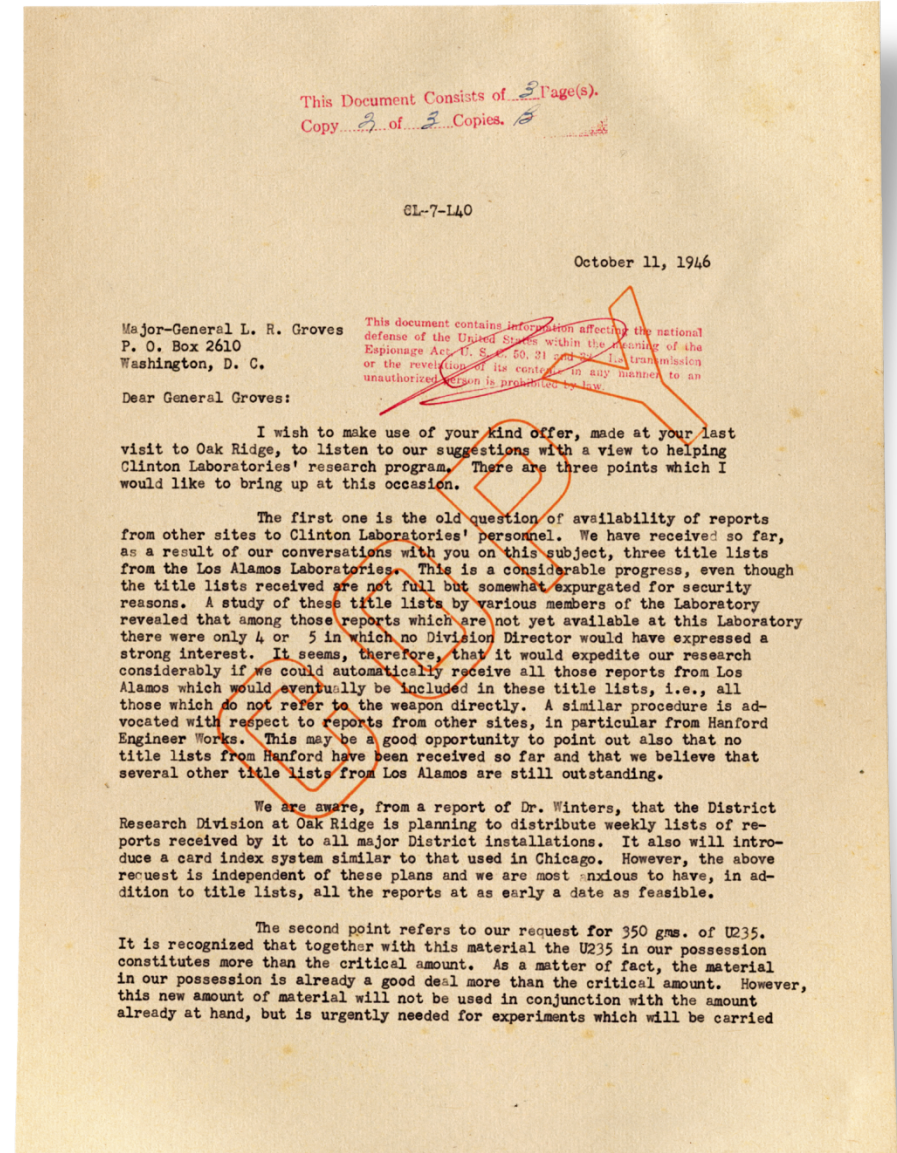
1946

ORGANIZATION CHART					
MONSANTO CHEMICAL COMPANY CLINTON LABORATORIES KNOXVILLE TENNESSEE					
1946 8-14-46	200 50 8-14-46	A 342 8-15-46	EPD 8-15-46	ES 8-15-46	
REV. 8-14-46 REV. 11-4-46					E-1097

# Conflicts with bureaucracy: Army oversight

## Wigner to Groves, October 1946

- The “old question of availability of reports from other sites to Clinton Laboratories’ personnel”
- Our request for 350 gms. of U235, “urgently needed for experiments”
- Future procedure in carrying out criticality experiments:
  - “The conditions which would result from adhering to the regulations of your letter and their interpretation by Colonel Leber would make it practically impossible to carry out critical experiments”



# Conflicts with bureaucracy: No improvement under AEC

- January 1947: Atomic Energy Commission assumes responsibility for national laboratories
  - Walter J. Williams, a civilian employee of the Army Corps of Engineers, is named AEC director of field operations
  - Colonel Walter Leber is Williams's representative at Clinton Labs
- March 1947: Critical experiments at Clinton are halted at the insistence of the AEC, despite Wigner's protests
- As reported in the official history of the AEC:
  - For Wigner and the Monsanto organization, the incident shook their confidence in the future of the Clinton Laboratories
  - Could hope the dispute was an isolated incident provoked by the transfer from Army to Commission control, but it could also be a forecast of more trouble ahead

“Oak Ridge at that time was so terribly bureaucratized that I am sorry to say I could not stand it”

# Wigner's decision to return to Princeton

“ While the future organization of Clinton Laboratories is still in a state of flux, I am happy to express my firm conviction that the future of the Laboratory as a research institution and as a development center is not in doubt . . . .

What the exact status of the Laboratories will be in the future depends primarily on you and on your contributions and initiative. It is particularly important at present that you do not lose faith in the future of our institution and that you continue your work during this somewhat trying period with the same vigor and industry that you have shown in the past.

Wigner's tenure as Laboratory Director had last for one year:  
June 1946 - June 1947



Eugene Wigner  
Memo to group leaders,  
May 24, 1947

# Matters did not improve after Wigner's departure

Scientists thought that Monsanto was unsuitable to remain contractor of Clinton Laboratories

1. Industrial companies certainly have an eventually important part in the development of atomic energy. They should, however, be brought in at the proper time and place, and with proper attention to their abilities. One would probably not give the Coca-Cola company a contract to work on steam turbines, and it is similarly ridiculous to put Monsanto in charge of neutron physics.

5. Monsanto has just lost about 10% (?) of its assets in the explosion at its Texas City plant, and will presumably be too preoccupied with this loss to be given important new responsibility in atomic work.

6. A company which has just killed 5% (?) of its employees with simple chemicals should hardly be encouraged to fool around with atomic energy of which it is completely ignorant.

Almost certainly Gale Young (not Wigner like!)

# Christmas 1947: “Black Christmas”

Decisions regarding future of Clinton Laboratories went against hopes and aspirations of scientists:

- Carbide Corporation to replace Monsanto as contractor not University of Chicago
- Reactor work would be transferred to Argonne

In Oak Ridge reaction was predictably negative:

Despite the bad start to the post Wigner era, Wigner’s contributions to the future of the, soon to be renamed, Oak Ridge National Laboratory were real and lasting.

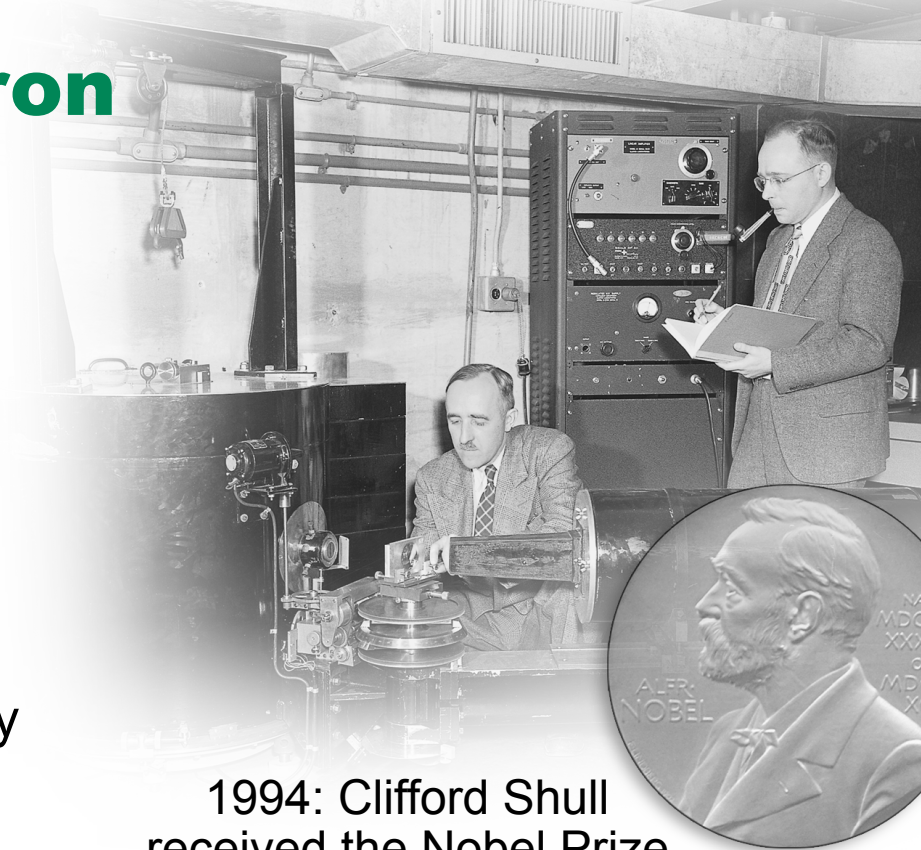
# Accomplishments at Clinton under Wigner's direction

- Reactor development
  - Daniels pile (never constructed, but inspired work on coated particle fuels and high temperature gas-cooled reactors)
  - Materials Testing Reactor, constructed at the National Reactor Testing Station in Idaho (now Idaho National Laboratory)
- Initiation of radioisotope production program
- Formation of new organizational units
  - Biology under Alexander Hollaender
  - Health physics under Karl Z. Morgan
  - Metallurgy under William A. Johnson
- Key hire for future computing: A. S. Householder
- Operation of the Clinton Training School
  - Directed by Frederick Seitz
  - Inspired Oak Ridge School of Reactor Technology, 1950–1965



# Foundations for neutron scattering research were laid at ORNL

- Nuclear reactors provided neutron beams of sufficient intensity to enable quantitative measurements of scattered neutrons
- Ernest Wollan and Clifford Shull used the Graphite Reactor to systematically establish neutron diffraction as a quantitative research tool
  - Fundamental principles of elastic neutron scattering
  - Application to important problems in nuclear physics, chemical crystallography, and magnetism



1994: Clifford Shull received the Nobel Prize in Physics for the development of neutron scattering techniques to analyze condensed matter





# Isotope production and research became a major activity for ORNL

First isotope shipment from Oak Ridge (carbon-14 to Barnard Hospital in St. Louis)

1946

ORNL makes >100,000 shipments of radioisotopes annually

1960s

1966

ORNL focuses on specialty isotope research and production

1970s–present

High Flux Isotope Reactor begins operations



20 mg of ultrapure Bk-249 used in discovery of element 117

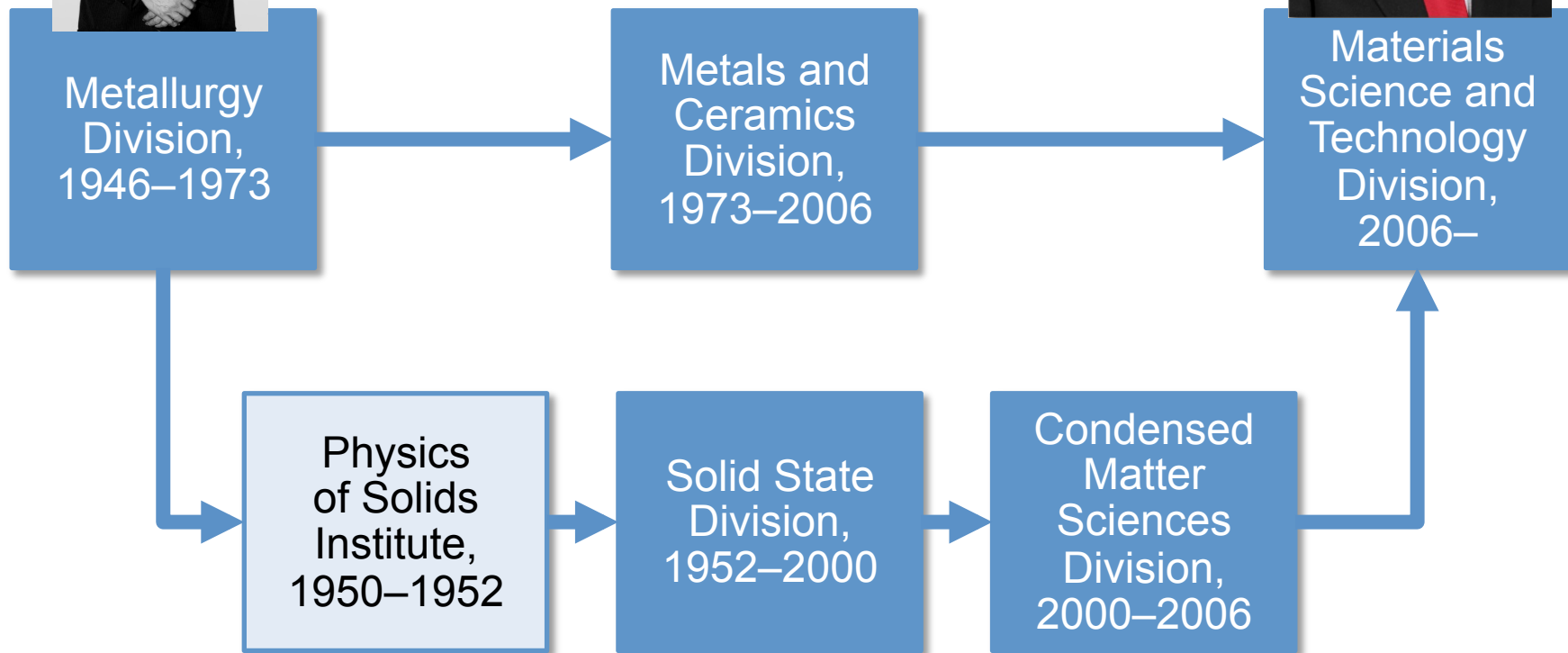
# Metallurgical research has remained a signature strength of ORNL



W. A. Johnson  
1946-1949

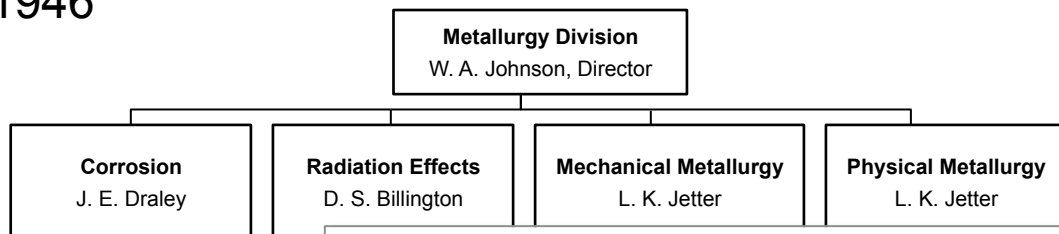


G. E. Ice  
2010-Present

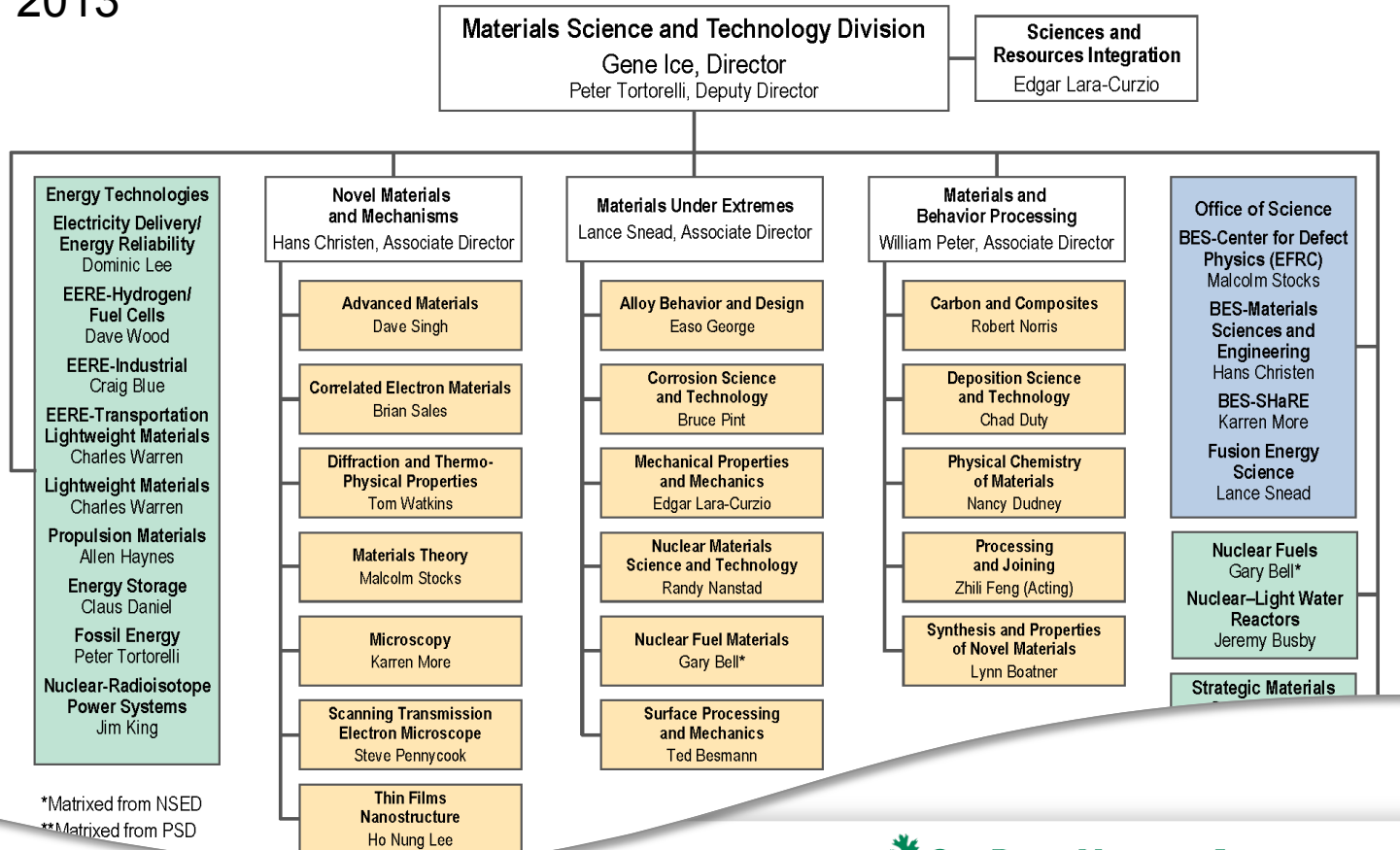


# Today's structure is more complicated

1946



2013



\*Matrixed from NSED

\*\*Matrixed from PSD

# Clinton Training School



Not pictured: 9 Navy officers, including Captain Hyman Rickover, whose attendance at the school was classified

# Wigner continued a close association with Oak Ridge

- Consultation and correspondence with Alvin Weinberg
  - Member of Wigner's Theoretical Group at Chicago
  - Followed Wigner to Clinton and succeeded him as research director
  - Director of ORNL, 1955–1973
- Specific assignments
  - Project Hope
  - Civil defense



# Wigner returned to Oak Ridge in 1949 for an AEC information meeting

- Weinberg persuaded Wigner "to participate in a round table discussion on nuclear reactors"
- Wigner expressed his hope that the recent announcement of a Soviet nuclear device would renew interest in reactor development
- Soon afterwards, he signed a contract to consult with ORNL



## NEWS

### OAK RIDGE NATIONAL LABORATORY

A Publication By and For the Employees of the Oak Ridge National Laboratory

Vol. 2—No. 19 OAK RIDGE, TENNESSEE Friday, November 4, 1949

#### Physical Waived For Group Insurance During November



**LINK ORNL, PAST WITH PRESENT**—Dr. Alvin M. Weinberg, left, Research Director of Oak Ridge National Laboratory, exchanges pleasantries with Dr. Eugene P. Wigner, former Research Director at ORNL, during interlude at the Information Meeting, Dr. Wigner, Professor of Physics at Princeton University, was associated with the Laboratory from June 1946 until June 1947.

A laboratory-wide campaign began this week to reach everyone with the information that permission has been granted to re-open the Group Life, Sickness, and Accident Plan with a waiver of physical examination or statement of health requirements during the month of November to those employees who are not presently participating. During this month the insurance becomes effective for each eligible applicant on the date the group insurance enrollment card is signed while the employee is actively at work, or becomes effective on the first day that the applicant returns to work. Those eligible to subscribe during this period include all who have been employed more than 31 days after having completed three months of Company service and who have not as yet subscribed to the plan or having become eligible. The Group Insurance Plan with its three-fold provisions of life, sickness, and accident benefits is underwritten by the Metropolitan Life Insurance Company and is available to employees of Oak Ridge through cooperation between employees and the Company. The employees pay part of the cost, and the Company pays part of the cost of the insurance, as well as the necessary expenses of the administration of the Plan. Through participation in the Group Insurance Plan an employee may provide a substantial sum of money for his family in event of his death. He may provide for himself an income during any period of disability caused by sickness or accident, either on or off the job, in accordance with the terms of the contract. Also contained in the contract is a provision that should the employee become totally and permanently disabled, the insurance would become payable to him in monthly installments. All these benefits are available at a small cost to the employee.

For information regarding the privilege of enrolling this month with the waiver of physical examination or statement of health and secure provision for yourself and family which begins at time of enrollment, see E. S. Spaulding, of the ORNL Insurance Office, Room 112-C, Engineering 702-C, telephone number 6648. It is hoped that all eligible employees will become participants in Group Insurance Plan.

Note—A chart of the Group Insurance Plan's benefits, cost, etc., appears on Page 3, never right hand corner.

**TO OBTAIN NEW DIRECTORIES**—It has been announced by E. P. H. that new directories will be distributed, that employees may obtain directories from their supervisors in their respective divisions.

#### Lab Laundry Employees First In Chest Drive Participation

Employees of the ORNL Laundry have gone over the top again! 100%! Imbued with the spirit of generosity that is so characteristic of Laboratory personnel toward worthy causes, all of the Laundry group had by Monday of this week contributed to the Red Feather two-weeks campaign for Community Chest funds, thus making them first among all Laboratory groups to participate 100 per cent in the campaign. The campaign, which was started on Wednesday of last week, is scheduled to end on Wednesday of next week.

W. N. Woodruff, Chairman of the ORNL drive for the Chest funds, reports that this is the second time this year that the Laundry group has made such a record. They were also first among Laboratory groups last spring in participating 100 per cent in the Red Cross campaign.

Following the Laundry workers closely in "going all the way" for the Community Chest was the Night Janitors crew. Mr. Woodruff reports:

Names of the employees composing these two groups are listed as follows: Laundry: C. B. Wells, J. B. Coleman, W. F. Wilson, W. O. Hicks, Nelson Moore, T. A. Boucher, M. H. Lusk, W. C. Williams, M. S. Carter, C. W. Whitson, V. L. Moore, Marie Battle, L. May, T. M. Davies, N. F. Henderson, Emma Mitchell, Gladys Hattigee, M. H. Jacob, L. W. Brown, L. E. Hicks, and W. L. Brown; Night Janitors: D. J. McDavoy, M. A. Griffin, R. H. Dunaway, C. Cole, J. L. Collins, S. Thomas, L. White, S. H. Lyons, E. E. Ferguson, H. E. Taylor, L. H. Mings, S. Montgomery, H. A. Montgomery, and J. Harris.

A substantial boost to the recent Community Chest Drive came as a result of an official announcement received by Mrs. Dana W. Nason, general chairman, that the Carbide and Carbon Chemicals Corporation's 1949 donation would be \$2,000.

According to the information gathered by the chairman and others directly concerned with the ORNL Red Feather drive, total donations from employees here will far exceed the \$4,000 quota set for the Laboratory. This information has been made known to students and the general public which is cordially invited to also contribute.

Aubrey J. Williams, Chief of the TVA Navigation and Transportation Branch, will speak on "Obtaining" at the next seminar, which is to be held Saturday, November 12.

**Chemistry Dance Tonight**—The Chemistry Division will hold its first big dance tonight at 8 o'clock at the Oak Ridge Golf and Country Club. Music will be supplied by Bill Dexter's orchestra, and drinks will be optional. Admission is \$1.50 per couple. All Chemistry Division personnel are invited and may bring guests.

#### Science Meetings

**OAK RIDGE PHYSICS SEMINAR** at 4 p. m., Friday, November 11, in the East Lounge of the Ridge Recreation Hall. Hyperspectral Spectroscopy, Dr. J. Hand McNelly, Jr. of the X-12 Isotope Physics Group.

Hyperspectral spectroscopy is concerned primarily with high resolution problems of atomic spectra and is investigated experimentally by crossing interferometric equipment with moderate dispersion spectrographs. Information can be obtained about such properties as nuclear spins, nuclear magnetic moments, and nuclear quadrupole moments from the hyperfine structures of spectrum lines. Important contributions through such research are being made which should assist in the evaluation of the various theories of nuclear shell structure.

**BIOLOGY SEMINAR** at 3:30 p. m., Thursday, November 10, in the Conference Room, third floor, Building 2027. The Relationship Between Vitamin B Factors and the Thyroid on Respiratory Enzyme Sensitivity. Dr. Samuel R. Taylor, Department of Zoology, University of Tennessee.

**CHEMISTRY SEMINAR** at 3:15 p. m., Wednesday, November 9, in the Chemistry Lounge, Building 706-A. Plans for the New Chemistry Division "Hot" Laboratory. Dr. H. A. Levy and G. W. Fisher.

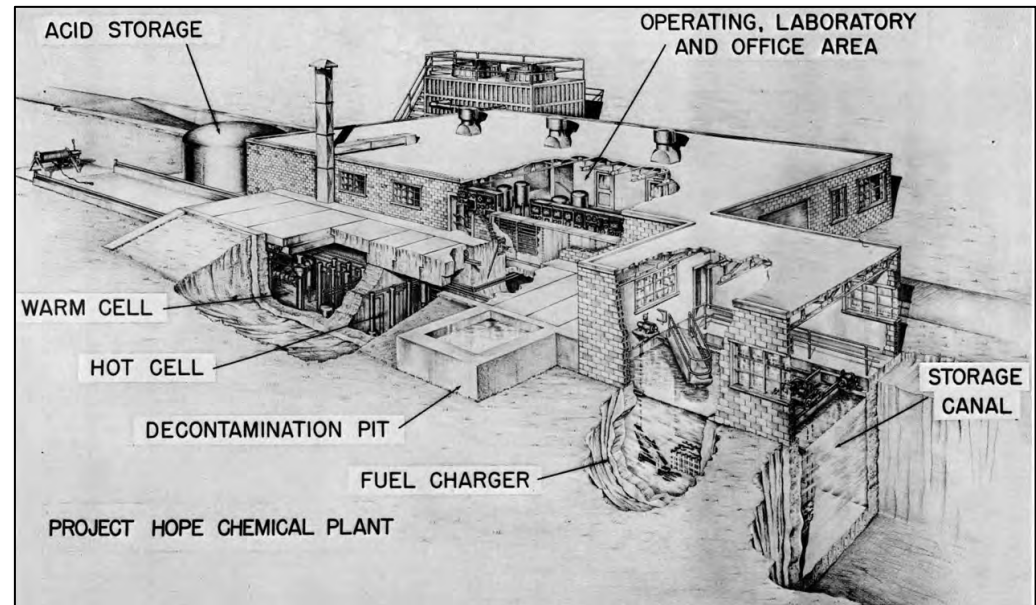
**SOCIETY OF SIGMA XI MEETING** at 8 p. m., Friday, November 4, in Room 203, Daley Hall, University of Tennessee. Results of investigations of the Physiology of Reproduction.

#### Safety Scoreboard

Your Laboratory Has Operated **4 Days** Without a Last Time Injury Through October 30

# Project Hope, 1953–1954

- Design of a radiochemical plant for reprocessing of spent fuel elements
  - Integrated process separated all nuclear materials at a single site
  - Cost of recovered U-235: \$1/gram, vs prevailing cost of \$7.50/gram for uranium from ore
- Because the plant would have competed with private industry, the AEC elected not to proceed
- Positive outcomes cited by Robert A. Charpie, assistant director of ORNL:
  - DuPont request for assistance with Savannah River Project
  - “Generation of a large amount of enthusiasm on the part of the metallurgists and chemical engineers” for developing new waste disposal techniques
  - ORNL’s ecology program



# Graphite Reactor shutdown, 4 November 1963

## Wigner was an honored guest



A Publication for the ORNL Employees of the Nuclear Division of Union Carbide Corporation

Vol. 16 — No. 19

OAK RIDGE, TENNESSEE

Friday, November 8, 1963

### Whirring of Control Rods Signals End of Graphite Reactor

#### Ford Foundation Grant Makes Possible Unique ORNL-UT Educational Program

A unique Oak Ridge National Laboratory—University of Tennessee arrangement made possible by a Ford Foundation appropriation promises to make available at UT graduate programs of the highest caliber in the sciences and engineering.

The \$750,000 appropriation will enable UT to employ, as part of its regular academic staff, outstanding staff members of the Laboratory, making possible a "unique opportunity to enrich the

UT Graduate School," according to UT President A. D. Holt who announced the appropriation yesterday.

Announcement of the Ford Foundation support was the culmination of a plan involving UT, ORNL, and the U.S. Atomic Energy Commission. Making possible the entire program, AEC agreed to release Laboratory staff members from 20 percent of their research responsibilities to teach at the University.

Immediate advantages of the new program are twofold. Offering very excellent graduate programs in the sciences and engineering will strengthen greatly UT and, resultantly, the educational standards of the south. Secondly, the program is expected to prove beneficial to ORNL, by providing a flow of young, able scientists and additional new ideas to the Laboratory.

The released time arrangement is described as "unprecedented" by officials of all three organizations, and it is hoped that the plan will be the forerunner of similar arrangements enabling research scientists employed by government and industry to join university staffs to strengthen educational programs throughout the nation.

A grant of \$200,000 from the Ford Foundation will make possible operation of the new program for the next two years, and it is expected that money from the appropriation.

Continued on Page 7

#### Four Participating In Reactor Meeting

Four Laboratory staff members are taking part this week in a Symposium on the Utilization of Research Reactors at the Georgia Institute of Technology. The symposium got underway yesterday and will continue through November 9.

H. A. Levy, Chemistry Division, is scheduled to discuss "Neutron Diffraction in Chemistry Research" during the session today concerning chemistry research.

R. K. Wilkinson, Solid State Division, will act as moderator of the physics research session scheduled for today. J. A. Harvey, Physics Division, will present during this session a paper entitled "Special Topics in Nuclear Physics."

Tomorrow morning Heinz Maier-Leibnitz, on temporary assignment with Director's Division, will discuss "The Resonance Program at the Technical University, Munich." Maier-Leibnitz is director of the Laboratorium für Technische Physik at the Munich, West Germany, university.



**PUSHING THE BUTTON** which shut down the historic Graphite Reactor for the last time is R. L. Doan, research director of ORNL at the time the reactor went off on November 4, 1963, less than a year after Enrico Fermi operated the first reactor at the University of Chicago. Watching the final shutdown are G. T. Seaborg, center, AEC chairman, and A. W. Warkentin.

#### R. L. Doan Pushes Button Which Ends 20 Years of Service

The whirring noise of neutron-absorbing control rods gliding along steel tracks signaled the end of the Graphite Reactor as it was put to rest last Monday after 20 years, 11 hours, and 13 minutes of faithful service.

A specially rigged galvanometer also dramatized the end seconds after R. L. Doan, one of the scientists present at the reactor's birth, pushed a button which actuated the control rods.

Among the dignitaries present for the shutdown ceremonies was E. P. Wigner, former Laboratory research director, who was notified before the same day that he was to share the 1963 Nobel Prize in Physics.

#### Packed House

Others jammed near, around, and on top of the reactor while Doan spoke on "Twenty Years Ago Today" in which he recounted some of the events of November 4, 1943 when the reac-

Continued on Page 2

#### Biology Information Meeting Scheduled for November 11-13

The Biology Division Annual Information Meeting, chaired by Alexander Hollaender, director of the Division, will be held November 11-13. Papers concerning re-

search of the Division will be offered Monday in the Large Conference Room, Building 9207, Y-12 Plant area, beginning at 9:30 A.M. Tuesday and Wednesday will be devoted to conferences with individual investigators.

The first papers to be offered concern studies in genetics and cytology. Speakers and their topics will be W. L. Russell, "Mammalian Genetic Studies"; H. F. Kimball, "Studies on Mutation and Cell Growth in Paramecium"; E. H. Y. Chu, "Cytological Effects of Ultraviolet Radiation"; E. C. von Borstel, "Cytological Localizations of the Primers and Products of the DNA and RNA Polymerases"; H. I. Adler, "Genetic Approach to Problems in Radiation Bacteriology"; and D. Lindley Jr., "Chromosome Behavior During Oogenesis."

Studies in immunology, physiology, and pathology will be considered in five papers. The papers scheduled for presentation are "Cytokinetics of Antibody Response," by T. Makinouchi; "Virus Isolation from Plasma and Neoplastic Tissues," by N. G. Anderson; "Cell Division and Organ Development," by A. H. Habber; "Transplantation of Hemopoietic and Lymphopoietic Cells," by Joan W. Goodman; and "Work of Pathology Physiology Section," by A. C. Upton.

The final papers covering research programs will concern biochemistry and biophysical studies. E. K. Jacobson will discuss "Amino Acid Acceptor RNA"; F. J. Finamore will offer "The Oligonucleotide Nature of Acid-Soluble RNA in Amphibian Eggs and Embryos"; and R. B. Setlow will

#### Nine ORNL Papers Scheduled for ACS Meeting Next Week

The members of the Advisory Committee for Biology are Erwin Chargaff, Columbia University; R. D. Hotchkiss, Rockefeller Institute, New York City; E. R. Stadman, National Heart Institute, Bethesda, Maryland; H. L. Hagan, University of Washington; and M. M. Watrobe, University of Utah.

The ORNL papers scheduled for Friday are "Volammetry and Chronopotentiometry of Iron in Molten Fluorides," by Grah Mamanov, ORNL consultant from University of Tennessee; and "Manning, Reactor Chemistry: Production and Isolation of Uranium-235," by R. E. Leuze and M. Chilton, both Chemical Technologists, at the Kinetics of the Pyrolytic Decomposition of Polyphenyl Hydrocarbons," by W. T. Rains, E. L. Yeats Jr., N. N. Hess, and H. F. McDuffie, all Reactor Chemists.

Five Laboratory papers will be offered Saturday. F. T. Kenney, Biology, will discuss "Mechanisms Involved in Enzyme Changes During Development." The other papers, all by Chemistry staff members, are "The Separation of Oxygen Isotopes," by S. Druy and A. H. Narten; "Concentration Dependence of Lithium Ionic Fractionation Factors in Ion Exchange Systems," by D. A. Lee; "Isotopic Fractionation in Amalgam Systems," by Donald Zucker; and "Isotope Effects in the Reduction of Some Inorganic Nitrogen Compounds," by L. L. Brown.

#### McCleary to Speak To Oak Ridge IEEE

The Oak Ridge Section of the Institute of Electrical and Electronics Engineers will meet Thursday, November 14 in the Green Room of the Ridge Recreation Hall beginning at 7:30 P.M. E. L. McCleary of the Specialty



McCleary

Control Department, General Electric Company, will speak on "Nuclear Control Today and Tomorrow." McCleary received his B.S. degree in physics from Monmouth College and did graduate work at the University of Illinois. He joined General Electric in 1948. While at General Electric McCleary has been involved primarily in the marketing, product planning and application aspects of instruments, adjustable speed drives, and since early 1958, in numerical control as manager of Program Control Sales.

#### Wigner Receives 1963 Nobel Prize

Former ORNL Research Director Shares Award



E. P. Wigner

One of Oak Ridge National Laboratory's most distinguished alumni and a former research director, E. P. Wigner, has been named to share the coveted 1963 Nobel Prize in physics.

Wigner, now a professor of mathematical physics at Princeton University, will receive half of the \$51,000 prize, while Maria Goeppert-Mayer, University of California, and Hans Jensen of Heidelberg, Germany will divide the other half.

A former director of research and development at ORNL in 1946-47, and already the holder of many of science's top prizes, Wigner was cited by the Swedish Royal Academy of Science for "his contributions to the theory of the atomic nucleus and elementary particles."

Mrs. Goeppert-Mayer and Jensen were honored "for their discovery concerning nuclear shell structure."

#### Plutonium Project

Wigner was a key member on a team of University of Chicago scientists who directed research

Continued on Page 2

- Presented an invited lecture on the future of nuclear science
- Learned the next day that he had been selected to receive the 1963 Nobel Prize in Physics



# Wigner was a passionate advocate for a strong civil defense program

Summer 1963

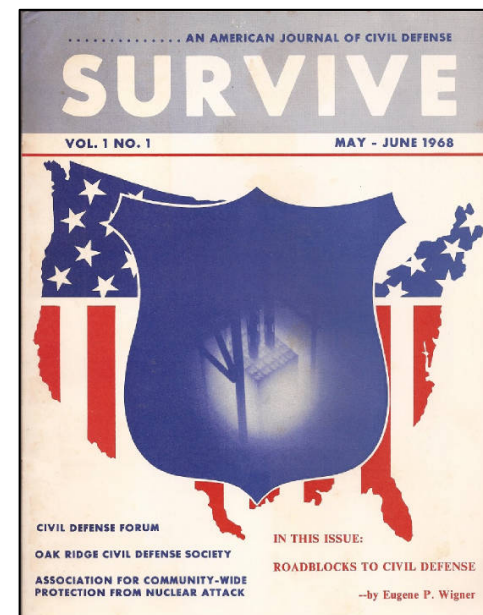
- Directed the 6 week Project Harbor study sponsored by the National Academy of Sciences
  - Engaged ~70 scientists, engineers, and statesmen, including Edward Teller, Herman Kahn, Willard Libby, and Chet Holifield
  - Produced a 1,000 page report calling for an expanded program, including blast shelters for large cities

1964–1965

- Directed Oak Ridge Civil Defense Project, spending 1 week a month at ORNL

1965

- Stepped down as project director, but continued work at ORNL



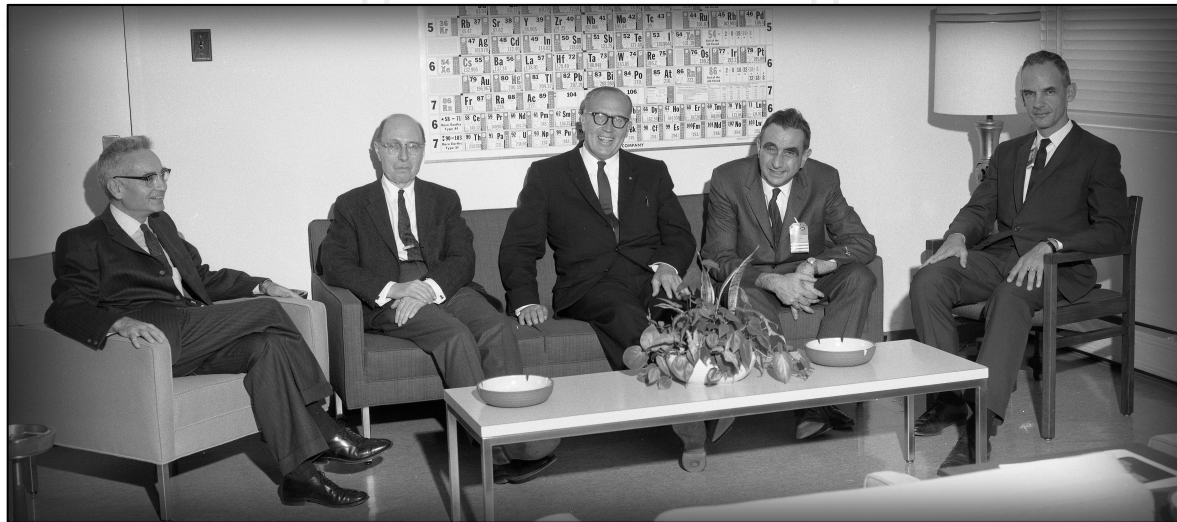
# Wigner's fellow "Martians" also feared the possibility of a nuclear war

Szilard:  
Campaigned  
vigorously  
for nuclear  
arms control

Teller: Early and  
passionate advocate  
of missile defense;  
a leader of Strategic  
Defense Initiative  
("Star Wars")

Von Kármán:  
Worked to  
strengthen U.S. air  
defense; created  
Nuclear Weapons  
Panel for Air Force  
Science Advisory  
Board

Von Neumann:  
Used game theory  
to model Cold War  
interactions  
between the U.S.  
and the Soviet  
Union



Weinberg and  
Wigner were  
disturbed  
by Teller's  
vehemence  
but also deeply  
concerned  
about the politics  
of civil defense

# 1963: Wigner wrote to Weinberg about their vision for a civil defense program

“... I am increasingly impressed by the seriousness of our undertaking. In fact, I am not a little concerned about its future and about the possible results of a failure. We must do all that is in our power to avoid this ...”

PALMER PHYSICAL LABORATORY  
PRINCETON UNIVERSITY  
PRINCETON, NEW JERSEY

4 February 1963

Dr. Alvin M. Weinberg, Director,  
Oak Ridge National Laboratory  
Oak Ridge, Tenn.

Dear Alvin,


Since we saw each other in Washington, I have, of course, pondered our plans a great deal, and I am increasingly impressed by the seriousness of our undertaking. In fact, I am not a little concerned about its future and about the possible results of a failure. We must do all that is in our power to avoid this. I am very much counting on your help and wisdom in this regard.

Since I saw you I have had a long conversation with Dr. Sidney Ratner, an economist. I discussed with him principally the people whom we could call in for the summer study for the less technical problems, on which I think we should have a thorough orientation. He called my attention to several people, and in particular strongly endorsed Jack Vernon's advice to get in touch with Hadley Cantrill. Unfortunately, he is out of the country now, but Sid mentioned several of his associates and students for whom he has a high regard, and I will try to see them. Unfortunately, it is very difficult for me to judge people whose fields are as far from mine as is Psychology and, of course, I will not make any definite commitment without your concurrence and a great deal of further thought. Sid Ratner also advised me to see Jerry Wiesner and McGeorge Bundy. I do not know when I will squeeze in these visits -- that is, if they are willing to see me -- but again I will do my best. It would be most useful, of course, if you could come along on these consultations, and I hope you will do so unless you are too busy. Incidentally, I have in the meantime read the article about Jerry Wiesner in the *New Yorker* and am very much impressed by it. Of course, I have heard a great deal about Bundy before. Also, incidentally, we had a telephone call last Friday from Joe Deal in Washington. He will come to Princeton on his way to New York and see me on Wednesday afternoon. I will also try to get in touch with Fred Seitz.

There is one unfortunate piece of news that I should give you and I only hope it does not come as a surprise to you. Bob Charpie writes that he will be too much tied up with the affairs of his company to participate in our work. I do not know whether it would be possible to persuade him to come for the summer study, and I do not know whether this in itself would be useful. I feel I should leave this to you. At any rate, the situation is that we have to think about another person who would be "second in command", and now that a choice must be made I see shortcomings in almost everyone. Maybe I should consult Bill Baker at Bell Labs when I visit there on the 25th.

This is about all that occurs to me right now, but I'm afraid I will have to write to you more frequently in the next few days. Please give me your reactions to the letter to George Baker most frankly and in as much detail as possible. This letter had to go out because of various reasons, but I want the other letters to be as nearly perfect as possible.

With all good wishes,

Sincerely,  
  
Eugène P. Wigner

EPW/JA

# Weinberg's response reflects concerns about U.S. leadership

“Would our incentive to resort to nuclear arms be greatly increased if we had strong Civilian Defense? As long as a tough but realistic guy like Kennedy is in the White House, I think one does not worry. Suppose Goldwater were President--would he be more willing to press the button because he knew that, as a result of our Civil Defense, our casualties would be fewer than if we had no Civil Defense?”

I have only one comment about your letter to Baker, but it is an important one. In the section Acceptance of the Need for Civil Defense you say "the incentive to use them or to threaten with their (i.e., H-bombs) use is particularly great if no defense against them is available". Here it seems to me you raise, by implication, one of the most difficult questions concerning attitude toward Civil Defense. In your sentence you are obviously referring to the Russians (or Chinese). But what about the United States? Would our incentive to resort to nuclear arms be greatly increased if we had strong

Professor Eugene P. Wigner

- 2 -

February 7, 1963

Civilian Defense? As long as a tough but realistic guy like Kennedy is in the White House, I think one does not worry. Suppose Goldwater were President--would he be more willing to press the button because he knew that, as a result of our Civil Defense, our casualties would be fewer than if we had no Civil Defense? I do not fully know the answer to this question, but I think it cannot be ignored. I should think you ought to include a phrase showing that you recognize this difficulty. Otherwise, I'm afraid the paragraph Acceptance of the Need for Civil Defense can be interpreted as being biased in the sense that the need for Civil Defense is assumed without weighing the risk of Civil Defense. I believe the answer is that the risk of Civil Defense which I mentioned is smaller than the gain in stability you mentioned (i.e., that Civil Defense in balance stabilizes the situation), but I think this is one of the fundamental results of the Summer Study, not the fundamental assumption of the study.

I assume our meeting is on for Tuesday afternoon, February 12, at 2:30. I shall call you to get full details.

Sincerely yours,

ORIGINAL SIGNED BY  
ALVIN M. WEINBERG  
Alvin M. Weinberg

AMW/z

P.S. Of course I shall be glad to see Bundy and Wiesner with you at any time.

A. M. W.

# ORNL created the Eugene P. Wigner Fellowship Program in 1975

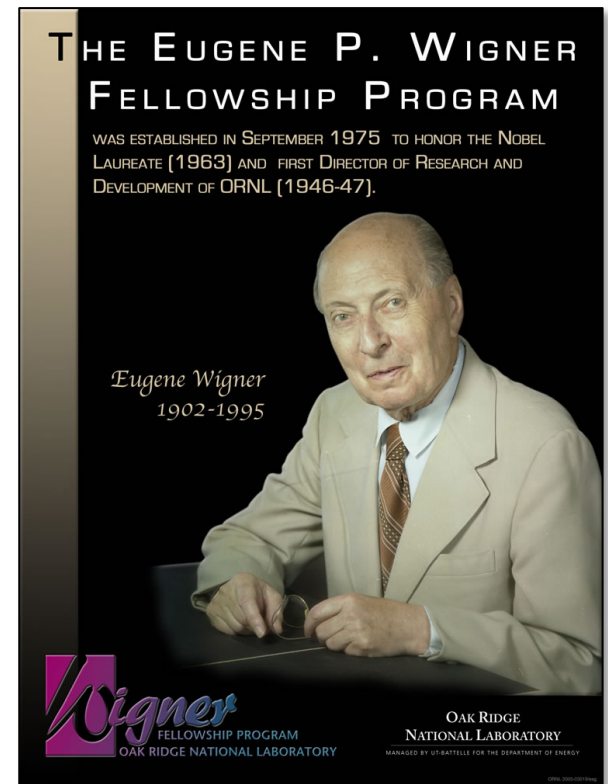
- Opportunity for physical, social, and life scientists and engineers no more than 3 years past the doctorate to gain experience in areas of science and technology related to national energy programs and needs
- First 4 recipients:
  - Environmental science
  - Theoretical physics
  - Plasma physics
  - Materials science



“Wigner, who won the Nobel Prize in Physics in 1963, is currently an ORNL consultant and spends the remainder of his time at Princeton University, where he is professor emeritus of mathematical physics”

# Wigner Fellows continue to make valuable contributions to ORNL's R&D

- The program is the capstone of a diverse set of research and education experiences aligned with Wigner's focus on science education
- ORNL currently hosts 9 Wigner Fellows whose work spans the Laboratory's portfolio
  - Chemical sciences (2 Fellows)
  - Computational science and mathematics
  - DNA nanotechnology
  - Materials science and technology (2 Fellows)
  - Microbial ecology and physiology
  - Nuclear physics
  - Quantum condensed matter



4 November 2013



# ORNL launched the Eugene P. Wigner Distinguished Lecture Series

Anniversary of first criticality at Oak Ridge Graphite Reactor, designed by Eugene Wigner, Alvin Weinberg, and Gale Young

Inaugural lecture presented by Albert Fert, winner of the 2007 Nobel Prize in physics



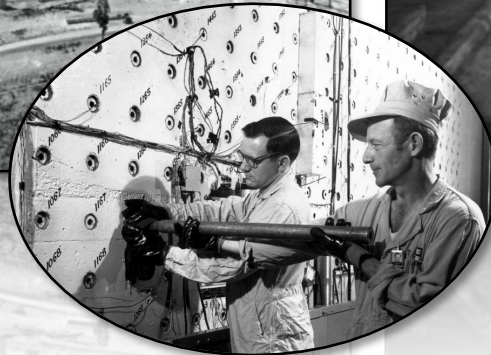
# Oak Ridge National Laboratory directors, 1943–2013

	Director		Contractor
1943–1945	Martin D. Whitaker		University of Chicago
1946–1947	James H. Lum, executive director <b>Eugene P. Wigner</b> , research director		Monsanto
1948–1950	C. Nelson Rucker, acting director Alvin Weinberg, research director		Union Carbide
1950–1955	Clarence Larson, director Alvin Weinberg, associate director		
1955–1973	Alvin Weinberg		
1973–1974	Floyd Culler, acting director		1984: Martin Marietta
1974–1988	Herman Postma		1995: Lockheed Martin
1989–1999	Alvin Trivelpiece		UT-Battelle
2000–2003	William Madia		
2003–2007	Jeffrey Wadsworth		
2007–present	<b>Thomas Mason</b>		



# Oak Ridge National Laboratory evolved from the Manhattan Project

The Clinton Pile was the world's first continuously operated nuclear reactor

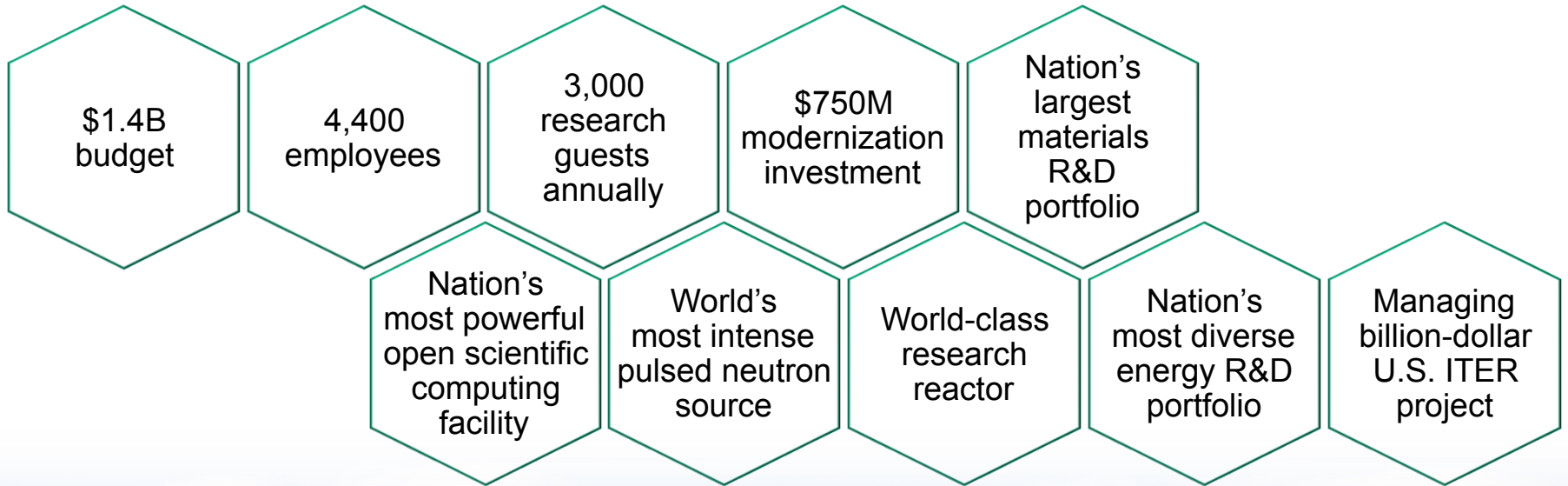


Chemical processing techniques were developed to separate plutonium from irradiated fuel



LIFE  
FILE

# Today, ORNL is a leading science and energy laboratory



# Further reading

- *The Recollections of Eugene P. Wigner: As Told to Andrew Szanton*, Basic Books, 2003
- *The Collected Works of Eugene Paul Wigner*, Springer-Verlag, 1992–1996
- I. Hargittai, *Martians of Science: Five Physicists Who Changed the Twentieth Century*, Oxford, 2008
- L. Johnson and D. Schaffer, *Oak Ridge National Laboratory: The First Fifty Years*, University of Tennessee Press, 1994

# Acknowledgments

- Timothy J. Gawne
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- Donna Jo Roy