METALLURGY
and
MATERIALS
PROGRAMS

FY 1969

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION of RESEARCH
LEGAL NOTICE

This book was prepared under the sponsorship of the U. S. Atomic Energy Commission. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:
A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this publication or that the use of any information, apparatus, method, or process disclosed in this book may not infringe privately owned rights; or
B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this publication.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.
METALLURGY
AND
MATERIALS
PROGRAMS
Fiscal Year 1969

September 1969

U. S. Atomic Energy Commission
Division of Research
FOREWARD

The Metallurgy and Materials Program constitutes one portion of a wide range of research supported by the AEC Division of Research. Other programs are administered by the Division's Controlled Thermonuclear Research, Chemistry, High Energy Physics, and Physics and Mathematics Offices. Metallurgy and Materials research is supported primarily at AEC National Laboratories and Universities. The research covers a wide spectrum of scientific and engineering areas of interest to the Atomic Energy Commission and is conducted generally by personnel trained in the disciplines of Solid State Physics, Metallurgy, Ceramics, and Physical Chemistry.

This report contains a listing of all research underway in FY 1969 together with a convenient index to the program.

Donald K. Stevens
Assistant Director of Research for
Metallurgy and Materials Programs
Division of Research
INTRODUCTION

The purpose of this report is to provide a convenient compilation and index of the AEC's Metallurgy and Materials Programs. This compilation is intended for use by administrators, managers, and scientists to help coordinate research and aid in selecting new programs.

The report is divided into Sections A and B, listing all the projects, Section C, a summary of funding levels, and Section D, an index.

Each project carries a number (underlined) for reference purposes. The FY 1969 funding level, title, personnel, budget activity number (e.g. 01-02), and key words and phrases accompany the project number. The first two digits of the budget number refer to either Physical Metallurgy and Ceramics (01) or Solid State Physics (02). The budget numbers carry the following titles:

- 01-01 - Materials, Properties and Processes
- 01-02 - Structure of Materials
- 01-03 - Radiation Damage
- 02-01 - Materials Preparation and Characterization
- 02-02 - Crystal Physics
- 02-03 - Energetic Particle Interaction

Section C summarizes the total funding level in a number of selected categories. Obviously most projects can be classified under more than one category and, therefore, it should be remembered that the categories are not mutually exclusive.

In Section D the references are to the project numbers appearing in Sections A and B and are grouped by (1) investigators, (2) materials, (3) technique, (4) phenomena, and (5) environment.

It should be recognized that it is impossible to include in this report all the technical data available for such a large program. By the time it could be compiled it would be outdated. The approach taken here was to summarize each project with key words and phrases reflecting the activity under the project. The best method for obtaining more detailed information about a given research project is to contact directly the investigators listed.

Louis C. Ianniello
Metallurgy and Materials Programs
Division of Research
TABLE OF CONTENTS

SECTION A - Laboratories

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ames Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Argonne National Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>Atomics International</td>
<td>8</td>
</tr>
<tr>
<td>Battelle Memorial Institute</td>
<td>8</td>
</tr>
<tr>
<td>Brookhaven National Laboratory</td>
<td>9</td>
</tr>
<tr>
<td>Idaho Nuclear Corporation</td>
<td>12</td>
</tr>
<tr>
<td>Illinois, University of</td>
<td>12</td>
</tr>
<tr>
<td>Lawrence Radiation Laboratory</td>
<td>16</td>
</tr>
<tr>
<td>Mound Laboratory</td>
<td>19</td>
</tr>
<tr>
<td>National Bureau of Standards</td>
<td>19</td>
</tr>
<tr>
<td>Oak Ridge National Laboratory</td>
<td>20</td>
</tr>
<tr>
<td>Pacific Northwest Laboratory</td>
<td>25</td>
</tr>
<tr>
<td>Puerto Rico Nuclear Center</td>
<td>25</td>
</tr>
</tbody>
</table>

SECTION B - Universities

Alphabetical Listing ......................................... 27-56

SECTION C - Funding Levels

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>58</td>
</tr>
<tr>
<td>Department</td>
<td>58</td>
</tr>
<tr>
<td>Laboratory versus University</td>
<td>59</td>
</tr>
<tr>
<td>Laboratories</td>
<td>59</td>
</tr>
<tr>
<td>Research Area</td>
<td>60</td>
</tr>
</tbody>
</table>

SECTION D - Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigators</td>
<td>A1</td>
</tr>
<tr>
<td>Materials</td>
<td>A8</td>
</tr>
<tr>
<td>Technique</td>
<td>A11</td>
</tr>
<tr>
<td>Phenomena</td>
<td>A16</td>
</tr>
<tr>
<td>Environment</td>
<td>A20</td>
</tr>
</tbody>
</table>
The information was taken from current Laboratory program budget submissions. Most projects are of a continuing nature although specific problems and some projects were concluded in FY 1969.
1. "Crystal Plasticity" $104,000 01-01
   T. E. Scott
   effect of H on deformation and fracture in V, Ta, Nb, deformation modes in Y, Yb, precipitation hardening in Cu-Co-Zn and bcc metals

2. "Metal Purification and Impurity Effects Studies" $ 75,000 01-01
   O. N. Carlson, D. T. Peterson
   purification of Ca, Mn, electromigration of C, O, N in Lu, electromigration of interstitials in Hf, Zr, Gd

3. "Ceramics Research" $ 75,000 01-01
   O. Hunter
   cation diffusion in $Y_2O_3$ and $Er_2O_3$, elastic properties of oxides of Tm, Yb, Lu, Y, Er, Dy and Ho, polymorphic transformation in HfO$_2$, thermal diffusivity to 1600°C

4. "Structure and Properties of Solids" $317,000 01-02
   P. Chiotti, K. A. Gschneidner, F. X. Kayser, J. F. Smith, D. M. Bailey
   thermodynamic properties, elastic constants, x-ray diffraction, magnetic susceptibility, Yb-Zn, Ga-Zn, Eu-Zn, U compounds, Mg alloys, Ce, In-Pb, In-Tl, Pb-Tl

5. "Diffusion and Transport Properties" $ 87,000 01-02
   O. N. Carlson, D. T. Peterson, J. D. Verhoeven
   constitutional supercooling, solid-liquid interface, effect of electric and magnetic fields on solidification, electrotransport in liquid metals, diffusion coefficients in Th-R.E. alloys, electromigration velocities of interstitials in Zr, Gd, Hf, Dy and U

6. "Properties of Surfaces" $ 38,000 01-02
   R. K. Trivedi
   surface energy and surface diffusion in V, growth and stability of interfaces, LEED study of epitaxial films
7. "Radiation Damage" $110,000 01-03
   C. W. Chen
   in-pile neutron damage studies down to 80°K, mechanical properties
   and internal friction studies of irradiated V, V-Ti alloys

Physics Division -02-
   C. A. Swenson - Phone: 294-5288

8. "Materials Preparation and
    Characterization" $165,000 02-01
   F. H. Spedding, G. Burnet
   preparation and purification of rare earth metals compounds and
   alloys, high temperature heat content of fluorides, phase relations
   in binary rare earth systems

9. "Electronic Properties of Metals" $ 99,000 02-02
   A. V. Gold, J. L. Stanford, L. Hodges,
   R. A. Phillips
   theoretical study of electronic structure of transition and noble
   metals, Fe, Co, Cu, Ag, Au, experimental study of Fermi surface in
   Cr alloys, V, de Haas-van Alphen effect in W, Pb, Th, ReO₃, rf
   size effect in Mo, Ga, Tl, infrared reflectivity in Cr, Mo, V, Mn,
   magnetoplasma waves in Zn, Tl

10. "Electronic Structure of Crystalline
    Solids" $115,000 02-02
    R. G. Barnes, D. R. Torgeson, L. V. Cherry
    NMR, ESR, NGR techniques applied to metals and compounds, NGR in Er
    and Yb alloys, NMR in R.E.-Mn compounds, transition metal borides,
    ESR of impurities in semiconductors

11. "Superconductivity" $166,000 02-02
    D. K. Finнемore, J. R. Clem,
    R. L. Cappelletti, W. J. Keeler
    surface superconductivity in Nb, anisotropy of energy gap in Th,
    thermal conductivity in Th-Gd, susceptibility of La-R.E. alloys,
    specific heat of Gd, flux motion in superconductors, magnetic
    impurity states

12. "Thermodynamic Properties of Solids" $148,000 02-02
    C. A. Swenson
    low temperature thermal expansion of solid A, Cu, Ag, Au, equation of
    state of Cs and inert gases up to 20 Kb, low temperature thermometry
13. "Transport Properties of Solids" $280,000 02-02
G. C. Danielson, J. J. Martin, K. Tanaka, P. H. Sidles, H. R. Shanks
electrical and thermal conduction in semiconductors and metals, superconductivity in tungsten bronzes, nuclear particle detectors, thermal conductivity of Th, NaWO₃, Mg₂Si, Mg₂Pb, thermal diffusivity of Pt to 1500°K using radial heat flow method

14. "Magnetic Materials: Rare Earth Metals and Rare Earth Compounds" $198,000 02-02
S. Legvold, S. H. Liu, J. L. Stanford, T. Wagner
magnetoelastic effects in rare earth metals, thermal conductivity of Gd, Tb, Ho, magnetoresistance of single crystals up to 100 Kg, theory of Fermi surface relation to magnetic ordering, ferromagnetic behavior of Gd-Th alloys

15. "Optical Properties of Solids" $198,000 02-02
D. W. Lynch, R. Fuchs, K. L. Kliewer, J. M. Keller
pure metals and alloys, experimental absorption studies down to 4°K in the visible and infrared region, optical properties and band structure of insulators, CsBr, CsCl, synchrotron radiation for vacuum ultraviolet studies on Cd, Zn, AgCl, defect studies of AgCl

16. "Neutron Scattering in Solids" $115,000 02-02
S. K. Sinha, R. A. Reese, R. P. Gupta, T. O. Brun
neutron triple axis spectrometer, lattice dynamics of solid He, Y, Sc, spin waves in Cr-Mn alloys, magnetic structure of Tm, nuclear polarization effects in solids at very low temperatures

17. "Optical and Magnetic Properties of Rare Earth Salts, Solutions, Metals and Alloys" $264,000 02-02
F. H. Spedding, R. H. Good
absorption spectra of Er and Ho ethylsulfates, Raman spectra of single crystals of rare earth compounds, heat capacity of Lu, Lu-Er and Lu-Tm alloys, magnetic susceptibility of polycrystalline and single crystal Sc, Y, La and Lu
18. "Physical Metallurgy" $397,000 01-01
M. B. Brodsky, A. J. Arko, L. M. Atlas,
J. J. Rechtien, W. J. Nellis
actinide metals, phase transformations, mechanical properties,
electronic and magnetic structure, thermodynamics and statistical
mechanics, preparation of high purity and single crystal Pu,
deformation of Pu, transformations in Np, magnetoresistance, Hall
coefficient, magnetic susceptibility Pu, Am, U, defect equilibria
in oxides

19. "Metal Physics" $462,000 01-01
N. L. Peterson, W. K. Chen, E. S. Fisher,
J. N. Mundy, S. J. Rothman, M. L. Volpe,
D. G. Westlake, D. A. Gerlich,
J. T. Robinson, D. O. Welch
diffusion in metals and ceramics, elastic modulus, plastic deforma-
tion, self diffusion Cu, Na, Ag, grain boundary diffusion in Ag,
impurity diffusion Ge in Al, Fe in Ti, Fe in U, cation self
diffusion and impurity diffusion in CoO, ZnO, NiO, property
measurements on Nb and V with H, H supercharging in Zr, elastic
moduli for Zr, Ti, Sc, U

20. "Mechanical Properties" $220,000 01-01
U. F. Kocks, C. Y. Cheng, R. O. Scattergood,
P. O. Kettunen, N. R. Risebrough
theoretical and experimental research on plastic deformation, flow
stress, work hardening, recovery, fatigue hardening, Cu

21. "Kinetic Studies" $210,000 01-01
N. L. Peterson, R. K. Hart, J. W. Miller,
F. V. Nolfi, Jr., R. H. Spitzer, Jr.
transport processes during oxidation, Zr, gravimetric study of
oxidation, growth or dissolution of bubbles and precipitates, He in
Cu, Al and Cu alloys, electron microscopy of Al oxidation
22. "Theory" $100,000 01-01
  temperature dependence of elastic constants of Sc, impurity screening potential in noble metals, relation between defect cluster size and resistivity, interactions of line and point defects in anisotropic metals, electronic structure of metals

23. "Alloy Properties" $557,000 01-02
  magnetization, neutron scattering, NMR and NGR on Pu, Np and U compounds, ferromagnetic alloys, Sc alloys, low temperature specific heat, optical properties, thermodynamics

24. "Magnetic Resonance and Positron Annihilation Research" $98,000 01-02
  D. O. Van Ostenburg, G. A. Matzkanin, J. J. Spokas
  Knight shift, linewidth and nuclear spin lattice relaxation in dilute alloys of Pt and Pd, concentrated Nb-Al alloys, compounds of Th and U

25. "Scattering Studies" $352,000 01-02
  M. H. Mueller, L. Heaton, M. Kuznietz, G. H. Lander, R. C. Maglic
  neutron scattering, U compounds, PuO$_2$, Np compounds, Fe-Cr, Sc-Gd, U, x-ray diffraction, neutron scattering by liquids

26. "Radiation Effects" $539,000 01-03
  neutron damage in BCC metals, Nb, flow stress, low temperature lattice parameter and resistivity on Cu, stored energy in Ag, Ni, irradiation hardening in Al, Au, Ag, transmission electron microscopy of irradiation induced defects, charged particle irradiation of films, theory of sputtering interaction of irradiation defects with flux in superconductors, Nb, Tc
27. "Material Preparation and Characterization" $86,000 02-01
S. Susman, D. Hinks
purification and crystal growth of KCl, KBr, KCN, KCN-KBr, transition metals, actinide compounds

28. "Neutron Scattering Studies" $666,000 02-02
slow neutron inelastic scattering Sn, liquid A, neutron diffraction, NiS, Au$_2$Mn, neutron sources

29. "Defects in Nonmetallic Crystals" $205,000 02-02
P. Yuster, C. Delbecq, D. Schoemaker, S. Susman
alkali halides, visible, near-UV, ESR, irradiation induced defects

30. "Very-low-temperature Studies" $147,000 02-02
J. Ketterson, Y. Eckstein, M. Kuchnir, P. Roach
$^3$He-$^4$He refrigerator, sound attenuation, sound velocities, phase separation, specific heat

31. "Superconductivity and Low-Temperature Calorimetry" $135,000 02-02
H. Culbert, R. Huebener, V. Rowe
specific heats of metals and oxides, Pb-Tl, Pb-In, rare earth oxides, transport of magnetic flux in thin films of Pb, Sn, In, Nb, flux pinning

32. "Phase Transitions and Critical Phenomena" $256,000 02-02
L. Guttman, H. Kierstead, D. O'Reilly, R. Blinc, R. Lechner
thermodynamic properties of He at low temperatures, phase transition in Fe$_3$Al, small angle x-ray scattering, neutron scattering from Ni-Al, NMR on compounds

33. "Electronic and Magnetic Properties" $311,000 02-02
G. Kalvius, J. Ketterson, L. Windmiller, A. Boyle, B. Dunlap, G. Shenoy
NGR in Np, U, Am, Pu, Ir, Yb compounds, Fermi surface studies of Pt, Pd, dHvA effect
34. "Electron Spin Resonance and Kinetic Studies" $272,000 02-02
   hydrogen atom lifetime, defects in calcite ThO₂, recombination kinetics of radiation produced H in fluorite

35. "Solid State Theory" $401,000 02-02
   insulator-to-metal transition, ferromagnetism, electron correlations, quantum liquids and solids, interatomic interactions, optical and electronic properties of insulators, atomic motions in liquids, electronic structure of metals, electron phonon effects, defects in solids, lattice dynamics

36. "Energetic Particle Interaction" $209,000 02-03
   J. Jackson, W. Primak, G. Montet
   energy release and resistivity of irradiated metals, D irradiation, Pt, Pt-Au, radiation behavior of vitreous silica, studies of graphite, MoS₂, NbSe₂
Physics Technology -02-
R. G. Breckenridge - Phone: 341-1000 x1316

37. "Electronic Structure of Metals and Alloys" $201,000 02-02
   H. J. Fink, A. G. Presson,
   L. J. Barnes, S. L. Wipf
   theory related to surface superconductivity, superconducting point contacts, thermal properties of superconductors

38. "Radiation Damage in Crystalline Solids" $288,000 02-03
   W. Bauer, H. H. Neely, D. W. Keefer,
   J. C. Robinson, K. Thommen, D. D. Vawter
   annealing spectrum of electron irradiated Cu, Al, W, Zr, electron and alpha irradiation of Ti dislocation pinning in Cu, Ag, electron irradiation of GaSb, GaAs, proton and alpha irradiation of Ni at elevated temperatures

39. "Electronic and Structural Properties of Metals and Semiconductors in the Liquid State" $60,000 01-02
   E. W. Collings, J. E. Enderby
   Hall effect, magnetic susceptibility, thermoelectricity, Mg-Bi, Ca, Sr, Ba
Materials Science Department -01-
D. H. Gurinsky - Phone: 924-6349

40. "Superconductivity" $300,000 01-02
M. Garber, D. Schweitzer, O. F. Kammerer, R. Thompson
fundamental properties of superconductors, irreversible properties, ultrathin films, transition metal films, low temperature spin ordering of solid He-3, high field-low loss superconductors, LEED, tunneling measurements

41. "Liquid Metals" $175,000 01-02
P. Adams, J. Dickey, S. Epstein
measurements of solubilities, densities, surface tension, electrical resistivities, thermoelectric power, mass transport, electromigration, neutron diffraction, theory, computer studies of atom motions

42. "Relationship Between Properties and Structure" $ -0- 01-02
J. Galligan, P. Soo, T. Oku, M. Suenaga
program to start in FY 70, radiation damage, plastic deformation, grain boundary behavior

Department of Physics -02-
G. J. Dienes - Phone: 924-6633

43. "Spin Waves and Critical Scattering" $290,000 02-02
M. F. Collins, V. J. Minkiewicz, R. Nathans, L. Passell, G. Shirane, E. J. Samuelson, M. T. Hutchings
inelastic scattering of neutrons by Fe and Ni, energy dispersion relation for spin waves in antiferromagnetic Cr$_2$O$_3$

44. "Lattice Dynamics and Phase Transitions" $435,000 02-02
G. Shirane, Y. Yamada, V. J. Minkiewicz, J. D. Axe, K. A. Muller, H. Meister, J. Skalyo, Jr., B. C. Frazer
neutron scattering studies of phase transitions in SrTiO$_3$, KMnF$_3$, LaAlO$_3$
45. "Dynamical Scattering of Neutrons" $145,000 02-02
   C. G. Shull
scattering of neutrons from perfect Si single crystals, atomic
scattering amplitude of Si for neutrons, dimensions on neutron wave
packet, single slit diffraction of slow neutrons

46. "Spin Density and Magnetic Structures" $145,000 02-02
   B. C. Frazer, D. E. Cox, K. H. Beckurts
   R. Nathans, R. E. Newnham, R. P. Santoro,
   M. G. Miksic, M. D. Miller
polarized neutron beam scattering studies, solid O₂, magnetic
structure in Cr₂BeO₄, Fe₂TiO₅

47. "Cold Neutron Moderator Program" $97,000 02-02
   L. Passell
hydrogen moderator to be installed in H-9 beam port of HFBR

48. "Materials Synthesis and Crystal Growth" $145,000 02-02
   D. E. Cox, J. Hurst, R. Graeser,
   C. Klamut, F. F. Y. Wang, F. Merkert
Ge single crystals for neutron monochromators, specimen preparation,
Pt-Fe, Au-V, RbFeF₃, magnetic measurement techniques

49. "Theory" $128,000 02-02
   M. Blume, M. F. Thorpe, J. Sokoloff,
   H. J. Lee, R. E. Watson, G. H. Vineyard,
   A. J. Freeman, H. Ehrenreich
theory of the Mossbauer Effect, ferromagnetism, ferroelectricity,
inelastic neutron scattering, granular superconductors, computer
calculations for the classical Heisenberg ferromagnet, magnetic
polarization of conduction bands by local moments, energy band
theory of FCC transition metals

50. "Organic Crystals" $140,000 02-03
   R. Arndt, W. Whitten, A. Damask, A. Korn
gamma-ray damage in anthracene, phenanthrene, naphthalene, Hall
mobility, dielectric measurements, neutron scattering

51. "Ionic Crystals" $175,000 02-03
   P. W. Levy, W. Brandt, H. F. Waung,
   P. Mattern, J. A. Rivas, P. D. Esser,
   A. Lemos, P. J. Herley
alkali halides, positron annihilation, NaBrO₃, NaClO₃, optical
absorption, luminescence, Tl doped KCl, ammonium perchlorate
52. "Diffraction Studies" $105,000 02-03
D. Keating, A. Goland, D. North
computer program for diffuse scattering and Bragg scattering from a HCP structure containing interstitial dislocation loops, clustering in liquid Cu-Ni using neutron scattering

53. "Alloy Studies" $70,000 02-03
G. J. Dienes, H. Herman, A. Damask
short range ordering in alpha brass during cyclic deformation, resistivity

54. "Superconductivity in Thin Films" $119,000 02-03
M. Strongin, J. Crow, O. Kammerer
critical temperatures of cryogenically deposited films of Al, Sn, In, Zn, Pd, critical fields of films, conductivity above Tc, quantization effects

55. "The Solid State Electron Accelerator" $210,000 02-03
irradiation response of beta-brass, irradiation of Pt and positron annihilation studies, transition-radiation studies on thin films, internal friction and resistivity of irradiated W and Pt, simultaneous irradiation and optical and ESR measurements on alkali halides

56. "Theory" $86,000 02-03
G. J. Dienes, R. Hatcher, W. Wilson
defect calculations in ionic crystals, clustering and annealing of vacancies in metals, scattering of x-rays by crystal defects
57. "High Pressure Neutron Diffraction" $155,000 02-02
R. M. Brugger, W. R. Myers, T. G. Worlton,
R. E. Schmunk, R. B. Bennion, D. L. Decker,
D. B. McWhan
neutron scattering studies of materials at pressures up to 100 Kb,
time-of-flight technique, Bi, MnAs, Ce, EuS

58. "Mechanisms of Solid State Transformations" $35,000 01-02
C. J. Altstetter
phase transformations, Co-Ni, kinetics and morphology of nitride precipitation in Nb, solubilities and thermodynamics of N and O in V

59. "Electronic Structure of Transition Metal Alloys" $49,000 01-02
P. A. Beck
magnetic clustering in Ni-Cu, temperature dependence of resistivity in Cr-Al, magnetism in Au-V, Pt-Cr, Pd-Cr, ferromagnetic to paramagnetic transition in Re-Co, magnetic susceptibility, electron specific heat

60. "Point Defect-Dislocation Interactions" $72,000 01-02
H. K. Birnbaum
Nb, Mo, internal friction and microcreep at cryogenic temperatures,
H diffusion in Nb, divacancy behavior in Au, diffusion along dislocations
61. "Mechanical and Surface Behavior of Crystals" $36,000 01-02
J. J. Gilman not to be continued in FY 70

62. "First Order Phase Transformations in Solids" $44,000 01-02
D. S. Lieberman orientation relationships in AuCu-I transformation, geometric relations and order of transformation in NbRu, RuTa, NiCr$_2$O$_4$ and BaTiO$_3$ ferroelectric transformation

63. "Dislocations and Surface Barriers" $64,000 01-02
M. Metzger dislocation distributions under coated Cu crystals, coated Zn, microstrain and etch pit studies of deformed Cu, Cu with W fibers, mechanical properties

64. "Decomposition of Unstable Solid Solutions" $1,000 01-02
J. Morral project to increase in FY 70, theoretical studies of precipitation and ordering in multicomponent solid solutions, decomposition of kinetics of unstable ternary solutions, spinodal decomposition

65. "Annealing of Cold-Worked Metals" $28,000 01-02
B. G. Ricketts annealing texture in high purity Al as a function of rolling deformation, Al with intermetallic particles in system Cu-Al, Al with Fe impurities, nucleation of recrystallization

66. "Nuclear Magnetic Resonance Studies" $84,000 01-02
T. J. Rowland $V_3$Si and $V_3$Ga under pressure, rate of solute diffusion and vacancy generation in Al alloys, precipitation in age hardening alloys of Cu and Be, Cu bombarded with alpha particles, Pt alloys

67. "Solid State Phase Transformations" $112,000 01-02
C. M. Wayman martensite transformations, epitaxial growth of vacuum evaporated metals on various substrates, crystallography of martensite in beta phase Au-Cd, growth of Au films on graphite, Co films on NaCl, thermoelectric power of Au-Ni thin film thermocouples, superplastic deformation of Cd-Zn
68. "Study of the Nature of Solid Solutions of Metals" $53,000 01-02
C. A. Wert
Mossbauer study of martensite decomposition, chemistry and morphology of higher carbides of V, nitrides of Ta, Nb, internal friction, electron microprobe

Physics Department -02-
R. J. Maurer - Phone: 333-1370

69. "Use of Very High Pressure to Investigate the Structure of Matter" $116,000 02-02
H. G. Drickamer
Mossbauer resonance and optical absorption studies on Fe compounds to 200 Kb, irreversible processes in organic crystals at 350 Kb, nature of electron transfer processes

70. "Anharmonic Effects in Solids" $107,000 02-02
A. V. Granato
equation of state of solids, interatomic potentials, anharmonic effects, defect properties, second and third order elastic constants, alkali metals, LiF, BaF$_2$, CoO, Mg, CdS, NaCl, Al

71. "Defect and Electronic Properties of Solids" $122,000 02-02
D. Lazarus
effects of pressure on defect formation and motion in solids, thermal conductivity in solid He, ferromagnetism, Fermi surface, annealing of quenched vacancies in Au, ionic conductivity at high temperatures and pressures in alkali halides

72. "Properties of Noble Gas Crystals" $124,000 02-02
R. O. Simmons
theories of lattice dynamics and atomic interactions in condensed state, thermal properties of A, Kr, Xe, temperature dependence of thermal defect content of Ne, BCC$^3$He, single crystal elastic constants of Kr, laser light scattering techniques

73. "Nuclear Magnetic Resonance in Solids" $148,000 02-02
C. P. Slichter
magnetic state of Fe in Cu, second order phase transitions, Gd, NH$_4$Cl, order-disorder transitions
74. "Physics of Refractory Materials"  $106,000  02-02
W. S. Williams
low temperature thermal conductivity of UN and transition metal carbides, electromigration in TiC, resistivity and Hall coefficient of WC, piezoelectric properties of natural bone, dislocation velocities in doped Si, carbon fibers, plastic flow in glassy semiconductors

75. "Energetic Particle Interaction"  $195,000  02-03
J. S. Koehler
anomalous x-ray transmission, electron microscopy, channeling, Ag, Cu, behavior of interstitials in Ge and Si, geometrical structure of interstitials in electron irradiated crystals, charge state of interstitials
76. "Kinetics of Dislocation Dynamics" $110,000 01-01
J. E. Dorn
theory and experiment, strain rates from $10^{-7}$/sec (creep) to $10^5$/sec (high velocity impact), high temperature creep, Al, solute atom interactions with dislocations, low temperature behavior in BCC metals, Mo, Mo-Re, AgMg, effect of stacking fault energy on dynamic behavior in FCC metals

77. "Fundamental Aspects of Strength and Toughness" $100,000 01-01
E. R. Parker
fracture toughness, ferrous, non-ferrous, polymeric, composite materials, Ti-Al shock deformation, cleavage fracture of W single crystals, Al-Zn, acoustic emission, electron fractography, scanning electron microscopy

78. "Relation Between Microstructure and Properties of Alloys: Electron Microscopy" $180,000 01-01
G. Thomas
electron microscopy and field ion microscopy, 650 kV electron microscope, steels, spinodal transformations, ordering and embrittlement in refractory alloys, non-metallic alloys, application of velocity analysis to composition variations in alloys, Fe-Ni-Cu, Ta-C, Fe-Al, biological specimens

79. "Ceramic Microstructure, Glass and Ceramic Metal Systems" $125,000 01-01
J. A. Pask
diffusion, high temperature reactions, mechanical behavior, ceramic-metal interfaces, NiO-MgO, Al-Al$_2$O$_3$, MgO, control of microstructure, conductivity of glasses
80. "Crystal Imperfections" $110,000 01-01
   J. Washburn
dislocation climb in Au, yielding in Cu, vacancy clustering in
quenched Al, glide velocity of dislocations in Si, field ion
microscopy, vacancy clustering in Ni, slip band formation and work
hardening in Cu

81. "Relation of Microstructure to
     Properties of Ceramics"
     $115,000 01-01
     R. M. Fulrath
sintering of lead zirconate titanate ferroelectric ceramics,
dispersion strengthened glass, He and H permeation through fused
silica, electrical and magnetic properties

82. "High Strength Materials"
     $190,000 01-01
     V. F. Zackay
processing and alloy design, steels, Al alloys, Ti alloys, corrosion
behavior, welding characteristics, TRIP steel behavior, H embrittle-
ment, strain induced martensite in Fe-Cr-Ni-Mo alloys, low cycle
fatigue, fatigue crack propagation, carbide precipitation on
stacking faults, dislocation mobility in TRIP steel using acoustic
emission

83. "High-Field Superconductivity"
     $145,000 01-02
     L. Brewer, E. R. Parker, V. F. Zackay
high field, high current densities, new methods for fabrication,
Nb-Zr, Nb-Sn, NbC, Nb, Nb(AlGe) with V and Ta, metastable materials
prepared by condensation in vacuum

84. "High Temperature Reactions"
     $115,000 01-02
     A. W. Searcy
kinetics of vaporization and solid-gas reactions, mass spectrometer,
Cr, P, Zn, S, Se, Te

85. "Thermodynamics of Metal Systems"
     $115,000 01-02
     R. Hultgren
heats of formation, liquid metal solution calorimeter, low temperature
heat capacities, high temperature heat contents, chemical potentials
from vapor pressure measurements, compilation and critical
evaluation of thermodynamic data, In-Pb, Au, Cu, AuCu
86. "Superconductivity in Alloy Systems" $ 25,000 02-02
M. Merriam, R. Hammond
apply superconducting transition temperature measurements to understanding electronic structure of alloys, Pb-Tl, Pb-In

87. "Theoretical Solid State Physics" $ 90,000 02-02
M. L. Cohen
electronic structure of solids, empirical pseudopotential method, very low temperature experimental program, calculation of superconducting transition temperatures, Mg, Fermi surface of In, Sb

88. "Magnetic Properties of Solids" $ 35,000 02-02
A. M. Portis
EPR, NMR, localized magnetic moments, KMnF₃, antiferromagnetic resonance in CsMnF₃, KMnF₃, RbMnF₃, spin wave resonance in Ni and permalloy films, nuclear relaxation of Cu in Ni, electron resonance in Ni-Rh, nuclear spin diffusion in Co

89. "Far Infrared Properties of Solids" $115,000 02-02
P. Richards
far infrared radiation 2-500 cm⁻¹ used to study solids, Josephson junction interactions with far infrared radiation, c.w. far infrared laser, tunable far infrared radiation source

90. "Experimental Solid State Physics and Quantum Electronics" $108,000 02-02
Y. R. Shen
optical properties of materials, Raman scattering, iodine complexes in solution, dynamics of self-focusing of a laser beam in liquids

91. "Research in Superconductivity" $ 90,000 02-02
G. I. Rochlin
ac and dc Josephson effects, zero bias anomaly, gapless superconductivity, properties of superconductor-metal-superconductor sandwiches, flux jumping in Type II superconductors, Pb-In, Pb-Cu-Pb sandwiches, tunneling in single crystal Cr, phase transition in CO₂

92. "Nuclear Spin Interaction" $ 20,000 02-02
E. L. Hahn
nuclear quadrupole moment interaction of nuclei with electric field gradients, nuclear magnetic moment interaction with applied magnetic field, KH₂PO₄, NMR studies of superconducting surface state in Al, electron cyclotron echoes in Cs vapor
93. "Research on Superconducting Junctions and Devices" $0-02-02
J. Clarke
program to start in FY 70, weak-link and tunneling phenomena, Pb-Cu-Pb, nature of steps induced on the junction characteristic by the application of rf radiation, superconducting galvanometer, tunneling through semimetals, and semiconductors

94. "Liquid Transuranium Metals Research" $100,000 01-01
L. J. Wittenberg, C. R. Hudgens, G. A. Vaughn
properties of liquid Pu and Np, thermal diffusivity of Pu up to 925°C, density, heats of transformation of Np, viscosity of liquid Np, x-ray diffraction of liquid Pu

95. "Constitution of Binary Alloys" $28,000 01-02
project funded through NSRDC of NBS and work done at IITRI, survey and compilation of all available data on binary systems

96. "High Temperature Crystal Growth Techniques" $63,000 02-01
W. S. Brower
growth of KTaO₃ from solution, zone melting of Cu₂O, zone refining of Mn ferrite, crystal characterization using X-ray topography
97. "Fundamental Ceramics Research" $79,000 01-01
W. Fulkerson
support of a coordinated program on UN electronic band structure, thermal conductivity, electrical resistivity, Seebeck coefficient, self diffusion, creep, neutron diffraction, ESR, NMR, single crystal growth

98. "Physical Property Research" $182,000 01-01
D. L. McElroy, J. P. Moore,
R. K. Williams, T. G. Kollie
thermal conductivity, electrical resistivity, thermopower, specific heat, 77 to 2600 K, W, Cr, Mo, Ni$_3$Fe, UN, ThO$_2$, UO$_2$, Cu, ThN-UN, LiF

99. "Metallurgy of Superconducting Materials" $119,000 01-01
G. R. Love, C. C. Koch
Nb alloys, Tc alloys, effect of metallurgical structure on superconducting properties, critical current, ac and dc magnetization, phase diagrams, reaction kinetics and morphology, Gd and Y additions to Nb, flux pinning, precipitation kinetics of omega in Ti-Nb, performance of materials in high frequency cavity oscillator applications

100. "Direct Observation of Lattice Defects" $119,000 01-01
J. O. Stiegler, K. Farrell,
A. Wolfenden, B. T. M. Loh
observations and studies of defects in metals including voids, bubbles, and cavities using electron microscopy, gas bubble distributions in CVD tungsten, voids and neutron damage in Al, role of H and He on void formation

101. "Physical Ceramics Studies" $79,000 01-01
C. S. Morgan, C. S. Yust
plastic deformation of single crystal UO$_2$, sintering of ThO$_2$, diffusion of Th in ThO$_2$, measurement of electrostatic charge on dislocations in UO$_2$, creep of UN
102. "Deformation of Crystalline Solids" $119,000 01-01
   R. O. Williams, R. W. Carpenter,
   M. H. Yoo
   development of texture, twinning, dislocation mechanics, precipitation, stored energy during deformation, structure of solid solutions, Re, Nb-Hf, Ta-Hf

103. "Deformation and Annealing Studies" $79,000 01-01
   R. A. Vandermeer, J. C. Ogle,
   P. V. Guthrie, W. J. Hulsey
   annealing of defects, nature of nucleation sites for recrystallization, mobility of grain boundaries, Nb, Cu₃Au, Be, U alloys, Nb-V alloys, Al

104. "Reactions at Metal Surfaces" $158,000 01-01
   J. V. Cathcart, R. E. Pawel
   role of stress on oxidation, Nb, Ta, Auger and photoelectron spectroscopy, electron bombardment induced desorption, LEED, oxidation of U-Nb, U-Zr, W diffusion, X-ray diffraction of thin oxide films

105. "Fundamental Research in X-Ray Diffraction" $119,000 01-02
   H. L. Yakel, L. A. Harris,
   C. J. Sparks, R. W. Hendricks
   highly oriented graphite, small angle X-ray scattering, Ti-Nb, crystal structure, thermal diffuse X-ray scattering

106. "Theoretical Research" $135,000 01-02
   J. S. Faulkner, H. W. Joy
   numerical calculations of electronic band structures for pure metals and ordered compounds, magnetism, Cu, Au, UN, Ca, entropy of UO₂ and PuO₂

107. "Electronic Properties of Metals and Alloys" $120,000 01-02
   J. O. Betterton, Jr., G. Czjzek
   low temperature specific heat and galvanomagnetic properties, Zr, La, Re, not to be continued in FY 70

108. "Diffusion in Solids" $198,000 01-02
   T. S. Lundy
   Nb, Ta and W diffusion in W, cation diffusion in UO₂, UN, effects of high pressure and temperature gradients, Nb, concentration gradients in sintering process
109. "Spectroscopy of Ionic Media" $198,000 01-02
G. P. Smith, C. R. Boston, J. Brynestad
liquid and solid salts, optical spectroscopy, oxidation states of Te,
quantitative optical spectroscopy of molten fluorides, coordination
of Ni in binary melts, Ti-chloroaluminate crystals

110. "Mössbauer Studies" $ -0- 01-02
G. Czjzek
to begin in FY 1970, electronic structure of alloys and radiation
damage, hyperfine fields and isomer shifts of Ni in Ni-Cu, Ni-Fe
and Ni-Co alloys, neutron-capture Mössbauer experiments

Solid State Physics Division -02-
D. S. Billington - Phone: 483-6713

111. "Research and Development on Pure Materials" $700,000 02-01
J. W. Cleland, C. T. Butler, G. W. Clark,
R. E. Reed, R. D. Westbrook
growth of single crystals, purification and characterization of
research materials, Research Materials Information Center, KCl, MgO,
biological single crystal materials, Ge, Nb, V, Tb, Ho, UO$_2$,
UO$_2$-ThO$_2$, UO$_2$-W, NpO$_2$, magnetic ferrites

112. "X-Ray Diffraction" $ 90,000 02-02
F. W. Young, Jr., T. O. Baldwin
investigation of defects in crystals by X-ray diffraction techniques,
anomalous X-ray transmission topography and measurement of diffraction
intensities, as grown, plastically deformed, irradiated single
crystals, Si, Ge, Cu

113. "Superconductivity" $115,000 02-02
S. T. Sekula, R. H. Kernohan
flux pinning in Nb from neutron irradiation, ac properties of
irradiated Nb, Nb-Zr, V, Nb-Mo, in-pile low temperature magnetic
measurements

114. "Spin Resonance" $110,000 02-02
M. M. Abraham, J. L. Kolopus
ESR used to study impurities and radiation induced defects in crystals,
BaS, MgO, MgF$_2$, SrCl$_2$, ZrSiO$_4$, HfSiO$_4$, ThSiO$_4$, ThO$_2$
115. "Neutron Spectrometry" $365,000 02-02
M. K. Wilkinson, H. G. Smith,
R. M. Nicklow, H. A. Mook
neutron scattering studies utilizing neutron beams at ORR and HFIR,
inelastic neutron scattering from magnetic and non-magnetic materials,
critical scattering near chemical and magnetic phase transitions,
polarized neutron scattering, small angle scattering with long wave
length neutrons, Ca, Tb, Gd, Ho, Li, In, alpha Sn, TiO$_2$, NH$_4$Cl, Ni

116. "Neutron Diffraction" $370,000 02-02
W. C. Koehler, J. W. Cable,
R. M. Moon, E. O. Wollan
neutron diffraction at ORR and HFIR, magnetic structure, paramagnetic
scattering, form factor determinations, nuclear polarization,
magnetic short range order, spin wave scattering, intra-rare earth
alloys, USB, Ni-Cu, Ni-Pd, Co, Ce-Y, VF$_2$

117. "Defect Structures in Nonmetals" $322,000 02-02
W. A. Sibley, E. Sonder, Y. Chen
impurity and radiation effects on alkali halides, alkaline earth
fluorides and oxides, optical absorption and luminescence, ESR,
electrical measurements, stress-strain tests, MgO, MgF$_2$, ZnO, KCl,
MnF$_2$, KMnF$_3$, ZnF$_2$

118. "Low Temperature Physics" $74,000 02-02
W. T. Berg, D. Walton
low temperature thermal conductivity, adiabatic calorimetry,
investigation of crystalline defects, LiI, AgCl, CuK$_2$Cl$_4$·2H$_2$O, KCl,
MnCl$_2$·4H$_2$O, YIG, Li ferrite, Cu

119. "Irradiation Effects in Thin
Films and Foils" $118,000 02-03
T. S. Noggle, J. C. Crump
direct observation of irradiated thin foils and bulk samples by
means of electron microscopy, defect clusters in Cu irradiated with
neutrons at temperatures from liquid He to elevated, evaporated
films of Au, Cd, Zn, in situ electron irradiation of graphite and Al

120. "Fundamental Studies of Elasticity
and Anelasticity of Metals" $135,000 02-03
V. K. Pare
anelasticity measurements used to study radiation defect diffusion
and annealing, dislocation pinning in irradiated Cu, third order
elastic constants, sound velocity measurements
Oak Ridge National Laboratory
Solid State Physics Division -02- (continued)

121. "Theory and Computations" $355,000 02-03
D. K. Holmes, R. F. Wood, M. T. Robinson
radiation damage, channeling, annealing of damage, electronic structure of solids, lattice dynamics, magnetism, spin waves in ferromagnets, numerical simulation of radiation damage cascades, shape of optical absorption bands due to point defects

122. "Surface Studies on Metals" $220,000 02-03
F. W. Young, Jr., L. H. Jenkins
effects of neutron irradiation on chemical reactivity of metal surfaces, growth and characterization of single crystals, dislocation generation, electrochemical techniques, Cu, computer simulated studies of crystal growth, electrodeposition on highly perfect substrates, LEED

123. "Ion Bombardment" $70,000 02-03
B. R. Appleton
channeling used to study radiation damage and ion-atom interactions, Au, ZnO

124. "Radiation Effects at Low Temperatures" $360,000 02-03
R. R. Coltman, Jr., C. E. Klabunde, J. K. Redman, A. L. Southern
thermal neutron damage introduced at liquid He temperature, Cd, annealing studies, recovery of thermal and fast neutron damage at room temperature, Cu, Au, Ni, Pt, Re, Mo, U-235 in Al, effect of radiation on magnetoresistance and superconductivity
125. "Transuranium Physical Metallurgy Research"  
R. D. Nelson, S. D. Dahlgren, 
F. E. Bowman, D. Merz  
Pu, phase transformation kinetics, deformation of Pu allotropes, properties of thin film sputter deposits superplastic behavior of beta Pu, recrystallization, fine-grained alpha Pu, crystallography of alpha-beta transformation, Np metallurgy  
$212,000 01-01

126. "Radiation Effects on Metals"  
T. K. Bierlein, J. L. Brimhall, 
G. L. Kulcinski, H. E. Kissinger, 
B. Mastel  
neutron damage to metals irradiated at elevated temperatures, single and polycrystalline Mo, Re, Ni, effect of irradiation parameters on defect microstructure, void formation, effects of grain boundaries and doping of Mo with C and Fe, annealing of irradiated metals at high pressure, deformation studies  
$202,000 01-03

127. "Neutron Diffraction"  
M. I. Kay, R. Kleinberg  
magnetic structure of inorganic salts, CoBr$_2$·6H$_2$O, NiCl$_2$·2D$_2$O, alum sulfate, phenanthrene, NaH$_3$SeO$_3$, NaN$_2$  
$185,000 02-02

A. Cobas  
anthracene, phenanthrene, ESR of gamma irradiated specimens, annealing studies  
$53,000 02-03
The information was taken from current 200-word summaries provided by the contractor. There is considerable (about 10%) turnover in the University program and some of the projects will not be continued beyond the current contract period.
ARIZONA, UNIVERSITY OF

129. "Impurity Diffusion in Solids" $72,900 02-02
C. T. Tomizuka - Department of Physics
solid state diffusion at high pressures up to 10 Kb, self diffusion and impurity diffusion in metals, semimetals, ionic crystals and covalent crystals, self diffusion in Na by NMR, defects in ionic crystals by Mössbauer effect, Ag-Au, Ag, Cu, Au, Zn, AgCl

130. "High Temperature Anneals of Defects Quenched in Metals" $24,785 02-02
R. M. Emrick - Department of Physics
formation and motional energy of vacancies, quench-and-anneal studies, self diffusion, Mössbauer spectroscopy, Au, Al

BOSTON UNIVERSITY

131. "Coincidence - Mössbauer Studies of Solid State Phenomena" $34,321 02-02
G. R. Hoy - Department of Physics
coincidence-Mössbauer techniques used to study environment at the locations of decaying nuclei, ionic spin fluctuations, charge redistributions

BRANDEIS UNIVERSITY

132. "Experimental Studies of Critical Point Behavior in Magnetically Ordered Solids Using Nuclear Gamma-ray Spectroscopy and Related Experiments" $31,680 02-02
C. Hohenemser - Department of Physics
time dependent perturbed angular correlation studies in magnetically ordered systems, impurity atom magnetic coupling

133. "Low Temperature Properties of Solid Helium" $34,760 02-02
H. D. Cohen - Department of Physics
magnetic susceptibility of solid $^3$He and $^3$He-$^4$He mixtures, nuclear resonance and magnetometer techniques, specific heat measurements in vicinity of phase separation critical point
134. "Thermodynamic Investigation of Alkali Metal Mixtures" $43,976 01-02
   J. B. Ott and J. R. Goates - Dept. of Chemistry
   thermodynamic properties of mixtures of Na, K, Rb and Cs, solid-liquid phase equilibria, heat of mixing calorimetry

135. "Study of Binary Multiphase Diffusion in Metallic Systems" $23,933 01-02
   L. S. Castleman - Department of Physical and Engineering Metallurgy
   mechanism of non-planar phase interface growth, Al-Sb, In-Sb, nucleation and growth of intermetallic compounds, X-ray techniques

   P. J. Bray - Department of Physics
   ESR and NMR of irradiated glasses and glasses doped with paramagnetic ions, alkali borate materials, niobate, titanate, and germanate glasses

137. "A Combined Macroscopic and Microscopic Approach to the Mechanical Properties of Metals" $106,972 01-01
   J. Gurland - Division of Engineering
   fracture strength and ductility transitions in carbon steels, embrittling parameters associated with the microstructure of multiphase alloys, strain and stress fields associated with a crack tip, interaction and coalescence of voids under triaxial stress

   P. Duwez - Department of Materials Science
   structure and properties of metastable alloys obtained by rapid quenching from the liquid state, electrical and thermal conductivity, Hall coefficient, magnetoresistance, magnetic properties, superconductivity, thermoelectric power, Mössbauer spectroscopy, Pd-Si, Fe-P-C, Te alloys, amorphous-crystalline transformation kinetics
139. "Dislocation Mobility and Density in Metallic Crystals" $75,000 01-01
D. S. Wood and T. Vreeland, Jr. - Dept. of Materials Science
Dislocation velocities, electron-dislocation interaction, effect of stress, temperature and crystal orientation, Fe, Cu, Zn, Mo, Nb

140. "The Effect of Controlled Variations of Particle Size Distributions on the Mechanical Properties of Precipitation-Hardened Nickel-Based Y/3' Alloys" $37,000 01-01
A. J. Ardell - Department of Engineering, Los Angeles
Study of unimodal and bimodal particle size distributions on strength, Ni-Al alloys, dislocation structure, transmission electron microscopy, thermal stability of precipitation structures

141. "Electroabsorption Studies in Semiconductors" $16,729 02-02
M. Chester - Dept. of Physics, Los Angeles
Electric field effect on optical absorption in HgI₂

142. "Electric and Magnetic Properties of Transition Metals and Their Compounds" $62,810 02-02
A. W. Lawson - Dept. of Physics, Riverside
Line width and spin wave relaxation in EuS, antiferromagnetic resonance in EuTe, TbP, TbAs, TbSb, pressure dependence of the paramagnetic Curie temperature in Gd, electric and magnetic properties of EuS, EuSe, EuTe, EuO

143. "New Materials by Low Temperature Condensation" $85,000 01-01
Huey-Lin Luo - Department of Applied Electrophysics, San Diego
Sputtering method for depositing superconducting materials, Nb-Al-Ge, magnetic and electrical properties of sputtered materials
CALIFORNIA, UNIVERSITY OF (continued)

144. "Research on the Properties of Materials at Very Low Temperatures" $142,869 02-02
J. C. Wheatley - Dept. of Physics, San Diego
spin diffusion in pure liquid $^3$He, flow properties of Fermi liquids, properties of solid and liquid $^3$He at high pressure, techniques for producing, maintaining and measuring temperatures in the millidegree range, nuclear cooling, isentropic compression of $^3$He, dilution refrigerator

CARNEGIE-MELLON UNIVERSITY

145. "Optical and Microwave Spectroscopy of Np and Co in Scheelites and Other Crystalline Environments" $30,000 02-02
J. O. Artman - Department of Physics and Electrical Engineering
optical absorption and fluorescence of doped crystals, EPR, calculation of energy level parameters

146. "Application of the Mössbauer Effect to the Study of Metallic Solid Solutions" $27,202 01-02
P. A. Flinn - Department of Physics and Metals Research Laboratory
phase transformations, diffusion, behavior of C and N in Fe, diffusion of Fe in BCC alloys, diffusion of Fe in Ti

CASE WESTERN RESERVE UNIVERSITY

147. "Motion of Ions in Solid Helium" $24,470 02-02
A. J. Dahm - Department of Physics
mechanism of motion of ions in solid He in an electric gradient, pulsed electron source, time of flight technique

148. "Dislocation-Solute Atom Interactions in Alloys" $37,000 01-01
R. Gibala - Department of Metallurgy
strain aging and interstitial-defect interaction in austenitic steels by anelastic techniques, dislocation-solute atom interaction in Nb alloys by dislocation damping, interstitial hardening and softening and the effect of solute partitioning on strengthening in high purity Nb, internal friction, electron microscopy
UNIVERSITIES - 31 -

CASE WESTERN RESERVE UNIVERSITY (continued)

149. "Kinetics of Phase Transformations in Zirconium, Hafnium and Titanium Alloys" $25,100 01-01
    R. F. Hehemann - Dept. of Metallurgy
    omega transformation in Zr, Ti and Hf base alloys, transition state in TiNi, cold stage electron microscopy

150. "Solid State Physics" $76,901 02-02
    R. W. Hoffman - Department of Physics
    Mössbauer spectra of ultra thin $^{57}$Co films, stress anisotropy in Ni films and in the Pt-Si epitaxial system, equation of state, lattice dynamics in alkali halides and alkaline earth halides, solid state theory of electron scattering in alloys

CHICAGO, UNIVERSITY OF

151. "Interactions on Metallic Surfaces" $30,917 02-02
    R. Gomer - Department of Chemistry
    adsorption on single crystal metal surfaces, field emission study of adsorption of inert gases, mass-spectrometric study of desorption of O and CO from W, field ion microscopy

CLARKSON COLLEGE OF TECHNOLOGY

152. "Transport and Magnetic Phenomena in Chromium and Iron Alloys" $24,751 02-02
    S. Arajs - Department of Physics
    electrical resistivity, thermoelectric power, magnetization, thermal conductivity, Cr alloys, Fe alloys

153. "The Oxidation of Copper Films" $21,000 02-02
    A. W. Czanderna - Dept. of Physics
    mechanism of Cu oxidation, optical constants of CuO, single crystal Cu film preparation on NaCl substrates

CLEMSON UNIVERSITY

154. "Radiation Effects in Crystalline Materials" $43,662 02-03
    R. L. Chaplin - Department of Physics
    electron irradiated metal crystals, damage production and thermal annealing, irradiations at liquid He temperature, Al, Mg, Ti
COLUMBIA UNIVERSITY

155. "A Study of the Feasibility of Obtaining Field Ion Microscope Images of Interstitial Solutes" $34,000 01-02
E. S. Machlin - Dept. of Metallurgy
behavior of solutes in refractory transition element base solid solutions, field ion microscopy, Ta, Hf, W, Re and Os solutes

156. "Defects in Crystals" $47,491 01-02
A. S. Nowick - Dept. of Engineering and Applied Science
dielectric and anelastic relaxation techniques, Cu2O, FeGe, relaxation effects due to vacancies or substitutional atoms, piezoelectric relaxation

CORNELL UNIVERSITY

157. "Studies of the Lattice Properties of High Field Superconductors and Vanadium" $43,138 01-02
B. W. Batterman - Department of Materials Science and Engineering
low temperature structural transformation in V3Si and Nb3Sn, X-ray diffraction and optical microscopy, phonon properties by thermal diffuse X-ray scattering phonon dispersion and spectrum in V

158. "Defects in Metal Crystals" $178,151 01-03
R. W. Balluffi and D. N. Seidman - Dept. of Materials Science and Eng.
radiation damage produced by keV ion bombardment, annealing kinetics of vacancy defects in quenched Au, self diffusion along dislocations in Al, dechanneling of channeled ions at dislocations, structure of high angle boundaries, field ion microscopy of Au, W, Pt

159. "Electronic Properties of Defects in Ionic Crystals" $34,881 02-02
D. B. Fitchen - Department of Physics
optical investigation of the dynamic behavior of color centers in alkali halides, electron-phonon interaction, Jahn-Teller effect, excited state lifetimes
CORNELL UNIVERSITY (continued)

160. "Effect of Environment on Fracture Behavior" $32,407 01-01
H. H. Johnson - Dept. of Materials Science and Engineering
role of hydrogen in environmental cracking of high strength steels, protective role of oxygen in hydrogen-bearing gas, Fe whiskers, diffusion of hydrogen ahead of cracks

161. "A Study of the Interaction Between Magnetic Fluxoids and Crystal Defects in Type II Superconductors" $33,365 01-02
E. J. Kramer - Dept. of Materials Science and Engineering
quantitative determination of the effect of surface roughness on the surface critical current, Nb single crystals

162. "Theoretical Phonon Physics" $74,496 02-02
J. A. Krumhansl and P. Carruthers - Laboratory of Atomic and Solid State Physics
phonons in highly anharmonic and quantum crystals, vibrations of disordered systems, transport involving phonons, soft modes and dynamics in phase changes

163. "Experimental Phonon Physics" $141,310 02-02
J. A. Krumhansl, R. O. Pohl, A. J. Sievers - Laboratory of Atomic and Solid State Physics
lattice vibrations in pure dielectric solids and in solids containing controlled amounts of impurities, optical absorption in superconductors, interatomic forces in solids, far infrared and microwave absorption, low temperature heat conduction and specific heat

164. "Theory of Slow Neutron Inelastic Scattering by Liquids" $39,380 02-02
M. Nelkin - Dept. of Applied Physics
density-density correlation function in liquids, nature of atomic motion in liquids, structure and forces in liquids and dense gases
CORNELL UNIVERSITY (continued)

165. "Elastic and Plastic Deformation of Solids"  
A. L. Ruoff - Dept. of Materials Science and Engineering  
$122,700  01-01  
elastic constants, pressure derivatives of elastic constants, shock- 
equation of state, Na, Li halides, Rb halides, Cu, Ag, Au, K, NMR 
used to study diffusion in Al, creep as a function of pressure

166. "A Study of Imperfections in Crystals"  
H. S. Sack - Dept. of Applied Physics  
$64,685  02-02  
study of impurities (Li⁺, CN⁻, F⁻, NO₂⁻) in alkali halides, dielectric 
and anelastic measurements at very low temperatures, internal friction 
in single crystals of Al

167. "Hard Superconducting Materials"  
J. Silcox and W. W. Webb -  
Dept. of Applied Physics  
$96,000  01-02  
critical current density, magnetic hysteresis, instabilities of 
hard superconductors in high magnetic fields, surface currents, 
flux creep, quantum effects associated with weak superconducting 
links

168. "Solid State Physics: Magnetic Phenomena"  
R. H. Silsbee and R. Bowers -  
Department of Physics  
$127,000  02-02  
influence of transition element ions and rare earth ions upon the 
conduction spin resonance in metals, electron spin resonance and 
paraelectric resonance of defects in crystals, electron transport 
properties of metals in magnetic fields, direct electromagnetic 
excitation of sound waves in metals, ac losses and flux motion in 
superconductors

169. "Radiation Damage Studies Using the Cornell 3.0 MeV Dynamitron Accelerator"  
A. Taylor - Dept. of Materials Science and Engineering  
$41,364  02-03  
annihilation kinetics of lattice and electronic defects in alkali 
halides, conductivity, thermoluminescence, optical absorption
DELAWARE, UNIVERSITY OF

170. "Radiation-Induced Defects in Alkali Halides, and Their Role in Recombination Processes" $35,315 02-03
R. B. Murray - Dept. of Physics
radiation induced point defects in alkali halides, KCl, LiF, NaI, NaCl

FLORIDA, UNIVERSITY OF

171. "Deformation Processes in Hexagonal Metals" $29,125 01-01
R. E. Reed-Hill - Dept. of Metallurgical and Materials Engineering
flow stress in HCP metals, Ti, Zr, dynamic strain aging, electron microscopy

FRANKLIN INSTITUTE

172. "Studies of Crystal Perfection--Tantalum Silicide and Beryllium" $66,150 01-01
J. D. Meakin, G. J. London and V. V. Damiano - Dept. of Materials Science and Engineering
field ion microscopy of TaC and Ta2Si, growth of large Be crystals for use as neutron monochromators

GEORGETOWN UNIVERSITY

173. "The Study of Very Pure Metals at Low Temperatures" $50,758 02-02
W. D. Gregory - Dept. of Physics
effect of boundary scattering on properties of superconductors, superconducting tunneling properties of Ga, superconducting phase transition

GEORGIA INSTITUTE OF TECHNOLOGY

B. G. LeFevre and E. A. Starke - Dept. of Chemical Engineering
order parameters in Ni-Si alloys, Ni3Si, mechanical property studies, transmission electron microscopy
GEORGIA INSTITUTE OF TECHNOLOGY (continued)

175. "Surface Properties of Magnetic Materials" $ 57,570 02-02
E. J. Scheibner - Engineering Experiment Station
LEED scattering mechanisms, W, Cu, Ni, graphite, Si, Ge

176. "Magnetic Phenomena at Metal Surfaces" $ 45,000 01-02
S. Spooner - Dept. of Chemical Engineering
structure and magnetic phenomena at surfaces using neutron scattering, Co and Fe films, magnetic field effects

ILLINOIS INSTITUTE OF TECHNOLOGY

177. "Effects of Combined Stress on the Fracture and Fatigue of Brittle Ceramic Materials" $ 34,000 01-01
L. J. Broutman - Dept. of Mechanics
to determine the failure envelope for alumina, isotropic graphite and silicate glass when subjected to combined states of stress, cylindrical specimens subjected to various combinations of internal and external hydrostatic pressure

178. "Thermal Measurements on Solids Below 1^oK" $ 49,000 02-02
H. Weinstock - Dept. of Physics
low temperature thermal conductivity and specific heat measurements to study localized defects produced by radiation, alkali halides, MgO

JOHNS HOPKINS UNIVERSITY

179. "Phonon Imprisonment Studies" $ 13,449 02-02
P. E. Wagner - Department of Electrical Engineering
study of phonon avalanche, detection of avalanche phonons by reabsorption in a second paramagnetic species, detection by Brillouin scattering

KANSAS, UNIVERSITY OF

180. "Experimental and Theoretical Studies of Magnetic Resonance and Relaxation" $ 31,150 02-02
P. M. Richards - Dept. of Physics and Astronomy
nuclear and electronic spin waves in RbMnF$_3$, measurement of spin lattice relaxation and line width in concentrated paramagnetic salts
KENTUCKY, UNIVERSITY OF

181. "Radiation Effects on Germanium"  $ 32,570  02-03
B. R. Gossick - Dept. of Physics and Astronomy
charge carrier transport properties of n-type Ge bombarded with fast neutrons, charge carrier ambipolar mobility

LEHIGH UNIVERSITY

182. "Analysis of Flow and Fracture of Composite Materials During Gross Plastic Deformation"  $ 35,000  01-01
B. Avitzur - Dept. of Metallurgy and Materials Science
deformation patterns of spherical inclusions in a matrix, void formation around inclusions, effects of geometry, strength ratio of inclusion to matrix and environmental pressure

183. "Strength and Structure in Cyclically Transformed Fe-Ni-C Alloys"  $ 13,816  01-01
G. Krauss, Jr. - Dept. of Metallurgy and Materials Science
cyclic transformation in steels to produce different microstructures of carbide distribution, transmission electron microscopy, mechanical property measurements

LOUISIANA STATE UNIVERSITY

184. "Conductivity Tensors in Metals and Semiconductors"  $ 75,476  02-02
J. M. Reynolds - Dept. of Physics and Astronomy
magnetoresistance, Hall effect, thermoelectric measurements, measurements made as a function of crystallographic orientation, electrical, thermal and thermoelectric tensors will be constructed, magnetoacoustic resonance, NMR, ESR, cyclotron resonance, Sb, Sn, Tl, Cd, Zn, Hg, Nb
185. "Defect Structures in Nonstoichiometric Oxides" $ 31,189 01-02
R. N. Blumenthal - Department of Mechanical Engineering
defect structure and transport properties in nonstoichiometric CeO$_2$,
electrical conductivity, Hall mobility, ionic transference, thermo-
gravimetric weight measurements, measurements up to 1500°C

186. "Conduction Electrons and Magnetism" $ 29,139 02-02
J. R. Anderson and S. M. Bhagat - Dept. of Physics and Astronomy
ferromagnetic resonance (FMR) in single crystals of Fe, Ni, Co and Gd, FMR measurements as a function of temperature and frequency to be correlated with dHvA effect measurements

R. J. Arsenault - Dept. of Chemical Engineering
neutron damage to V and Ti-V BCC solid solutions, mechanical properties, activation parameters for flow stress, rate controlling mechanism for low temperature plastic deformation

188. "An Investigation of Solid Solution Hardening in Metallic Solid Solution Alloys" $ 26,610 01-01
R. M. Asimow - Dept. of Mechanical Engineering
strength of FCC solid solutions, critical resolved shear stress in Ag-Au, effect of single crystal growth rate on CRSS of Ag-3%In, quantitative theory of solid solution strengthening

189. "Atomic Strengthening Due to Atomic Order" $ 34,000 01-02
M. J. Marcinkowski - Dept. of Mechanical Engineering
study of work hardening, compressive stress-strain curves for single and polycrystalline alloys, effect of stacking fault energy and anti-phase boundary energies, transmission electron microscopy
MARYLAND, UNIVERSITY OF (continued)

190. "The Galvanomagnetic Properties of Graphite in the Temperature Range 4-300°K and Pressure Range 0-10,000 kg/cm²" $29,908 01-01
I. L. Spain - Inst. for Molecular Physics
Hall coefficient and magnetoresistance of graphite crystals, variation of carrier density and mobility with pressure and temperature

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

191. "Mechanical Properties of Metals" $18,608 01-01
W. A. Backofen - Dept. of Metallurgy
shear fracture in polycrystalline Zr, oriented single crystals of Zr and polycrystalline textured Zircaloy-4, compressive flow stress

192. "Thermal Neutron Scattering Studies of Molecular Dynamics and Critical Phenomena in Liquids and Solids" $90,211 02-02
S. H. Chen and S. Yip - Dept. of Nuclear Engineering
inelastic thermal neutron scattering using a 3-axis spectrometer at MIT reactor

193. "Basic Research in Ceramics and Non-crystalline Systems" $282,820 01-01
W. D. Kingery and R. L. Coble - Dept. of Metallurgy
crystal growth by chemical vapor transport (FeO, ZnS, UO₂), freeze-dry preparation of mixed oxides, solid solubilities in MgO, high pressure sintering, oxygen diffusion in Al₂O₃, tunneling spectroscopy in amorphous Si, nonstoichiometry in fluorite-type structures (UO₂, ThO₂)

194. "Low Temperature Neutron Physics Studies" $93,347 02-02
C. G. Shull - Dept. of Physics
polarized neutron diffraction techniques used to investigate coherent paramagnetic scattering in pure V and in dilute Kondo-state alloys, reflectivity for the (222) forbidden reflection in Ge, dynamical diffraction of neutrons in perfect crystals
MASSACHUSETTS INSTITUTE OF TECHNOLOGY (continued)

195. "Microcracking in Welds of Nickel Base Alloys" $ 17,000 01-01
   T. O. Ziebold - Depts. of Nuclear Eng. and Metallurgy and Materials Science
   electron microprobe investigation of chemical elements in the vicinity of grain boundaries in Ni base alloys

MASSACHUSETTS, UNIVERSITY OF

196. "Ultrasonic Attenuation Studies of the Electronic Structure of Metals" $ 36,000 02-02
   A. R. Hoffman - Dept. of Physics and Astronomy
   diamagnetic domain formation in metals (Be, Ag), acoustic attenuation as a function of magnetic field, temperature and angular orientation in K, high frequency acoustic attenuation in pure Type I superconductors (Nb)

MICHIGAN STATE UNIVERSITY

197. "Studies of Electrical and Defect Properties of Thin Metallic Wires" $ 37,000 02-02
   J. Bass - Dept. of Physics and Astronomy
   point defects in Pt, Ta, W, Mo by the quenching technique, effects of specimen size and magnetic field on the thermopower of Al

198. "Study of Interactions between f-Shell Transition Ions in Non-metallic Crystals" $ 29,850 02-02
   E. H. Carlson - Dept. of Physics
   super exchange interactions and magnetic ordered states, NMR as a function of temperature, pressure, applied field and doping, GdCl₃, PrCl₃

199. "Properties of Rare-Gas Solids" $ 35,266 02-02
   G. L. Pollack - Dept. of Physics and Astronomy
   thermodynamic properties, surface physics, anharmonicity, defect structure, solid A, Kr, Xe, Ne
MICHIGAN TECHNOLOGICAL UNIVERSITY

A. A. Hendrickson - Department of Metallurgical Engineering
FCC and BCC solid solutions, flow stress and activation energy for deformation in Ag alloys, thermally activated glide in Nb-Mo single crystals

201. "Effect of Annealing on the Substructure of Cold Worked fcc Metals and Alloys" $25,286 01-02
D. E. Mikkola - Department of Metallurgical Engineering
X-ray diffraction and transmission electron microscopy of annealing studies, solid solutions of Ge in Cu, Cu₃Au, Pt₃Fe, kinetics of antiphase domain growth, configuration of antiphase domain boundary

MICHIGAN, UNIVERSITY OF

202. "Fission Fragment Induced Electrical Transients in Dielectric Materials" $11,870 01-03
D. R. Bach - Dept. of Nuclear Engineering
detection of fission fragments through observations of transient electrical pulse caused by passage of fission fragment through dielectric materials

203. "Thermodynamic Activities in Solid Alloys" $31,000 01-02
R. D. Pehlke - Dept. of Chemical and Metallurgical Engineering
thermodynamic properties of solid alloys using solid state electrochemical cells, Fe-Cr and Ni-Cr systems

MINNESOTA, UNIVERSITY OF

204. "In Situ' Electron Microscope Investigation of the Nucleation and Growth of Sputtered Thin Films" $47,000 01-01
T. E. Hutchinson - School of Mineral and Metallurgical Engineering
mechanism of nucleation and growth of films deposited by inert gas ion sputtering, films deposited in situ in the electron microscope on both single crystal and amorphous substrates
MINNESOTA, UNIVERSITY OF (continued)

205. "Effect of Short-Range Order on the Mechanical Properties of Alloys"  $ 19,000  01-01
M. E. Nicholson - Dept. of Mineral and Metallurgical Engineering
Bauschinger strain and overshooting in short range order alloys, Au-Pd alloys, single crystals pulled in tension

D. F. Stein - School of Mineral and Metallurgical Engineering
analysis of fracture surfaces to determine chemical composition using Auger Electron Emission, Fe with additions of P, C, and O

207. "Diffusion Studies in Liquid Metals"  $ 48,709  01-02
R. A. Swalin - Dept. of Mineral and Metallurgical Engineering
self diffusion under constant volume conditions, Na, Soret effect in liquid Ag, X-ray diffraction studies of alkali liquid metals

208. "Experimental and Theoretical Studies in Solid State and Low Temperature Physics"  $179,300  02-02
W. Zimmerman, Jr., L. H. Nosanow, A. M. Goldman, and W. Weyhmann - School of Physics
superconductivity, theory of quantum crystals, theoretical and experimental studies of the magnetic properties of solid $^3$He, theory of $^3$He-$^4$He mixtures, magnetism in metals, superfluidity in He, millidegree temperature range techniques

MISSISSIPPI, UNIVERSITY OF

209. "The Effects of Neutron Irradiation on the Binary Alloys"  $ 5,747  02-03
A. B. Lewis - Dept. of Physics and Astronomy
Cu alloys, neutrons from target reaction using dynamitron, resistivity, to be discontinued
MISSOURI, UNIVERSITY OF

210. "Ferroelectric Properties of Bismuth Ferrate and Related Materials" $ 21,482 02-02
   R. Gerson and W. J. James - Department of Physics
   growth of single crystals of BiFeO₃, dielectric measurements, x-ray and neutron diffraction, magnetic properties

211. "Nuclear Radiation Effects on Silicon P-N Junctions" $ 45,000 02-03
   C. A. Goben - Dept. of Nuclear Engineering
   voltage-current characteristics of neutron irradiated junctions, neutron fluence dependence of the quasi-Fermi potentials, recombination statistical model for the neutron-induced base current component, scanning electron microscopy to examine defect clusters

MURRAY STATE UNIVERSITY

212. "Interaction of Fission Fragments with Thin Films" $ 22,700 02-03
   L. Bridwell - Dept. of Physics
   interaction of fission fragments of ²⁵²Cf with thin films, mechanism of heavy ion kinetic energy losses, time-of-flight system to determine the mass mode of the fission event

NEW YORK, STATE UNIVERSITY OF

213. "Theory of Reaction Kinetics" $ 49,000 02-03
   J. W. Corbett - Dept. of Physics, Albany
   role of spatial correlation in diffusion limited reaction kinetics, recovery in discrete lattices, simultaneous production and diffusion-limited recovery, radiation damage, void formation

214. "Study of Microplastic Behavior of Tungsten and Other Refractory Metals in Relation to the Brittle Fracture Problem" $ 17,729 01-01
   J. C. Bilello - Dept. of Materials Science, Stony Brook
   low temperature microstrain tests on W single crystals, etch pit and electron microscopy observations
NEW YORK, STATE UNIVERSITY OF (continued)

215. "Fatigue-Enhancement of Diffusion" $14,752 01-01
H. Herman - Department of Materials Science, Stony Brook
low amplitude cyclic straining of alpha brass, electrical resistivity, short range order effects

216. "Thermal Neutron Scattering on Magnetic Materials and Liquids" $49,000 02-02
R. Nathans - Department of Physics, Stony Brook
magnetic critical scattering in $\text{MnF}_2$ and $\text{ZrZn}_2$, magnetic spin density in alloy systems showing Kondo behavior, inelastic neutron scattering in liquid Ne, A, $^3\text{He}$-$^4\text{He}$, neutrons from BNL HFBR reactor

NORTH CAROLINA STATE UNIVERSITY

217. "Behavior of Gases in Solids" $32,909 01-03
T. S. Elleman - Department of Nuclear Engineering
diffusion coefficients of $^{133}\text{Xe}$ in single crystals of KI and RbI, hydrogen bubble formation in metals irradiated with protons, tritium gradients in metals

218. "Grain Boundary Sliding in Alumina Bicrystals" $20,000 01-01
H. Palmour, III - Department of Engineering Research
high temperature deformation of synthesized bicrystals of $\text{Al}_2\text{O}_3$, orientation dependence of deformation mechanisms

219. "An Experimental Investigation of Boiling Bubbles" $25,996 01-01
R. F. Saxe - Department of Nuclear Engineering
establishment of parameters which control emission of sound from boiling bubbles, acoustic emission measurements on model systems
NORTH CAROLINA, UNIVERSITY OF

220. "Investigation of Defect Structures by Electric Polarization and Relaxation Methods" $34,031 02-02
J. H. Crawford, Jr. - Dept. of Physics
studies of dipolar defects and lattice imperfections, optical absorption, luminescence, EPR, ionic thermo-current method, KCl

221. "The Properties of Metals and Alloys" $66,000 02-02
L. D. Roberts - Dept. of Physics
measurement of screening charge distribution in alloys, Mössbauer effect, Au alloys, Fe-Cu, Kondo effect, pressure dependence of the characteristic temperature associated with screening

222. "Atomic Diffusion in Crystals" $31,208 02-02
L. Slifkin - Dept. of Physics
ion mobility in metals and ionic crystals, EPR in Mn doped AgCl, Ag in Al, isotope effect measurements of diffusion in Ag halides, cation diffusion in alkaline earth halides and oxides

223. "Pressure Variation of Single Crystal Elastic Constants" $19,907 02-02
C. S. Smith - Dept. of Physics
elastic constants of Rb halides, ultrasonic pulse echo method, pressure and temperature dependence

NORTH DAKOTA, UNIVERSITY OF

224. "Physical Phenomena in Crystals Consisting of a Finite and Countable Number of Atoms in One Direction" $35,000 02-02
H. H. Soonpaa - Dept. of Physics
study of size effect quantization using Bi$_8$Te$_7$S$_5$ crystals, thin crystals with atomically smooth surfaces, electrical conductivity, optical transmission, x-ray diffraction

NORTHEASTERN UNIVERSITY

225. "Structural, Thermal, and Electronic Properties of Metastable Binary Alloys of Thorium and Uranium Produced by Rapid Quenching" $32,662 01-01
B. C. Giessen - Dept. of Chemistry
metastable binary alloys containing actinide elements, splat cooling, Th and U alloys
NORTHEASTERN UNIVERSITY

226. "Calorimetric Studies of the Proximity Effect in Superconductors" $31,771 02-02
C. A. Shiffman - Dept. of Physics
excess superconductive ordering associated with proximity effect when superconducting and normal metals are brought into contact, measurements of specific heat of laminar eutectic alloy, Sn-Pb, Sn-Zn, Au-Tl, Cd-Tl

NORTHWESTERN UNIVERSITY

227. "Effect of Point Defects on Mechanical Properties of Metals" $43,049 01-03
M. Meshii - Dept. of Materials Science
effect of interstitials produced by electron irradiation on mechanical properties, quenched-in vacancies, dislocation-defect interactions

228. "Analytical Study on Dislocations in Thin Films" $34,180 01-02
T. Mura - Dept. of Civil Engineering
elastic stress and strain fields associated with dislocation distributions in thin films, dislocation interactions with impurities, dislocations, vacancy clusters and cavities

OHIO STATE UNIVERSITY

229. "An Investigation of Mixed Conduction in Solid Electrolytes" $31,015 01-02
R. A. Rapp - Dept. of Metallurgical Engineering
measurement and interpretation of solid state galvanic cell conduction, ThO$_2$, Y$_2$O$_3$, UO$_2$, ZrO$_2$, Dy$_2$O$_3$, Gd$_2$O$_3$, mixed conduction in molten salt electrolytes

230. "Liquid Metals Research--Electrotransport and Solidification Studies" $34,043 01-02
D. A. Rigney - Dept. of Metallurgical Engineering
electrotransport in dilute liquid alloys, supercooling of liquid metal droplets using coil and bridge technique
231. "The Effects of Surface Coatings on the Plastic Deformation of Metal Single Crystals" $28,176 01-01
R. J. Block - Dept. of Chemical Engineering and Materials Science
- evaporated metal coatings, effect of residual stress on film strengthening effect, etch-pit and mechanical property tests, Cu crystals

232. "Thermoelectric Size Effect in Noble Metals" $26,604 02-02
R. R. Bourassa - Dept. of Physics
- measurement of the electronic component of the thermoelectric power, Au, Cu, Ag, influence of specimen size on phonon drag component

233. "Natural Convection Heat Transfer in Liquid Metals" $20,843 01-01
J. R. Welty - Dept. of Mechanical, Industrial and Nuclear Engineering
- natural convection of Hg between two vertical parallel plane walls, magnetic velocity probe to measure velocity

234. "Nonlinear Elastic and Thermoelastic Properties of Materials" $50,036 02-02
G. R. Barsch - Materials Research Lab.
- nonlinearity of interatomic forces with respect to atomic displacements in U compounds and alkali halides RbCl, RbBr, RbI, CsI, third order elastic compounds, phonon dispersion relations

235. "Ceramic Research on Transformational Superplasticity and Ferroelectric Domain Boundaries" $26,000 01-01
R. C. Bradt and J. H. Hoke - Dept. of Materials Science
- mechanical properties of bismuth oxide solid solutions, transmission electron microscopy of ferroelectric domain boundaries in BaTiO$_3$
236. "Thermodynamic Properties of Solid 
Solutions at High Temperatures" $29,309 01-02
A. Muan - Dept. of Geochemistry 
and Mineralogy
study of titanate solid solutions, ZnO-CoO-TiO$_2$, ZnO-NiO-TiO$_2$, activity-
composition relations, MgO-FeO-NiO-SiO$_2$ quaternary system, stability 
of silicon oxynitride

237. "Transformations in AB$_2$ Intermetallic 
Compounds" $11,000 01-02
E. Ryba - Dept. of Metallurgy
search for phase transformations in compounds, YbZn$_2$, SmZn$_2$, x-ray 
diffraction, magnetic susceptibility of R.E. Zn$_2$ compounds, elastic 
constants of HoZn$_2$, phase diagrams for YCu$_2$-YZn$_2$, YbZn$_2$-YbAl$_2$

238. "Research on Graphite" $110,333 01-01
P. L. Walker, Jr. - Department of Materials 
Science
carbon formation and graphitization, gas-graphite interactions, 
dynamic mechanical properties of carbon and graphite, microscopy 
of defects in graphite, electronic transport properties of B doped 
graphite

239. "Precipitation From Supersaturated 
Copper-Titanium Solid Solutions: 
The Aging Process in Copper-Titanium 
Side-Band Alloys" $25,902 01-02
W. A. Soffa - Dept. of Metallurgical 
and Materials Engineering
study of very early stages of decomposition in supersaturated Cu-Ti 
solid solutions, kinetics and mechanism followed electrical 
resistivity and X-ray diffraction

240. "A Study of Radiation Induced Defects 
in Metals" $30,154 02-03
J. R. Townsend - Dept. of Physics
10 MeV proton irradiation of Cu and W crystals, anelastic measure-
ments, computer calculations of defect configurations and their 
effect on the shear modulus, piezoresistance measurements
PITTSBURGH, UNIVERSITY OF (continued)

241. "Thermal, Structural and Magnetic Studies of Metals and Intermetallic Compounds" $97,972 02-02
W. E. Wallace and R. S. Craig - Dept. of Chemistry
crystal field spectra of lanthanide ions, constitution and magnetic behavior of ternary systems containing lanthanides, electronic specific heats of Mg-Cu-Zn alloys, electronic status of 3d transition elements in intermetallic compounds, magnetic coupling of lanthanides in ternary Laves, Haucke and 2:17 phases

PURDUE UNIVERSITY

242. "Diffusion and Precipitation of Inert Gases in Metals" $31,080 01-03
J. R. Cost - School of Materials Science and Metallurgical Engineering
helium atoms in Al, Nb, internal friction, lattice parameter, electron microscopy, low temperature calorimetry

243. "Transport and Thermodynamic Properties of Solids" $27,163 01-02
R. E. Grace - Dept. of Metallurgical Engineering
diffusion in Ag-Cd-Zn, Cu-Zn-Mn, and Cu-Zn-Ni, electron microprobe analysis, electrical conductivity and Seebeck coefficient used to determine identity and diffusivity of lattice defects in CaTiO$_3$ and SrTiO$_3$

244. "Basic Radiation Damage Studies" $81,000 02-03
J. W. MacKay - Dept. of Physics
radiation damage in Ge and Si, electron irradiation, impurity effects in n-type Ge, length changes in irradiated Ge, annealing, photo-effects in irradiated p-type Ge, radiation annealing in Si

245. "Mössbauer Studies of the Properties of Solids" $32,000 02-02
J. G. Mullen - Dept. of Physics
Mössbauer hyperfine patterns of $^{57}$Fe in CoCl$_2$ and CoF$_2$, studies of NiO and CoO vacancy structure
RENSSELAER POLYTECHNIC INSTITUTE

246. "Theoretical Research on Electron Behavior in Crystals" $ 29,000 02-02
   E. Brown - Dept. of Physics
determination of the frequencies of several phonon modes in Cu,
   method of calculating the energy of a solid as a function of the
   amplitude of the deformation corresponding to a mode of vibration

247. "Effect of Hydrostatic Pressure on Self-Diffusion Rates in Hexagonal Metals" $ 33,000 02-02
   H. M. Gilder - Dept. of Physics
effect of pressure on the diffusion in Zn and Cd, anisotropy in
   activation volume for diffusion, diffusion of Ag in Zn, isotope
   effect in Cd

248. "Anisotropic Diffusion and Electromigration" $ 55,200 02-02
   H. B. Huntington - Dept. of Physics
electromigration, thermomigration, diffusion in non-cubic crystals,
   Zn, Mg, Cd, effect of absorbed gases on electromigration, thermo-
   migration in Ti, electromigration in liquid Na-K

249. "Research in Powder Metallurgy" $ 33,000 01-01
   F. V. Lenel - Dept. of Materials Engineering
   role of mechanical constraints due to multiple neck formation on
   sintering, Cu powder, electron microscopy of sintering of thin foils,
   electron microprobe study of inhomogeneity in alloys

250. "Precipitation and Dispersion Hardening in Hexagonal Alloys" $ 22,700 01-01
   N. S. Stoloff - Dept. of Materials Engg.
   slip and twin systems in Hf, influence of H on Hf strength and
   ductility, superplastic behavior in Mg-Th-Zr and Mg-Zr alloys, effect
   of heat treatment on strength, ductility, and fracture mechanisms

ROCHESTER, UNIVERSITY OF

251. "Electron Spin Resonance in Solids" $ 16,333 02-02
   T. G. Castner - Dept. of Physics and Astronomy
   stress dependence of spin-lattice relaxation for P and As in Si,
   ENDOR and spin lattice relaxation of O in alkali halides, trans-
   mission conduction electron resonance in Ga
SOUTHERN CALIFORNIA, UNIVERSITY OF

252. "Materials Research on High-Field Superconductors" $ 95,000 02-02
    Y. B. Kim - Depts. of Physics and Electrical Engineering
    effects of spin-orbit interactions on high field superconducting alloys, effect of metallurgical structure on loss characteristics, loss characteristics of Type II superconductors at microwave frequencies

253. "The Effects of Electric and Magnetic Fields on the Nucleation, Structure, and Residual Properties of Vapor Deposited Metal Films" $ 25,000 01-02
    L. E. Murr - Dept. of Materials Science
    effect of electric field and magnetic field on the residual structure and properties of vapor deposited films of Pd, In and Fe, transmission electron microscopy

STANFORD UNIVERSITY

254. "Structure Dependence of High Temperature Deformation of Metals" $ 44,000 01-01
    C. R. Barrett and W. D. Nix - Dept. of Materials Science
    structure dependence of high temperature deformation of metals, recovery in precipitation hardened Ni alloys, mechanism of creep and creep rupture in Ni-W alloys, viscous creep in Al, effects of shock deformation on creep

255. "Nitride Forming Reactions in Liquid Uranium Alloys" $ 37,636 01-01
    N. A. Parlee - Dept. of Mineral Engineering
    thermodynamics and kinetics of reactions of nitrogen with liquid U-Sn alloys, precipitation and resolution of UN

256. "Thermodynamic Properties and Defect Structure of Intermetallic Compounds" $ 30,000 01-02
    D. A. Stevenson - Dept. of Materials Science
    defect chemistry of compounds, self diffusion and impurity diffusion in ZnSe, precipitation studies in II-VI compounds, defect equilibria in CdTe
SYRACUSE UNIVERSITY

257. "In Situ Ultra High Vacuum High Energy Electron Diffraction Studies" $29,000 01-02
R. Vook - Dept. of Chemical Engineering and Metallurgy
nucleation and growth of epitaxial thin films, vapor deposited films on CaF$_2$, mica or NaCl substrates, HEED and transmission electron microscopy

TEMPLE UNIVERSITY

258. "A Study of the IB-IIB Beta Phase Alloys" $97,500 01-02
L. Muldawer and H. Amar - Department of Physics
optical constants of IB-IIB alloys and ordered and disordered Cu$_3$Au, Hall coefficients of CuZn-AuZn alloys, transport properties of metallic alloys in relation to their band structure, theory of long period superlattice based on the electronic structure of CuAu-I, studies of ordering using quantum statistical mechanics

TENNESSEE, UNIVERSITY OF

259. "Application of Adiabatic Calorimetry to Metal Systems" $23,180 01-01
E. E. Stansbury and C. R. Brooks - Dept. of Chemical and Metallurgical Engineering
heat capacity of Pt, Au, W, Cu, stainless steel, Al$_2$O$_3$, up to 1000°C, structure of Ni-base solid solutions, neutron irradiated Al

TEXAS, UNIVERSITY OF

T. H. Courtney - Dept. of Mechanical Engg.
microstructure changes due to high temperature exposure in composite materials, elevated temperature mechanical properties, directionally solidified rod eutectic alloys
TUSKEGEE INSTITUTE

261. "Density Determinations Using a Gamma Radiation Attenuation Technique" $34,270 01-01
I. G. Dillon - School of Engineering
densities of coexisting vapor and liquid alkali metals by attenuation of gamma rays from Cs-137 source, measurements up to 2500 K

UTAH, UNIVERSITY OF

262. "Recrystallization and Sintering of Oxides" $14,634 01-01
I. B. Cutler - Dept. of Ceramic Engineering
measurement of shrinkage rates, characterization of powders, effects of impurities on diffusivity, Al₂O₃, MgO, CaO

263. "Impurity Effects on the Creep of Polycrystalline Magnesium and Aluminum Oxides at Elevated Temperatures" $19,513 01-01
R. S. Gordon - Dept. of Materials Science and Engineering
creep under four point loading conditions up to 1600°C, MgO doped with FeO, vacuum hot pressing of powders, grain size dependence of viscous creep

264. "Interstitial Diffusion in Non-Metallic Crystals" $21,500 01-02
O. W. Johnson - Dept. of Physics
interstitial diffusion, point defects and complexes in TiO₂, Li diffusion as a function of pressure, H and D diffusion

265. "A Magnetic Resonance Study of Defects in Solids" $14,421 02-02
W. D. Ohlsen - Dept. of Physics
NMR in mixed alkali halides, LiF and NaF

266. "The Fundamentals of Radiation Damage" $78,203 02-03
A. Sosin - Dept. of Physics
electron radiation damage to solids with electron energies up to 8 MeV, damage rate as a function of energy, annealing, role of displacement spikes
VANDERBILT UNIVERSITY

267. "Deformation Studies of Superlattice Structure" $29,693 01-02
J. J. Wert and R. J. Bayuzick - Dept. of Mechanical Engineering
X-ray diffraction study of deformed Cu$_3$Pt, degree of long range order, antiphase domain size, resistivity and thermoelectric measurements

VERMONT, UNIVERSITY OF

268. "Thermodynamic and Transport Properties of Interstitial Hydrogen Isotopes in Palladium" $22,836 02-02
J. S. Brown - Dept. of Physics
theory of the behavior of transition metal hydrides, analysis of data based on the pseudopotential and model potential techniques, transport and thermodynamic properties of PdH$_x$ and PdD$_x$

269. "Absorption of Hydrogen and Deuterium by Palladium-Rich Alloys" $29,456 01-02
T. B. Flanagan - Dept. of Chemistry
diffusion of H and D in a series of Pd alloys using an electro-chemical relaxation technique, absorption studies on Cu-Pd, Ir-Pd and Pb-Pd alloys

VIRGINIA, UNIVERSITY OF

270. "Electronic Properties of Metals and Alloys" $76,692 02-02
R. V. Coleman - Dept. of Physics
magnetoresistance studies of ferromagnetic metals, effect of stress on magnetoresistance of Fe, tunneling and conduction phenomena in thin Fe-FeO-Fe sandwiches, Fermi surface topology in Cu, Ag and Pb, optical reflectivity measurements

271. "Investigations on the Behavior of Point Defects and Dislocations" $61,149 02-02
D. Kuhlmann-Wilsdorf - Dept. of Engineering Physics
investigation of Cu crystals of high perfection, theoretical investigations on the structure of monatomic liquids, theoretical research on the stresses due to various dislocation configurations, voids in metals
272. "Dynamic Dislocation Phenomena in Single Crystals of Metals and Alloys" $ 37,516 02-02
J. W. Mitchell - Dept. of Physics
second and third order elastic constants, elastic and plastic behavior near the yield point, deformation band formation, dislocation velocities, accurately oriented alpha phase Cu-Al single crystal rods of high purity and perfection

273. "A Study of Atomic Mobility in Crystalline Materials" $ 17,250 02-02
T. J. Turner and G. P. Williams - Dept. of Physics
atomic mobilities in metals and ionic crystals, internal friction, resistivity, optical absorption, dielectric relaxation, Ta, Ag-Au, RbCl, NH₄Cl, CaO, SrO

274. "Mössbauer Studies at High Pressure" $ 34,750 02-02
R. L. Ingalls - Dept. of Physics
Mössbauer effect studies in solids up to 300 kb pressure, internal magnetic field and isomer shift of transition metals, alloys and compounds containing $^{57}$Fe, Fe-Ni alloys

275. "A Study of Phase Transformations and Superconductivity" $ 33,086 01-01
D. H. Polonis - Dept. of Metallurgical Engineering
effects of thermal and mechanical history on the constitution and superconducting properties of alloys that exhibit diffusionless transformations and precipitation reactions, Ti alloys, flux pinning

276. "Electron Paramagnetic Resonance Studies of Radiation Effects in Solids and Chemical Compounds" $ 50,000 02-03
Yeong-Wook Kim - Dept. of Physics
single crystals of alkali halides, single crystals of phosphors including CaWO₄ and CsWO₄, superconducting films and junctions
WAYNE STATE UNIVERSITY (continued)

277. "Investigation of the Atomic Structure and Nature of the Magnetism in Several Magnetic Glasses" $25,000 02-02
H. O. Hooper - Dept. of Physics
Mossbauer techniques, magnetic susceptibility and NMR measurements, magnetic ordering, bonding of B and Li atoms in iron alkali borate glasses

WISCONSIN, UNIVERSITY OF

278. "Creep Mechanisms in B.C.C. Alloy Crystals" $26,782 01-01
R. A. Dodd - Dept. of Minerals and Metals Engineering
creep properties of stoichiometric NiAl single crystals, single crystals of CoAl and GaZn

YALE UNIVERSITY

279. "X-Ray Study of the Structure of Liquid Metals and Alloys" $25,824 01-02
C. N. J. Wagner - Dept. of Engineering and Applied Science
structure and electronic transport properties of molten binary alloys, temperature dependence of the structure of liquid metals, Hg-Tl, Hg-In, Au-Sn, Ag-Sn, Cu-Sn, In, Tl, Cd, Zn, Sn

280. "Study of Ideal Magnetic Crystals" $115,000 02-02
W. P. Wolf - Depts. of Physics and Engineering and Applied Science
low temperature ESR and NMR, high and low field magnetization, magneto-thermal measurements, neutron scattering, rf relaxation methods, CeCl₃, Dy₃Al₅O₁₂, Ce(C₂H₅SO₄)₃·9H₂O, rare earth hydroxides, nature of magnetic phase changes
SECTION C

Summary of Funding Levels

The summary funding levels for various research categories were determined from the index listing in Section D and estimating the percentage from the project devoted to a particular subject. There is overlap in the figures. For instance, funding for a project on diffusion in oxides at high pressure would appear in all three categories of diffusion, oxides, and high pressure.
During the fiscal year ending June 30, 1969, the Metallurgy and Materials Programs total support level amounted to about $27.7 million in operating funds and $2.7 million in equipment funds. These separately identified equipment funds are expended primarily at AEC Laboratories and are not shown in this report. Equipment funds for the University projects are included in the total contract dollars, being part of the operating budget. The following analysis of costs is concerned only with the $27.7 million operating funds.

1. By Region of the Country:

<table>
<thead>
<tr>
<th>Region</th>
<th>University Program (%)</th>
<th>Total Program (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Northeast</td>
<td>49.0</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>(N.Y., Mass., Vt., Conn., R.I., Penn., Md., Del., D.C.)</td>
<td></td>
</tr>
<tr>
<td>(b) South</td>
<td>12.5</td>
<td>22.4</td>
</tr>
<tr>
<td></td>
<td>(Va., Ky., Tenn., N.C., S.C., Ga., Fla., Ala., Miss., La., Puerto Rico)</td>
<td></td>
</tr>
<tr>
<td>(c) Midwest</td>
<td>19.7</td>
<td>40.3</td>
</tr>
<tr>
<td></td>
<td>(Ohio, Ind., Mich., Ill., Wisc., Minn., Iowa, Mo., Kansas, N.D.)</td>
<td></td>
</tr>
<tr>
<td>(d) West</td>
<td>18.8</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>(Texas, Okla., Ariz., Calif., Utah, Idaho, Oregon, Wash.)</td>
<td></td>
</tr>
</tbody>
</table>

2. By Academic Department or Laboratory Division:

<table>
<thead>
<tr>
<th>Department</th>
<th>University Program (%)</th>
<th>Total Program (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Metallurgy, Materials Science, Ceramics, Other Engineering (Office Budget Activity Numbers 01-)</td>
<td>47.6</td>
<td>50.4</td>
</tr>
<tr>
<td></td>
<td>42.2</td>
<td>49.3</td>
</tr>
<tr>
<td>(b) Physics, Solid State Science, Solid State Physics (Office Budget Activity Numbers 02-)</td>
<td>52.4</td>
<td>49.6</td>
</tr>
<tr>
<td></td>
<td>57.8</td>
<td>56.7</td>
</tr>
</tbody>
</table>
### SUMMARY OF FUNDING LEVELS

#### 3. By AEC Laboratory and University:

- **Total Program (%)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) University Program (including,</td>
<td>46.8</td>
</tr>
<tr>
<td>those laboratories where graduate students</td>
<td></td>
</tr>
<tr>
<td>are involved in research to a large extent</td>
<td></td>
</tr>
<tr>
<td>-- e.g., Ames Laboratory and</td>
<td></td>
</tr>
<tr>
<td>Lawrence Radiation Laboratory-Berkeley</td>
<td></td>
</tr>
<tr>
<td>(b) AEC Laboratory Program (including</td>
<td>53.2</td>
</tr>
<tr>
<td>laboratories where there is very little</td>
<td></td>
</tr>
<tr>
<td>graduate student involvement -- e.g.,</td>
<td></td>
</tr>
<tr>
<td>Atomics International)</td>
<td></td>
</tr>
</tbody>
</table>

#### 4. By Laboratory:

<table>
<thead>
<tr>
<th>Laboratory Name</th>
<th>Total Program (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ames Laboratory</td>
<td>9.3</td>
</tr>
<tr>
<td>Argonne National Laboratory</td>
<td>20.4</td>
</tr>
<tr>
<td>Atomics International</td>
<td>1.8</td>
</tr>
<tr>
<td>Brookhaven National Laboratory</td>
<td>10.0</td>
</tr>
<tr>
<td>Idaho Nuclear Corporation</td>
<td>0.6</td>
</tr>
<tr>
<td>Illinois, University of (Materials Research Laboratory)</td>
<td>5.2</td>
</tr>
<tr>
<td>Lawrence Radiation Laboratory/Berkeley</td>
<td>6.5</td>
</tr>
<tr>
<td>Mound Laboratory</td>
<td>0.4</td>
</tr>
<tr>
<td>Oak Ridge National Laboratory</td>
<td>18.6</td>
</tr>
<tr>
<td>Pacific Northwest Laboratory</td>
<td>1.5</td>
</tr>
<tr>
<td>Puerto Rico Nuclear Center</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Total: 75.2%
5. By Area of Research:

<table>
<thead>
<tr>
<th>Area of Research</th>
<th>Number of Projects (Total=280)</th>
<th>Total Program $ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actinide Metals and Compounds</td>
<td>6.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Ceramics</td>
<td>15.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Rare Earth Metals and Compounds</td>
<td>7.5</td>
<td>5.4</td>
</tr>
<tr>
<td>Inert Gas Solids and Liquids</td>
<td>4.6</td>
<td>3.3</td>
</tr>
<tr>
<td>(b) Technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutron Scattering</td>
<td>6.1</td>
<td>13.1</td>
</tr>
<tr>
<td>Theory</td>
<td>8.6</td>
<td>6.6</td>
</tr>
<tr>
<td>(c) Phenomena</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diffusion</td>
<td>12.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Strength</td>
<td>17.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Superconductivity</td>
<td>7.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Surface Phenomena and Thin Films</td>
<td>10.7</td>
<td>6.5</td>
</tr>
<tr>
<td>(d) Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Pressure</td>
<td>7.9</td>
<td>4.1</td>
</tr>
<tr>
<td>Radiation</td>
<td>13.9</td>
<td>15.8</td>
</tr>
</tbody>
</table>
ICRF decay FT 1971
March 1, 1970

HEP

- Sys. proj. in HEP— why?
  - storage ring
  - energy gap developing with budget council
  - gravity waves— atomic & classical physics
  - disadvantaged youths
  - business & open housing

AGS, SLAC, colliding beams (accelerator price vs area)

PPA— White to find funds elsewhere e.g. NSF $1-2 million

Russia, HEP students— Pomer— priorities

ZGS—Beratron, GAO & audit

MEP

- Patent— Varian Assoc.— LAMPF
- Rosen— Radiotherapy— EPA

CTR—
SECTION D

Index of Investigators, Materials, Phenomena, Technique and Environment

The index refers to project numbers in Sections A and B.
INVESTIGATORS - A -

Abraham, M. M., 114
Achar, N. B. N., 22
Adams, P., 41
Aldred, A. T., 23
Alfred, L. C. R., 22
Altstetter, C. J., 58
Amar, H., 258
Anderson, J. R., 186
Appleton, B. R., 123
Arai, T., 35
Arajs, S., 152
Ardell, A. J., 140
Arenberg, C. A., 26
Arko, A. J., 18
Arndt, R., 50
Arsenault, R. J., 187
Artman, J. O., 145
Asimow, R. M., 188
Atlas, L. M., 18
Avitzur, B., 182
Axe, J. D., 44

Bach, D. R., 202
Backofen, W. A., 191
Bailey, D. M., 4
Baldwin, T. O., 112
Balluffi, R. W., 158
Bardos, D. I., 23
Barnes, L. J., 37
Barnes, R. G., 10
Barrett, C. R., 254
Barsch, G. R., 234
Bartram, R., 56
Bass, J., 197
Batterman, B. W., 157
Bauer, W., 38
Bayuzick, R. J., 267
Beck, P. A., 59
Beckurts, K. H., 46
Bennion, R. B., 57
Berg, W. T., 118
Betterton, J. O. Jr., 107
Bhat, S. M., 186
Bierlein, T. K., 126
Bilello, J. C., 214

Birnbaum, H. K., 60
Blewitt, T. H., 26
Blinc, R., 32
Block, R. J., 231
Blume, M., 49
Blumenthal, R. N., 185
Bosacchi, B., 35
Boston, C. R., 109
Bourassa, R. R., 232
Bowers, R., 168
Bowman, F. E., 125
Boyle, A., 33
Bradt, R. C., 235
Brandt, W., 51
Bray, P. J., 136
Brewer, L., 83
Bridwell, L., 212
Brinham, J. L., 126
Brodsky, M. B., 18
Brooks, C. R., 259
Broutman, L. J., 177
Brower, W. S., 96
Brown, E., 246
Brown, J. S., 268
Brugger, R. M., 57
Brun, T. O., 16
Brynestad, J., 109
Burnet, G., 8
Butler, C. T., 111

Cable, J. W., 116
Cappelletti, R. L., 11
Carlson, E. H., 198
Carlson, O. N., 2, 5
Carpenter, R. W., 102
Carruthers, P., 162
Castleman, L. S., 135
Castner, T. G., 251
Cathcart, J. V., 104
Chan, S. K., 23
Chaplin, R. L., 154
Chen, C. W., 7
Chen, S. H., 192
Chen, W. K., 19
Chen, Y., 117
CHENG, C. Y., 20
Cherry, L. V., 10
Chester, M., 141
Chiotti, P., 4
Clark, G. W., 111
Clarke, J., 93
Cleland, J. W., 111
Clem, J. R., 11
Cobas, A., 128
Coble, R. L., 193
Cohen, H. D., 133
Cohen, M. L., 87
Coleman, R. V., 270
Collings, E. W., 39
Collins, M. F., 43
Coltman, R. R. Jr., 124
Connor, D. W., 28
Corbett, J. W., 213
Cost, J. R., 242
Courtney, T. H., 260
Cox, D. E., 46, 48
Craig, R. S., 241
Crangle, J., 23
Crawford, J. H. Jr., 220
Crow, J., 54
Crump, J. C., 119
Culbert, H., 31
Cutler, I. B., 262
Czanderna, A. W., 153
Czjjzek, G., 107, 110

Dahlgren, S. D., 125
Dahm, A. J., 147
Damask, A., 50, 53, 55
Damiano, V. V., 172
Danielson, G. C., 13
Darby, J. B. Jr., 23
Decker, D. L., 57
Delbecq, C., 29
Dickey, J., 41
Dienes, G. J., 53, 56
Dillon, I. G., 261
DiNardo, R., 55
Dodd, R. A., 278
Dorn, J. E., 76

Drickamer, H. G., 69
Dunlap, B., 33
Duwez, P., 138

Eckstein, S., 35
Eckstein, Y., 30
Ehrenreich, H., 49
Elleman, T. S., 217
Emrick, R. M., 130
Enderby, J. E., 39
Epstein, S., 41
Esser, P. D., 51

Farrell, K., 100
Faulkner, J. S., 106
Felcher, G., 28
Fink, H. J., 37
Finnemore, D. K., 11
Fischer, C. R., 56
Fisher, E. S., 19
Fitchen, D. B., 159
Flanagan, T. B., 269
Flinn, P. A., 146
Fradin, F. Y., 23
Frazer, B. C., 44, 46
Freeman, A. J., 49
Fuchs, R., 15
Fulkerson, W., 97
Furlath, R. M., 81

Galligan, J., 42
Garber, M., 40
Gerlich, D. A., 19
Gerson, R., 210
Gibala, R., 148
Giessen, B. C., 225
Gilbert, T., 35
Gilder, H. M., 247
Gilman, J. J., 61
Goates, J. R., 134
Goben, C. A., 211
Goland, A., 52, 55, 56
Gold, A. V., 9
INVESTIGATORS

Goldman, A. M., 208
Gomer, R., 151
Good, R. H., 17
Goodman, G. M., 23
Gordon, R. S., 263
Goroff, I. R., 22
Gossick, B. R., 181
Grace, R. E., 243
Graeser, R., 48
Granato, A. V., 70
Gregory, W. D., 173
Gruber, E. E., 26
Gschneidner, K. A., 4
Gupta, R. P., 16
Gurland, J., 137
Guthrie, P. V., 103
Guttman, L., 32

Hahn, E. L., 92
Halpern, T., 34
Hammond, R., 86
Harris, L. A., 105
Hart, R. K., 21
Hatcher, R., 56
Heaton, L., 25
Hehemann, R. F., 149
Hendricks, R. W., 105
Hendrickson, A. A., 200
Herley, P. J., 51
Herman, H., 53, 55, 215
Hinks, D., 27
Hodges, L., 9
Hoffman, A. R., 196
Hoffman, R. W., 150
Hohenemser, C., 132
Hoke, J. H., 235
Holmes, D. K., 121
Hooper, H. O., 277
Hoy, G. R., 131
Hudgens, C. R., 94
Huebener, R., 31
Hulsey, W. J., 103
Hultgren, R., 85
Hunter, O., 3
Huntington, H. B., 248

Hurst, J., 48
Hutchings, M. T., 43
Hutchinson, T. E., 204

Ingalls, R. L., 274
Isaacs, L. L., 23

Jackson, J., 36
James, W. J., 210
Jenkins, L. H., 122
Johnson, H. H., 160
Johnson, O. W., 264
Johnson, R. A., 56
Joy, H. W., 106

Kalvius, G., 33
Kammerer, O. F., 40, 54
Kay, M. I., 127
Kayser, F. X., 4
Keating, D., 52, 56
Keeler, D. W., 38
Keeler, W. J., 11
Keller, J. M., 15
Kemmey, P., 56
Kernohan, R. H., 113
Kerr, W., 35
Ketterson, J., 30, 33
Kettunen, P. O., 20
Kierstead, H., 32
Kim, Y. B., 252
Kim, Yeong-Wook, 276
Kimball, C. W., 23
Kingery, W. D., 193
Kissinger, H. E., 126
Klabunde, C. E., 124
Klamut, C., 48
Klank, A. C., 26
Kleb, R., 28
Kleinberg, R., 127
Kliwerer, K. L., 15
Koch, C. C., 99
Kocks, U. F., 20
Koczak, M., 55
<table>
<thead>
<tr>
<th>Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koehler, J. S.</td>
<td>75</td>
</tr>
<tr>
<td>Koehler, W. C.</td>
<td>116</td>
</tr>
<tr>
<td>Kollie, T. G.</td>
<td>98</td>
</tr>
<tr>
<td>Kolopou, J. L.</td>
<td>114</td>
</tr>
<tr>
<td>Korn, A.</td>
<td>50</td>
</tr>
<tr>
<td>Kostorz, G.</td>
<td>26</td>
</tr>
<tr>
<td>Kramer, E. J.</td>
<td>161</td>
</tr>
<tr>
<td>Krauss, G. Jr.</td>
<td>183</td>
</tr>
<tr>
<td>Krumhansl, J. A.</td>
<td>162,163</td>
</tr>
<tr>
<td>Kuchnir, M.</td>
<td>30</td>
</tr>
<tr>
<td>Kuhlmann-Wilsdorf, D.</td>
<td>271</td>
</tr>
<tr>
<td>Kulcinski, G. L.</td>
<td>126</td>
</tr>
<tr>
<td>Kusmiss, J.</td>
<td>55</td>
</tr>
<tr>
<td>Kuzniertz, M.</td>
<td>25</td>
</tr>
<tr>
<td>Lam, D. J.</td>
<td>23</td>
</tr>
<tr>
<td>Land, R.</td>
<td>35</td>
</tr>
<tr>
<td>Lander, G. H.</td>
<td>25</td>
</tr>
<tr>
<td>Lawson, A. W.</td>
<td>142</td>
</tr>
<tr>
<td>Lazarus, D.</td>
<td>71</td>
</tr>
<tr>
<td>Lechner, R.</td>
<td>28,32</td>
</tr>
<tr>
<td>Lee, H. J.</td>
<td>49</td>
</tr>
<tr>
<td>LeFevre, B. G.</td>
<td>174</td>
</tr>
<tr>
<td>Legvold, S.</td>
<td>14</td>
</tr>
<tr>
<td>Lemos, A.</td>
<td>51</td>
</tr>
<tr>
<td>Lenel, F. V.</td>
<td>249</td>
</tr>
<tr>
<td>Levy, P. W.</td>
<td>51,55</td>
</tr>
<tr>
<td>Lewis, A. B.</td>
<td>209</td>
</tr>
<tr>
<td>Lieberman, D. S.</td>
<td>62</td>
</tr>
<tr>
<td>Liu, S. H.</td>
<td>14</td>
</tr>
<tr>
<td>Loh, B. T. M.</td>
<td>100</td>
</tr>
<tr>
<td>London, G. J.</td>
<td>172</td>
</tr>
<tr>
<td>Loomis, B. A.</td>
<td>26</td>
</tr>
<tr>
<td>Love, G. R.</td>
<td>99</td>
</tr>
<tr>
<td>Lundy, T. S.</td>
<td>108</td>
</tr>
<tr>
<td>Luo, Huey-Lin</td>
<td>143</td>
</tr>
<tr>
<td>Lynch, D. W.</td>
<td>15</td>
</tr>
<tr>
<td>MacKay, J. W.</td>
<td>244</td>
</tr>
<tr>
<td>Machlin, E. S.</td>
<td>155</td>
</tr>
<tr>
<td>Maglic, R. G.</td>
<td>25</td>
</tr>
<tr>
<td>Marcinkowski, M. J.</td>
<td>189</td>
</tr>
<tr>
<td>Marshall, S.</td>
<td>34</td>
</tr>
<tr>
<td>Martin, J. J.</td>
<td>13</td>
</tr>
<tr>
<td>Mastel, B.</td>
<td>126</td>
</tr>
<tr>
<td>Mattern, P.</td>
<td>51,55,56</td>
</tr>
<tr>
<td>Matzkanin, G. A.</td>
<td>24</td>
</tr>
<tr>
<td>McElroy, D. L.</td>
<td>98</td>
</tr>
<tr>
<td>McMillan, J.</td>
<td>34</td>
</tr>
<tr>
<td>McWhan, D. B.</td>
<td>57</td>
</tr>
<tr>
<td>Meakin, J. D.</td>
<td>172</td>
</tr>
<tr>
<td>Meister, H.</td>
<td>44</td>
</tr>
<tr>
<td>Merkert, F.</td>
<td>48</td>
</tr>
<tr>
<td>Merkle, K. L.</td>
<td>26</td>
</tr>
<tr>
<td>Merriam, M.</td>
<td>86</td>
</tr>
<tr>
<td>Merz, D.</td>
<td>125</td>
</tr>
<tr>
<td>Meshii, M.</td>
<td>227</td>
</tr>
<tr>
<td>Metzger, M.</td>
<td>63</td>
</tr>
<tr>
<td>Mikkola, D. E.</td>
<td>201</td>
</tr>
<tr>
<td>Miksic, M. G.</td>
<td>46</td>
</tr>
<tr>
<td>Miller, J. W.</td>
<td>21</td>
</tr>
<tr>
<td>Miller, M. D.</td>
<td>46</td>
</tr>
<tr>
<td>Minkiewicz, V. J.</td>
<td>43,44</td>
</tr>
<tr>
<td>Mitchell, J. W.</td>
<td>272</td>
</tr>
<tr>
<td>Montet, G.</td>
<td>36</td>
</tr>
<tr>
<td>Mook, H. A.</td>
<td>115</td>
</tr>
<tr>
<td>Moon, R. M.</td>
<td>116</td>
</tr>
<tr>
<td>Moore, J. P.</td>
<td>98</td>
</tr>
<tr>
<td>Morgan, C. S.</td>
<td>101</td>
</tr>
<tr>
<td>Morrall, J.</td>
<td>64</td>
</tr>
<tr>
<td>Muan, A.</td>
<td>236</td>
</tr>
<tr>
<td>Mueller, F. M.</td>
<td>22,35</td>
</tr>
<tr>
<td>Mueller, M. H.</td>
<td>25</td>
</tr>
<tr>
<td>Muldawer, L.</td>
<td>258</td>
</tr>
<tr>
<td>Mullen, J. G.</td>
<td>245</td>
</tr>
<tr>
<td>Muller, K. A.</td>
<td>44</td>
</tr>
<tr>
<td>Mundy, J. N.</td>
<td>19</td>
</tr>
<tr>
<td>Mura, T.</td>
<td>228</td>
</tr>
<tr>
<td>Murr, L. E.</td>
<td>253</td>
</tr>
<tr>
<td>Murray, R. B.</td>
<td>170</td>
</tr>
<tr>
<td>Myers, W. R.</td>
<td>57</td>
</tr>
<tr>
<td>Nathans, R.</td>
<td>43,46,216</td>
</tr>
<tr>
<td>Neely, H. H.</td>
<td>38</td>
</tr>
<tr>
<td>Nelkin, M.</td>
<td>164</td>
</tr>
<tr>
<td>Nellis, W. J.</td>
<td>18</td>
</tr>
<tr>
<td>Nelson, R. D.</td>
<td>125</td>
</tr>
<tr>
<td>Newnham, R. E.</td>
<td>46</td>
</tr>
<tr>
<td>Nicholson, M. E.</td>
<td>205</td>
</tr>
</tbody>
</table>
INVESTIGATORS

Nicklow, R. M., 115  
Nix, W. D., 254  
Noggle, T. S., 119  
Nolfi, F. V. Jr., 21  
North, D., 52  
Nosanow, L. H., 208  
Nowick, A. S., 156  

Ogle, J. C., 103  
Ohlsen, W. D., 265  
Oku, T., 42  
O'Reilly, D., 32  
Ott, J. B., 134  

Palmour, H. III, 218  
Pare, V. K., 120  
Parker, E. R., 77,83  
Parlee, N. A., 255  
Pask, J. A., 79  
Passell, L., 43,47  
Pawel, R. E., 104  
Pehlke, R. D., 203  
Pelah, I., 28  
Peterson, D. T., 2,5  
Peterson, N. L., 19,21  
Phillips, R. A., 9  
Pohl, R. O., 163  
Pollack, G. L., 199  
Polonis, D. H., 275  
Portis, A. M., 88  
Presson, A. G., 37  
Price, D. L., 28  
Primak, W., 36  

Rahman, A., 35  
Rapp, R. A., 229  
Rechtien, J. J., 18  
Redman, J. K., 124  
Reed, R. E., 111  
Reed-Hill, R. E., 171  
Reese, R. A., 16  
Reynolds, J. M., 184  
Richards, P. M., 180  
Richards, P. M., 180  
Ricketts, B. G., 65  
Rigney, D. A., 230  
Risebrough, N. R., 20  
Rivas, J. A., 51  
Roach, P., 30  
Roberts, L. D., 221  
Robinson, J. C., 38  
Robinson, J. E., 35  
Robinson, J. T., 19  
Robinson, M. T., 121  
Rochlin, G. I., 91  
Ross, J. W., 23  
Rothman, S. J., 19  
Rowe, J. M., 28  
Rowe, V., 31  
Rowland, T. J., 66  
Ruvov, A. L., 165  
Ryba, E., 237  

Sack, H. S., 166  
Samuelson, E. J., 43  
Santoro, R. P., 46  
Saxe, R. F., 219  
Scattergood, R. O., 20  
Scheibner, E. J., 175  
Schmunk, R. E., 57  
Schoemaker, D., 29  
Schweitzer, D., 40  
Scott, T. E., 1  
Searcy, A. W., 84  
Seidman, D. N., 158  
Sekula, S. T., 113  
Shanks, H. R., 13  
Shen, Y. R., 90  
Shenoy, G., 33  
Shiffman, C. A., 226  
Shirane, G., 43,44  
Shull, C. G., 45,194  
Sibley, W. A., 117  
Sidles, P. H., 13  
Sievers, A. J., 163  
Sigmund, H. P., 26  
Silsbee, R. H., 168
Simmons, R. O., 72
Singwi, K., 35
Sinha, S. K., 16
Sjölander, A., 35
Skalyo, J. Jr., 44
Sköld, K., 28
Slichter, C. P., 73
Slifkin, L., 222
Smaller, B., 34
Smith, C. S., 223
Smith, D., 35
Smith, F., 28
Smith, G. P., 109
Smith, H. G., 115
Smith, J. F., 4
Smoluchowski, R., 56
Snead, L., 55
Soffa, W. A., 239
Sokoloff, J., 49
Sonder, E., 117
Soo, P., 42
Soonpaa, H. H., 224
Sosin, A., 266
Southern, A. L., 124
Spain, I. L., 190
Sparks, C. J., 105
Spedding, F. H., 8,17
Spitzer, R. H. Jr., 21
Spokes, J. J., 24
Spooner, S., 176
Stanford, J. L., 9,14
Stansbury, E. E., 259
Starke, E. A., 174
Stein, D. F., 206
Stevenson, D. A., 256
Stiegler, J. O., 100
Stoloff, N. S., 250
Strongin, M., 54
Suenaga, M., 42
Susman, S., 27,29
Swalin, R. A., 207
Swenson, C. A., 12

Tanaka, K., 13
Taylor, A., 169

Thomas, G., 78
Thommen, K., 38
Thompson, R., 40
Thorpe, M. F., 49
Tomizuka, C. T., 129
Torgeson, D. R., 10
Tosi, M., 35
Townsend, J. R., 240
Trivedi, R. K., 6
Turner, T. J., 273

Van Ostenburg, D. O., 24
Vandermeer, R. A., 103
Vaughn, G. A., 94
Vawter, D. D., 38
Verhoeven, J. D., 5
Vineyard, G. H., 49
Volpe, M. L., 19
Vook, R., 257
Vreeland, T. Jr., 139

Wagner, C. N. J., 279
Wagner, P. E., 179
Wagner, T., 14
Waldfre, F., 34
Walker, P. L. Jr., 238
Walker, R. A., 23
Wallace, W. E., 241
Walton, D., 118
Wang, F. F. Y., 48
Washburn, J., 80
Watson, R. E., 49
Waung, H. F., 51
Wayman, C. M., 67
Webb, W. W., 167
Weinstock, H., 178
Welch, D. O., 19
Welty, J. R., 233
Wert, C. A., 68
Wert, J. J., 267
Westbrook, R. D., 111
Westlake, D. G., 19
Weyhmann, W., 208
Wheatley, J. C., 144
INVESTIGATORS

Whitten, W., 50
Wilkinson, M. K., 115
Williams, G. P., 273
Williams, R. K., 98
Williams, R. O., 102
Williams, W. S., 74
Wilson, W., 56
Windmiller, L., 33
Wipf, S. L., 37
Wittenberg, L. J., 94
Wolf, W. P., 280
Wolfenden, A., 100
Wollan, E. O., 116
Wood, D. S., 139
Wood, R. F., 121
Worlton, T. G., 57

Yakel, H. L., 105
Yamada, Y., 44
Yip, S., 192
Yoo, M. H., 102
Young, F. W. Jr., 112, 122
Yust, C. S., 101
Yuster, P., 29

Zackay, V. F., 82, 83
Ziebold, T. O., 195
Zimmerman, W. Jr., 208
### Actinide Metals and Compounds

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>25</td>
<td>104</td>
</tr>
<tr>
<td>11</td>
<td>27</td>
<td>106</td>
</tr>
<tr>
<td>18</td>
<td>33</td>
<td>125</td>
</tr>
<tr>
<td>19</td>
<td>94</td>
<td>145</td>
</tr>
<tr>
<td>23</td>
<td>97</td>
<td>225</td>
</tr>
<tr>
<td>24</td>
<td>103</td>
<td>234</td>
</tr>
<tr>
<td></td>
<td></td>
<td>255</td>
</tr>
</tbody>
</table>

### Ceramics

<table>
<thead>
<tr>
<th>Carbides</th>
<th>Glass</th>
<th>Nitrides</th>
<th>Oxides</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>36</td>
<td>74</td>
<td>3</td>
<td>79</td>
</tr>
<tr>
<td>83</td>
<td>79</td>
<td>97</td>
<td>18</td>
<td>96</td>
</tr>
<tr>
<td>172</td>
<td>136</td>
<td>101</td>
<td>19</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>177</td>
<td>255</td>
<td>25</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>277</td>
<td></td>
<td>31</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>43</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Graphite

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
</tr>
<tr>
<td>105</td>
</tr>
<tr>
<td>119</td>
</tr>
<tr>
<td>177</td>
</tr>
<tr>
<td>190</td>
</tr>
<tr>
<td>238</td>
</tr>
</tbody>
</table>

### Intermetallic Compounds

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>66</td>
<td>174</td>
</tr>
<tr>
<td>32</td>
<td>103</td>
<td>189</td>
</tr>
<tr>
<td>36</td>
<td>116</td>
<td>201</td>
</tr>
<tr>
<td>57</td>
<td>135</td>
<td>241</td>
</tr>
<tr>
<td>62</td>
<td>149</td>
<td>256</td>
</tr>
<tr>
<td></td>
<td></td>
<td>278</td>
</tr>
</tbody>
</table>
### Ionic Crystals

<table>
<thead>
<tr>
<th></th>
<th>Alkali Halides</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>55</td>
<td>150</td>
</tr>
<tr>
<td>27</td>
<td>56</td>
<td>159</td>
</tr>
<tr>
<td>29</td>
<td>70</td>
<td>165</td>
</tr>
<tr>
<td>34</td>
<td>71</td>
<td>166</td>
</tr>
<tr>
<td>35</td>
<td>111</td>
<td>169</td>
</tr>
<tr>
<td>51</td>
<td>117</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>178</td>
</tr>
</tbody>
</table>

### Liquids

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>90</td>
<td>230</td>
</tr>
<tr>
<td>25</td>
<td>94</td>
<td>233</td>
</tr>
<tr>
<td>28</td>
<td>109</td>
<td>248</td>
</tr>
<tr>
<td>35</td>
<td>164</td>
<td>255</td>
</tr>
<tr>
<td>39</td>
<td>207</td>
<td>261</td>
</tr>
<tr>
<td>41</td>
<td>216</td>
<td>271</td>
</tr>
<tr>
<td>52</td>
<td>229</td>
<td>279</td>
</tr>
</tbody>
</table>

### Metals

<table>
<thead>
<tr>
<th></th>
<th>Alkali</th>
<th>BCC</th>
<th>Ferrous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td></td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>207</td>
<td></td>
<td>6</td>
<td>55</td>
</tr>
<tr>
<td>248</td>
<td></td>
<td>7</td>
<td>58</td>
</tr>
<tr>
<td>261</td>
<td></td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Organics

| 50 | 140 |
| 74 | 10  |
| 78 | 10  |
| 128| 53  |

### Rare Earth Metals and Compounds

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>16</td>
<td>33</td>
<td>116</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>17</td>
<td>57</td>
<td>142</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>19</td>
<td>111</td>
<td>198</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>23</td>
<td>115</td>
<td>237</td>
</tr>
</tbody>
</table>

241
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>211</td>
<td></td>
</tr>
<tr>
<td>244</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>133</td>
<td>12</td>
</tr>
<tr>
<td>30</td>
<td>144</td>
<td>28</td>
</tr>
<tr>
<td>32</td>
<td>147</td>
<td>72</td>
</tr>
<tr>
<td>40</td>
<td>208</td>
<td>199</td>
</tr>
<tr>
<td>72</td>
<td></td>
<td>216</td>
</tr>
</tbody>
</table>
# TECHNIQUE

## Elastic Constants

| 4  | 165 |
| 19 | 223 |
| 70 | 234 |
| 72 | 237 |
| 120 | 272 |

## Electrical Resistance

| 7   | 38   | 98   | 202 |
| 13  | 39   | 124  | 209 |
| 14  | 40   | 138  | 215 |
| 18  | 50   | 169  | 228 |
| 26  | 53   | 185  | 239 |
| 33  | 67   | 190  | 267 |
| 36  | 74   | 197  |

## Electron Microscopy

| 21  | 78   | 148  | 201 |
| 26  | 100  | 149  | 204 |
| 65  | 101  | 171  | 235 |
| 67  | 119  | 174  | 238 |
| 75  | 126  | 183  | 249 |
| 77  | 138  | 189  | 253 |

## Electron Scattering

| 6   | 150  |
| 40  | 175  |
| 78  | 206  |
| 104 | 257  |
| 122 |

## Electron Spin Resonance

<p>| 10  | 88   | 159 |
| 29  | 114  | 168 |
| 34  | 128  | 220 |
| 51  | 136  | 251 |
| 55  | 145  | 280 |</p>
<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Ion Microscopy</td>
<td>78 80 151 155 158 172</td>
</tr>
<tr>
<td>High Temperature Heat Capacity</td>
<td>8 17 23 85 98 259</td>
</tr>
<tr>
<td>Infrared Spectroscopy</td>
<td>9 15 89 163</td>
</tr>
<tr>
<td>Internal Friction</td>
<td>7 156 55 166 60 187 68 242 120 273 148</td>
</tr>
<tr>
<td>Laser Beam Scattering</td>
<td>72 89 90 179</td>
</tr>
<tr>
<td>Low Temperature Specific Heat</td>
<td>11 85 178 30 107 226 31 133 241 59 163 242</td>
</tr>
</tbody>
</table>
## Magnetic Susceptibility

<table>
<thead>
<tr>
<th>4</th>
<th>23</th>
<th>237</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>39</td>
<td>241</td>
</tr>
<tr>
<td>17</td>
<td>59</td>
<td>277</td>
</tr>
<tr>
<td>18</td>
<td>133</td>
<td>280</td>
</tr>
</tbody>
</table>

## Mossbauer Effect

<table>
<thead>
<tr>
<th>10</th>
<th>110</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>129</td>
<td>221</td>
</tr>
<tr>
<td>33</td>
<td>130</td>
<td>245</td>
</tr>
<tr>
<td>68</td>
<td>131</td>
<td>274</td>
</tr>
<tr>
<td>69</td>
<td>146</td>
<td>277</td>
</tr>
</tbody>
</table>

## Neutron Scattering

<table>
<thead>
<tr>
<th>16</th>
<th>45</th>
<th>164</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>47</td>
<td>172</td>
</tr>
<tr>
<td>28</td>
<td>52</td>
<td>176</td>
</tr>
<tr>
<td>32</td>
<td>57</td>
<td>192</td>
</tr>
<tr>
<td>43</td>
<td>115</td>
<td>194</td>
</tr>
<tr>
<td>44</td>
<td>127</td>
<td>216</td>
</tr>
</tbody>
</table>

## Nuclear Magnetic Resonance

<table>
<thead>
<tr>
<th>10</th>
<th>88</th>
<th>180</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>92</td>
<td>186</td>
</tr>
<tr>
<td>24</td>
<td>129</td>
<td>198</td>
</tr>
<tr>
<td>32</td>
<td>133</td>
<td>265</td>
</tr>
<tr>
<td>66</td>
<td>136</td>
<td>277</td>
</tr>
<tr>
<td>73</td>
<td>142</td>
<td>280</td>
</tr>
</tbody>
</table>

## Optical Absorption

<table>
<thead>
<tr>
<th>15</th>
<th>55</th>
<th>145</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>69</td>
<td>153</td>
</tr>
<tr>
<td>23</td>
<td>90</td>
<td>163</td>
</tr>
<tr>
<td>29</td>
<td>109</td>
<td>169</td>
</tr>
<tr>
<td>51</td>
<td>117</td>
<td>220</td>
</tr>
<tr>
<td>141</td>
<td>273</td>
<td></td>
</tr>
<tr>
<td>TECHNIQUE</td>
<td>- A14 -</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td></td>
</tr>
</tbody>
</table>

**Sputtering**

<table>
<thead>
<tr>
<th></th>
<th>26</th>
<th>125</th>
<th>143</th>
<th>204</th>
</tr>
</thead>
</table>

**Stress-Strain**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>101</th>
<th>191</th>
<th>7</th>
<th>137</th>
<th>205</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19</td>
<td>177</td>
<td>218</td>
<td>20</td>
<td>187</td>
<td>227</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>188</td>
<td>231</td>
<td>53</td>
<td>189</td>
<td>272</td>
</tr>
</tbody>
</table>

**Theory**

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>49</th>
<th>121</th>
<th>228</th>
<th>20</th>
<th>56</th>
<th>162</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22</td>
<td>64</td>
<td>164</td>
<td>246</td>
<td>26</td>
<td>76</td>
<td>188</td>
<td>258</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>87</td>
<td>208</td>
<td>268</td>
<td>37</td>
<td>106</td>
<td>213</td>
<td>271</td>
</tr>
</tbody>
</table>

**Thermal Conductivity**

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>71</th>
<th>118</th>
<th>11</th>
<th>74</th>
<th>152</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>94</td>
<td>163</td>
<td>14</td>
<td>98</td>
<td>178</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>233</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Thermodynamics**

<table>
<thead>
<tr>
<th></th>
<th>12</th>
<th>102</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>134</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>155</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>199</td>
</tr>
<tr>
<td></td>
<td>58</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>84</td>
<td>236</td>
</tr>
<tr>
<td></td>
<td>94</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>95</td>
<td>256</td>
</tr>
</tbody>
</table>
X-Ray Scattering

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>105</td>
<td>201</td>
</tr>
<tr>
<td>25</td>
<td>112</td>
<td>207</td>
</tr>
<tr>
<td>32</td>
<td>125</td>
<td>224</td>
</tr>
<tr>
<td>52</td>
<td>135</td>
<td>237</td>
</tr>
<tr>
<td>75</td>
<td>138</td>
<td>239</td>
</tr>
<tr>
<td>94</td>
<td>157</td>
<td>242</td>
</tr>
<tr>
<td>104</td>
<td>174</td>
<td>267</td>
</tr>
<tr>
<td></td>
<td></td>
<td>279</td>
</tr>
</tbody>
</table>
### Channeling

<table>
<thead>
<tr>
<th></th>
<th>75</th>
<th>121</th>
<th>123</th>
<th>158</th>
</tr>
</thead>
</table>

### Crystal Structure, Atomic Distribution and Crystal Transformations

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>53</th>
<th>73</th>
<th>138</th>
<th>225</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>57</td>
<td>78</td>
<td>146</td>
<td>237</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>58</td>
<td>94</td>
<td>149</td>
<td>258</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>62</td>
<td>95</td>
<td>157</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>64</td>
<td>105</td>
<td>174</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>67</td>
<td>109</td>
<td>193</td>
<td>277</td>
<td></td>
</tr>
<tr>
<td></td>
<td>68</td>
<td>125</td>
<td>201</td>
<td>279</td>
<td></td>
</tr>
</tbody>
</table>

### Diffusion

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>68</th>
<th>135</th>
<th>207</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>71</td>
<td>146</td>
<td>215</td>
<td>248</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>74</td>
<td>147</td>
<td>217</td>
<td>256</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>79</td>
<td>158</td>
<td>222</td>
<td>262</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>108</td>
<td>160</td>
<td>230</td>
<td>264</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>129</td>
<td>165</td>
<td>242</td>
<td>268</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>130</td>
<td>193</td>
<td>243</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>273</td>
<td></td>
</tr>
</tbody>
</table>

### Electron Transport

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>67</th>
<th>107</th>
<th>181</th>
<th>229</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>71</td>
<td>138</td>
<td>184</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>74</td>
<td>142</td>
<td>185</td>
<td>238</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>79</td>
<td>143</td>
<td>190</td>
<td>243</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>81</td>
<td>152</td>
<td>193</td>
<td>258</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>97</td>
<td>168</td>
<td>197</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>173</td>
<td>224</td>
<td>279</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electronic Structure

#### Fermi Surface

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>106</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>186</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Other

<table>
<thead>
<tr>
<th></th>
<th>10</th>
<th>35</th>
<th>69</th>
<th>131</th>
<th>198</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>37</td>
<td>86</td>
<td>145</td>
<td>221</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>39</td>
<td>87</td>
<td>159</td>
<td>241</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>49</td>
<td>97</td>
<td>168</td>
<td>245</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>59</td>
<td>110</td>
<td>184</td>
<td>246</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>66</td>
<td>121</td>
<td>186</td>
<td>258</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>196</td>
<td>270</td>
</tr>
</tbody>
</table>
# PHENOMENA - A17 -

## Ferromagnetism

| 14 | 59 | 152 |
| 23 | 88 | 186 |
| 35 | 106 | 208 |
| 49 | 121 | 270 |

## Magnetic Structure

| 14 | 46 | 132 |
| 16 | 49 | 176 |
| 25 | 57 | 198 |
| 28 | 73 | 210 |
| 33 | 115 | 216 |
| 43 | 116 | 241 |
| 44 | 127 | 277 |
|     |     | 280 |

## Materials Preparation and Characterization

| 2  | 96  |
| 8  | 111 |
| 27 | 193 |
| 48 | 210 |
|     | 272 |

## Phonons

| 16 | 163 |
| 35 | 179 |
| 43 | 192 |
| 115 | 232 |
| 157 | 234 |
| 162 | 246 |

## Point Defects

| 15 | 56     | 114    | 156    | 220 |
| 26 | 70     | 117    | 158    | 227 |
| 29 | 71     | 118    | 159    | 238 |
| 34 | 72     | 119    | 160    | 238 |
| 36 | 75     | 124    | 170    | 243 |
| 38 | 80     | 126    | 181    | 244 |
| 40 | 100    | 128    | 185    | 251 |
| 51 | 103    | 130    | 197    | 256 |
| 55 | 112    | 154    | 213    | 265 |
|     |        |        |        | 271 |
## PHENOMENA

### Precipitation

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>183</td>
</tr>
<tr>
<td>21</td>
<td>102</td>
<td>217</td>
</tr>
<tr>
<td>58</td>
<td>135</td>
<td>239</td>
</tr>
<tr>
<td>65</td>
<td>140</td>
<td>242</td>
</tr>
<tr>
<td>66</td>
<td>155</td>
<td>250</td>
</tr>
<tr>
<td>80</td>
<td>171</td>
<td>255</td>
</tr>
</tbody>
</table>

### Sintering

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>193</td>
</tr>
<tr>
<td>101</td>
<td>249</td>
</tr>
<tr>
<td>108</td>
<td>262</td>
</tr>
</tbody>
</table>

### Solidification

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
</tr>
<tr>
<td>195</td>
</tr>
<tr>
<td>230</td>
</tr>
<tr>
<td>260</td>
</tr>
</tbody>
</table>

### Strength

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Superplasticity</th>
<th>Creep</th>
<th>Flow Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>76</td>
<td>7</td>
</tr>
<tr>
<td>77</td>
<td>125</td>
<td>101</td>
<td>18</td>
</tr>
<tr>
<td>82</td>
<td>235</td>
<td>125</td>
<td>19</td>
</tr>
<tr>
<td>137</td>
<td>165</td>
<td>20</td>
<td>101</td>
</tr>
<tr>
<td>160</td>
<td>254</td>
<td>26</td>
<td>102</td>
</tr>
<tr>
<td>195</td>
<td>263</td>
<td>60</td>
<td>139</td>
</tr>
<tr>
<td>206</td>
<td>278</td>
<td>61</td>
<td>140</td>
</tr>
<tr>
<td>250</td>
<td></td>
<td>63</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td></td>
<td>74</td>
<td>171</td>
</tr>
</tbody>
</table>

### Superconductivity

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>83</td>
<td>99</td>
</tr>
<tr>
<td>31</td>
<td>86</td>
<td>113</td>
</tr>
<tr>
<td>37</td>
<td>87</td>
<td>138</td>
</tr>
<tr>
<td>40</td>
<td>91</td>
<td>143</td>
</tr>
<tr>
<td>54</td>
<td>93</td>
<td>157</td>
</tr>
</tbody>
</table>
Surface Phenomena and Thin Films

<table>
<thead>
<tr>
<th>6</th>
<th>61</th>
<th>104</th>
<th>153</th>
<th>224</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>63</td>
<td>119</td>
<td>161</td>
<td>228</td>
</tr>
<tr>
<td>26</td>
<td>67</td>
<td>122</td>
<td>175</td>
<td>231</td>
</tr>
<tr>
<td>40</td>
<td>79</td>
<td>125</td>
<td>176</td>
<td>253</td>
</tr>
<tr>
<td>54</td>
<td>84</td>
<td>150</td>
<td>204</td>
<td>257</td>
</tr>
<tr>
<td>55</td>
<td>91</td>
<td>151</td>
<td>212</td>
<td>276</td>
</tr>
</tbody>
</table>
# Environment

## Electric Field

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>141</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>248</td>
<td></td>
</tr>
<tr>
<td></td>
<td>253</td>
<td></td>
</tr>
</tbody>
</table>

## Gas

<table>
<thead>
<tr>
<th>Oxidizing</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>104</td>
<td>19</td>
</tr>
<tr>
<td>153</td>
<td>81</td>
</tr>
<tr>
<td>82</td>
<td>269</td>
</tr>
<tr>
<td>151</td>
<td></td>
</tr>
</tbody>
</table>

## Magnetic Field

<table>
<thead>
<tr>
<th>High Field</th>
<th>Low Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>33</td>
<td>17</td>
</tr>
<tr>
<td>40</td>
<td>31</td>
</tr>
<tr>
<td>54</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td></td>
</tr>
<tr>
<td>99</td>
<td></td>
</tr>
</tbody>
</table>

## Pressure

<table>
<thead>
<tr>
<th>Above Atmospheric</th>
<th>Shock Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>77</td>
</tr>
<tr>
<td>18</td>
<td>254</td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>
ENVIRONMENT - A21 -

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Electron</th>
<th>Ion</th>
<th>Neutron</th>
<th>Theory</th>
<th>Gamma</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>26</td>
<td>169</td>
<td>7</td>
<td>126</td>
<td>26</td>
</tr>
<tr>
<td>55</td>
<td>36</td>
<td>202</td>
<td>26</td>
<td>181</td>
<td>56</td>
</tr>
<tr>
<td>75</td>
<td>38</td>
<td>212</td>
<td>100</td>
<td>187</td>
<td>121</td>
</tr>
<tr>
<td>119</td>
<td>75</td>
<td>217</td>
<td>119</td>
<td>209</td>
<td>213</td>
</tr>
<tr>
<td>154</td>
<td>100</td>
<td>240</td>
<td>122</td>
<td>211</td>
<td>240</td>
</tr>
<tr>
<td>227</td>
<td>123</td>
<td>242</td>
<td>124</td>
<td></td>
<td></td>
</tr>
<tr>
<td>244</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>266</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Below Liquid Helium</th>
<th>High Temperature (about 1000°K or higher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>54</td>
<td>13</td>
</tr>
<tr>
<td>30</td>
<td>87</td>
<td>84</td>
</tr>
<tr>
<td>31</td>
<td>118</td>
<td>85</td>
</tr>
<tr>
<td>32</td>
<td>133</td>
<td>98</td>
</tr>
</tbody>
</table>

\[ V\text{onk} \ 7 \text{proje} \text{t} @ 416K \]
Support of Research Reactors (Neutrons Only)

<table>
<thead>
<tr>
<th>Institution</th>
<th>EST. FY 1970 K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANL</td>
<td>414</td>
</tr>
<tr>
<td>BNL</td>
<td>435</td>
</tr>
<tr>
<td>ORNL</td>
<td>166</td>
</tr>
<tr>
<td>Ames</td>
<td>180</td>
</tr>
<tr>
<td>PRNC</td>
<td>60</td>
</tr>
<tr>
<td>INC</td>
<td>20</td>
</tr>
<tr>
<td>MIT</td>
<td>106</td>
</tr>
<tr>
<td>Georgia Inst. Tech.</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,460</strong></td>
</tr>
</tbody>
</table>

Support of Research at Reactors (Including Cost of Neutrons)

<table>
<thead>
<tr>
<th>Activity</th>
<th>EST. FY 1970 K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutron Scattering</td>
<td>3,900</td>
</tr>
<tr>
<td>Neutron Irradiation Damage</td>
<td>1,400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,300</strong></td>
</tr>
</tbody>
</table>

(19% of operating funds)
DIVISION OF RESEARCH

NEW PROPOSALS - FISCAL YEAR 1969
(\$ in 1000's)

<table>
<thead>
<tr>
<th>On Hand 7/1/68</th>
<th>Received during FY 1969</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Amount</td>
<td>No.</td>
</tr>
<tr>
<td>gh Energy Physics</td>
<td>22</td>
<td>$2,098</td>
</tr>
<tr>
<td>Physics &amp; Mathematics</td>
<td>44</td>
<td>$31,461 1/</td>
</tr>
<tr>
<td>Chemistry</td>
<td>40</td>
<td>$1,381</td>
</tr>
<tr>
<td>Metallurgy &amp; Materials</td>
<td>42</td>
<td>$1,264</td>
</tr>
<tr>
<td>Controlled Thermonuclear</td>
<td>27</td>
<td>$3,861</td>
</tr>
<tr>
<td>TOTAL</td>
<td>175</td>
<td>$40,065</td>
</tr>
</tbody>
</table>

ACTIONS TAKEN - NEW PROPOSALS - FY 1969
(\$ in 1000's)

<table>
<thead>
<tr>
<th>Approved</th>
<th>Declined, etc.</th>
<th>On Hand 6/30/69</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Amount</td>
<td>No.</td>
</tr>
<tr>
<td>gh Energy Physics</td>
<td>7</td>
<td>$302</td>
</tr>
<tr>
<td>Physics &amp; Mathematics</td>
<td>16</td>
<td>592</td>
</tr>
<tr>
<td>Chemistry</td>
<td>22</td>
<td>639</td>
</tr>
<tr>
<td>Metallurgy &amp; Materials</td>
<td>31</td>
<td>1,049</td>
</tr>
<tr>
<td>Controlled Thermonuclear</td>
<td>10</td>
<td>383</td>
</tr>
<tr>
<td>TOTAL</td>
<td>86</td>
<td>$2,965</td>
</tr>
</tbody>
</table>

Includes a Cal. Tech. proposal for $9.5 million for a Cyclotron Facility and a $9.4 million request from UCLA-Nuclear Consortium for a $9.4 million Cyclotron Facility.

Includes a proposal from Univ. of Michigan for $23.6 million for an Ultra High Cosmic Ray Physics Facility.

Not including support for Conferences, National Academy of Sciences Committees, and miscellaneous items such as book translations, awards, etc.