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BR 93/1 Draft #2 18 May 1953

CONFERENCE SUMMARY: First Meeting of Basic Research Group, 17 and 18 March 1953

INTRODUCTORY REMARKS

The first meeting of the Basic Research Group, Research and Development Board, convened at 0945, Tuesday, 17 March 1953, Dr. Warren Weaver presiding. The meeting opened with an orientation address by Mr. Walter G. Whitman, Chairman of the RDB. In outlining the aims and mission of the Group, Mr. Whitman had this to say:

"In organizing the Basic Research Group, we had in mind that this tremendously important field needed some policy guidance which we would like to get in a somewhat less formal manner than the usual RDB committee set-up. Therefore, we called in the Basic Research Group, and, in this group, we want those people who are most concerned with the basic research of the Department of Defense, men of vision and understanding, outstanding men who can apply to the guidance the thinking which cannot come merely from those of us who are actually engaged in the process itself.

"We are particularly anxious to have Alan Waterman join with us because what the Department of Defense does in basic research in a general way should of course be related to the total governmental program, and the National Science Foundation has that responsibility heavily on its shoulders.

"I think that my views with respect to what you might do can be rather simply expressed, but I am not so sure they can be so simply carried out. However, it seems to me this group should concern itself with what the Department of Defense is doing in the way of basic research, and it should come up with the best advice possible to me and the Board as to what the policy and the programs should be in terms of basic research. One might think, therefore, of the primary function as giving guidance and advice so that policy can be properly executed, but I think that, at the same time, a second important function is to stimulate a closer understanding and cooperation as well as the unification of the basic research effort in the Department of Defense. That is done, I think, not so much by reports as by the mutual exchange of ideas and the education that comes to each of the responsible Department of Defense people by thrashing this out in a forum where they get the benefit

of the advice and counsel from others who are not immediately responsible for the execution of the program.

"We need to know the answers to such questions as: What are we doing? What should be the policy and the program of the Department of Defense? We need to know the answers to such questions so that the Board and I can be informed of your best views.

"Thirdly, and this is very important, we need the forum effect of mutually getting together across the table, looking at the program and increasing the competence of the individuals most closely involved in carrying out the basic research that is under their supervision. Each of the three departments is here to represent that ability to carry out what is decided to be advisable."

Mr. Whitman's remarks were followed by an appraisal of the American science scene by Dr. Weaver, in summary as follows:

In the course of the last two major wars, a good many people began to realize that science had something to do with our national capacity to defend ourselves and, more broadly, to maintain our way of life -- in an economic sense, in a social sense, and in a cultural sense. During the last ten years, more or less, there has been a tremendous development, a change in the general organization and support of science in the country, with a much greater degree of centralization in the organization and in the support of science than there used to be.

As yet, there is altogether too modest support of science through the National Science Foundation. This is still, most of us hope, in the embryonic stage rather than in the stage of real development. There is very substantial support of pure science through the Government by the Department of Defense, the Atomic Energy Commission, the U.S. Public Health

Service, and the Department of Agriculture; and the question as to what is really a healthy relationship between the support of science through these agencies of the Federal Government and the support of science through all of the other agencies in this country has become a rather curious, troublesome, and a rather pressing problem.

Variety of support of science seems to be a very important thing--variety is a great source of strength to American life. Now, are we losing balance in that variety? Are we channeling too much of it through certain types of channels? American science still remains somewhat weak in its capacity to develop truly imaginative, deep, original ideas. We are very good at the application of fundamental ideas in science, but the fact is that we still are not as good as we ought to be in the development of original, imaginative ideas. We are still living on a good many of the truly imaginative ideas that were generated in other parts of the world and by people of other nationalities. In some way or another, we have to get some of these original, imaginative ideas into American science. Are we producing in our country the kind of intellectual climate for the advancement of science under which that kind of development really prospers? If we are not, then we are, in the long run, headed for trouble for our country.

ARMY PRESENTATION

Summary of Introductory Remarks by Dr. Lloyd E. Swearingen, Director of Basic Sciences Research, Research and Development Division, G-4, Army:

Research and development responsibilities in the Army begin with the Office of the Chief of Staff and are delegated to the Deputy Chief of Staff

for Plans and Research. The G-4 section* of the General Staff coordinates the R&D activities of the seven Technical Services of the Army (Ordnance Corps, Signal Corps, Chemical Corps, Engineer Corps, Quartermasters Corps, Transportation Corps, and Medical Corps).

The FY 1953 and FY 1954 basic research programs were planned on the basis of RDB policy on basic research (RDB 173/9, dated 17 January 1951, since revised) which stipulated that not less than 6% of the average R&D budgets for the preceding 5 years be obligated for basic research.

The basic research program of the Army has the following over-all characteristics:

(1) About two-thirds of the total Army basic research effort is strictly programmatic in character in that it seeks answers to specific problems. This type of basic research is defined as "supporting basic research" and is programmed throughout the operational and supporting categories of the RDB Classification System. (See Appendix to this Conference Summary for terminology.)

(2) The remaining one-third is defined as "exploratory basic research". This type of research is of interest to the Army but has no immediate specific application. It is programmed under the Basic Research category of the RDB Classification System.

(3) Approximately half of the exploratory basic research is sponsored by the Ordnance Corps; the remaining half is sponsored by the other six Technical Services.

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* The Army General Staff is comprised of four staff sections: G-1, Personnel; G-2, Intelligence; G-3, Operations; and G-4, Logistics.

(4) All of the Technical Services of the Army, with the exception of the Ordnance Corps, administer exploratory basic research in the same manner as they administer other types of research and development; that is, no separate office has been established for the administration of research performed under contract. The worthiness of proposed exploratory basic research projects is evaluated by the permanent scientific staffs of the Services.

(5) The Ordnance Corps, on the other hand, has established an Office of Ordnance Research to administer its exploratory basic research program. The Office is physically located at Duke University; it operates as an Army facility and is independent of the Duke University administrative organization. The worthiness of proposed basic research projects is evaluated by the permanent OOR scientific staff, by the scientists at the Ordnance arsenals, and in a large number of cases by advisory committees which are established by the National Research Council of the National Academy of Sciences under a contract arrangement for this purpose between OOR and NRC. The contract provides for the services of clerical help and administration; the scientists serving on the advisory committees receive no compensation for their services.

The Army recognizes that much of its total basic research effort will be performed through the medium of contracts with universities, but to foster creative productivity and to further technical interest and competence within the Army, it is felt essential that a portion of the basic research effort be performed within the Army's own laboratories. The annual rate of this portion of the basic research performed internally in Army facilities is roughly $1 million.

The accompanying tables show the present and planned funding of basic research in the Army. The exploratory basic research program is supported entirely by funds explicitly budgeted for that purpose; that is, there is no indirect source of funds to augment this program. The supporting basic research program is funded indirectly, inasmuch as the effort is programmed to provide the scientific investigations underlying the attainment of end objectives of development programs intended to satisfy Army weapons requirements. The three tables provided are as follows:

(1) Table I: The exploratory basic research program (BR category), showing funding levels for FY-53, 54 and 55 by fields, and detailed subdivisions of these fields with appropriate remarks.

(2) Table II: The supporting basic research program (funded in categories such as Land Combat, Air Defense, Airborne Landing, Supporting Research and Development, etc.), not captured in data provided in Table I.

(3) Table III: Summary of Army's total basic research program.

TABLE I

[redacted]

SUMMARY OF ARMY EXPLORATORY BASIC RESEARCH PROGRAM
DIRECT FUNDS*
(In Millions of Dollars)

| FIELD | SUB-FIELD | FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Physical and Engineering Sciences | Physics of matter, materials and processes: Solid state physics, high temperature materials; crystal, nuclear atomic, molecular structure; thermodynamic cryogenics; particle physics and electronics; optics and photography; acoustics and ultrasonics; interface structure and properties; energy absorption, reflection and transmission; wave generation, propagation and properties; instrumentation and design; electricity, magnetism, mechanics and radiation; nuclear and theoretical physics. | 2.9 | 4.0 | 3.6 | (1) Contracts distributed as follows: 66 with universities, 2 with National Bureau of Standards, 1 with U.S Bur. of Mines, 3 with non-profit institutions, 1 with profit-making company.<br>(2) Includes 0.4 million for infrared studies.<br>(3) Includes 1.2 million as Army support of joint Army, Navy, Air Force contracts at:<br>Cruft Laboratory - Harvard U.<br>Radiation Lab. - Columbia U.<br>Research Lab. of Electronics - MIT<br>Millimeter Wave Research - Western Electric Co.<br>Electronics Lab. - Stanford U.<br>(4) Office of Ordnance Research program in Physics FY 53 is about 1.3 million. About 13 contractors in Physics sponsored by OOR also receive funds from one or both of the other two services. |
| | Chemistry of matter, materials and processes: Elastomers, plastics and polymers; lubricants, fuels, oxidants, propellants, explosives; adhesives and cellulose; ceramics and refractories; metallic and nonmetallic coatings; structure-property relationships; combustion, detonation and explosion | 2.4 | 2.6 | 2.8 | (1) All chemistry research being done by OOR. About 33 contractors in chemistry sponsored by OOR also receive funds from one or both of the other two services.<br>(2) Contracts distributed as follows: 129 with universities; 7 with National Bureau of Standards; 1 with U.S. Bur. of Mines; 1 with Dept. of Agriculture; 4 with profit-making organization; 7 with government arsenals. |

* The Exploratory Basic Research Program receives no indirect funds.

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Summary of Army Exploratory Basic Research Program (cont'd)

| FIELD | SUB-FIELD | DIRECT FUNDS (In Millions of Dollars) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| | Chemistry (continued) phenomena; lubrication and surface phenomena; corrosion and deterioration; metallurgy, reaction kinetics and equilibria; inorganic, analytical, organic, physical, electro and colloid chemistry. | | | | |
| | Mathematics, pure and applied: Statistics, probability, analysis, algebra, number theory, geometry, topology, numerical analysis, mechanics, elasticity, plasticity, subsonic and transonic fluid dynamics and boundary value problems on manifolds. | 0.8 | 0.8 | 0.9 | (1) Joint programs with other two services in applied mathematics and statistics. Army support for FY 53 is 0.1 million.<br>(2) Joint sponsorship of Direction Systems research. (MOBILAC Computer)<br>(3) OOR effort for FY 53 is 0.6 million. About 9 contractors in mathematics sponsored by OOR also receive funds from one or both of the other two services.<br>(4) A total of about 44 contracts — all with universities. |
| | Engineering Sciences: Materials and materials processing, heat and mass transfer; soil mechanics, mechanics, vibration and acoustics; friction, wear and lubrication; fuels, thermodynamics and combustion; heat resistant materials, low temperature materials, lightweight metals and alloys; human engineering, instrumentation and design. | — | 1.5 | 1.5 | (1) All contracts sponsored by OOR,<br>(2) 23 contracts with universities, 4 with National Bureau of Standards, 1 with non-profit institutions, 1 with profit-making company, 2 with government arsenals.<br>(3) About 6 contractors in Engineering Sciences sponsored by OOR also receive funds from one or both of the other two services. |
| PHYSICAL AND ENGINEERING SCIENCES - TOTAL | | 6.1 | 8.9 | 8.8 | |

[redacted]

Summary of Army Exploratory Basic Research Program (cont'd)

| FIELD | SUB-FIELD | DIRECT FUNDS (In Millions of Dollars) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Medical and Biological Sciences | Medical Sciences: Internal medicine, surgery, preventive medicine, dentistry, veterinary, and basic medical sciences. | 0.2 | 0.2 | 0.2 | (1) All contracts sponsored by Medical Corps. (2) 25 university and hospital contracts. |
| Social Sciences | Social Sciences: Methods and rationales of personality measurement; psychology of learning and perceptual processes in individual and social behavior. | 0.1 | 0.1 | 0.1 | No contracts active. Two proposals are being considered. |
| Earth Sciences | Earth Sciences: Amphibious oceanography, environmental research, snow, ice, and and frozen ground. | 0.7 | 0.1 | 0.1 | (1) Transportation Corps has joint program with Navy on amphibious oceanography (52 thousand) (2) Corps of Engineers has cognizance of all basic research in cryological phenomena on ea surface. About 0.6 million of FY 53 funds is f Snow, Ice and Permafrost Research Establishme Five university contracts are supported in ad tion to internal programs. For FY's 54 and 55. this program is included in the Physics and Chemistry subdivisions of technical objective BR-1. |
| EXPLORATORY BASIC RESEARCH - TOTAL | | 7.1 | 9.3 | 9.2 | |

[redacted]

## TABLE II

ARMY'S SUPPORTING BASIC RESEARCH PROGRAM
(This type of basic research is assigned to the various categories of RDB Planning Guide other than the Basic Research category)

| | FUNDING BY FISCAL YEARS (In Millions of Dollars) | | |
|---|---|---|---|
| | 1953 | 1954* | 1955 |
| PHYSICAL AND ENGINEERING SCIENCES | $14.8 | $ 9.4 | $ 8.8 |
| MEDICAL AND BIOLOGICAL SCIENCES | 4.0 | 7.1 | 6.6 |
| SOCIAL SCIENCES | 0.4 | 0.3 | 0.3 |
| EARTH SCIENCES | 0.4 | 0.4 | 0.5 |
| TOTAL | $19.6 | $17.2 | $16.2 |

* As submitted to Congress

## TABLE III

SUMMARY OF THE ARMY'S TOTAL BASIC RESEARCH PROGRAM

| TYPE OF RESEARCH | FUNDING BY FISCAL YEARS (In Millions of Dollars) | | |
|---|---|---|---|
| | 1953 | 1954* | 1955 |
| EXPLORATORY BASIC RESEARCH (Table I) | $ 7.1 | $ 9.3 | $ 9.2 |
| SUPPORTING BASIC RESEARCH (Table II) | 19.6 | 17.2 | 16.2 |
| TOTAL | $26.7 | $26.5 | $25.4 |

* As submitted to Congress

## NAVY PRESENTATION

Summary of Opening Remarks by Dr. E. R. Piore, Deputy Chief and Chief Scientist, Office of Naval Research:

The Office of Naval Research is the principal agency within the Navy Department involved in research. Historically, ONR started as a group organization late in 1945 and was established by Congress in 1946 under Public Law 588, 79th Congress. By law, ONR has distinct responsibilities in the Navy for: (1) planning, fostering, and encouragement of scientific research; (2) coordination of bureau activities in research, and Navy research activities with other agencies; (3) apprising the Chief of Naval Operations and the Secretary of the Navy of the impact of science on the Navy.

The Naval Research Advisory Committee (of which Dr. Warren Weaver was second chairman) consults with and advises the Chief of Naval Research on matters pertaining to research. The Committee has recently asked for a study by ONR of fields where funds are especially needed for research. This study by ONR is expected to be available by the close of FY-53

Summary of Remarks by Dr. Randal M. Robertson, Science Director, ONR:

The ONR contract research program includes basic research, applied research, and exploratory development. Annual operating funds of ONR derive from various sources, a rough approximation of source and distribution being as follows:

(a) The total program administered by ONR is roughly about $55 million, of which about $44 million is directly appropriated to ONR and

11 million represents funds transferred to ONR from other agencies, such as the Navy bureaus and the AEC, for contract research.

(b) Of the $55 million total, about $4 million is used by ONR to fund the Special Devices Center, a small amount for the Underwater Sound Reference Laboratory, and about $9 million for the Division of Naval Sciences -- an organization carrying out applied research and exploratory development in special warfare fields. This leaves about $42 million as funds under ONR management available for contract research and for funding of basic and applied research at the Naval Research Laboratory (a facility falling organizationally under ONR).

(c) This $42 million is apportioned annually roughly as follows:

(1) About $10 million is used to fund the Naval Research Laboratory. (In addition, NRL receives roughly another $10 million from the Navy bureaus to support individual projects of special interest to them.

The Division Directors made presentations in the following order:

| | |
|---|---|
| Dr. Mina Rees | Mathematical Sciences |
| Dr. E. Montroll | Physical Sciences |
| Dr. I. Estermann | Material Sciences |
| Dr. Orre Reynolds | Biological Sciences |
| Dr. H. E. Page | Psychological Sciences |
| Dr. J. N. Adkins | Earth Sciences |

The presentations are summarized in tabular form (attached) with the more important comments noted in the "Remarks" column.

[redacted]

SUMMARY OF CONTRACT RESEARCH* PROGRAM, OFFICE OF NAVAL RESEARCH

*Contract research includes both basic and applied research.

| FIELD | SUB-FIELD | FUNDS ($ Million)—Current Annual Rate: ONR DIRECT | INDIRECT (Amount & Source) | TOTAL | REMARKS |
|---|---|---|---|---|---|
| Mathematical Sciences | Analysis; applied math; theoretical and applied statistics; computers, primarily numerical analyses; logistics; mechanics | 4.0 | 2.0 Navy Bureaus | 6.0 | (1) Joint programs with the other two Services in applied statistics.<br>(2) In cooperation with NBS finances Institute of Numerical Analysis (UCLA)<br>(3) Mechanics Branch is largest of 5 branches, budget of $2.0 million. |
| Physical Sciences | Nuclear physics—— elementary particles, cosmic rays; mathematical physics, solid state physics, radiation, molecular structure, low temperature physics; electronics——semi-conductors, ceramics, radio propagation, theory of communication and theory of information. | 6.5 | 4.0 - AEC & to 5.0 Others | 10.5 - to 11.5 | (1) Many joint programs, especially in nuclear physics. Other joint contracts in large electronics programs at MIT, Stanford, Harvard, & Columbia.<br>(2) Elementary particles program is largest, about 1.5 million. Cosmic ray program 0.5 million, matched by another 0.5 million by AEC.<br>(3) Two extremes in support of the physical science program: the support of large groups (Harvard, Stanford, Chicago), and the support of individuals, at average rate of $15,000 a year.<br>(4) In physical sciences 4.0 million is the order of magnitude of all [illegible] contracts. |

[redacted]

Summary of Contract Research Program, Office of Naval Research (Cont'd)

| FIELD | SUB-FIELD | FUNDS ($ Million)—Current Annual Rate ONR DIRECT | INDIRECT (Amount & Source) | TOTAL | REMARKS |
|---|---|---|---|---|---|
| Material Sciences | Organic materials; metallurgy; physical chemistry — metals and alloys; plastic deformation of metals; chemical research; power—transformation of chemical energy into mechanical thrust | 5.0 | 2.0 | 7.0 | (1) Not more than one-third of ONR funds and very little indirect funds are used for strictly basic research programs.<br>(2) Chemistry Branch carries out the bulk of basic research in the Material Sciences Division. Total budget of Chemistry Branch is 1.75 million of which 1.5 is ONR funds; of this 1.0 million is basic research.<br>(3) Joint program at 0.5 million on basic research in extractive metallurgy of titanium.<br>(4) SQUID deals with fundamental aspects of jet propulsion; at level of 0.8 million per year, joint with Air Force. |
| Biological Sciences | Physiology—biophysics, nerve physiology; biochemistry—proteins, enzyme activity, immunochemistry; microbiology—metabolism, nutrition & genetics of micro-organisms; biology—marine biology, environmental physiology. | 2.4 | 1.5 Navy Bur. and other Gov't agencies (but almost all this is on applied programs). | 3.9 | (1) About 0.5 million ONR budget [redacted] each of physiology, biochemistry, microbiology, and biology branches. Two other branches, strictly appli[redacted] are Clinical Branch and Dental Br[redacted] each with budget of 0.1 or slightly more.<br>(2) The Microbiology Branch is not [redacted] cerned with principal disease stu[redacted] that are supported at present by [redacted]. There are some diseases not particularly important in civilian or public health context but important for the military services—these are supported by ONR.<br>(3) Biol. Sci. Div. operates jointly supported laboratory in biological warfare.<br>(4) Effort on marine biology is about 0.3 million or less. |

Summary of Contract Research Program, Office of Naval Research (cont'd)

| FIELD | SUB-FIELD | FUNDS ($ Million)—Current Annual Rate ONR DIRECT | INDIRECT (Amount & Source) | TOTAL | REMARKS |
|---|---|---|---|---|---|
| Psychological Sciences | Physiological psychology —vision, audition, motion sickness, human engineering; personnel and training (differential psychology); group psychology (includes psychological warfare) | 1.2 | 0.8 Navy Burs. | 2.0 | (1) Physiological Psychology Branch has budget of 0.45 million from ONR, and about 0.2 million from Navy Bureaus.<br>(2) Personnel and Training Branch has budget of 0.4 million from ONR and about 0.6 million from Bu Per.<br>(3) Group Psychology Branch has budget of about 0.4 million from ONR (none from outside). |
| Earth Sciences | Meteorology; oceanography; submarine geology; earth physics; geochemistry; geography | 2.0 | ? | 2.0 | (1) Joint contract (Sig. C. administered) on cloud physics at General Electric Company.<br>(2) Classified activity in Artificial Cloud Nucleation. |
| | | 21.1 | 10.8 | 31.9 | – Contract research program of ONR (less USRL, SDC, and Naval Science Div.) (About 12 million is basic research.) |
| NOTE: Other activities supported by ONR: | | | | | |
| USRL | | (small) | | | |
| SDC | | 4.0 | | | |
| Naval Sciences Div of ONR | | 9.0 | | | |
| NRL* | | 10.0 | | | |
| | | 44.1 | 10.8 | 54.9 | – ROUGHLY THE TOTAL FUNDS ADMINISTERED BY ONR. OF THESE<br>(a) 12 million is basic research contracted for by ONR<br>(b) 3 million is basic research at NRL |

*Navy Bureaus support NRL in a like amount, roughly.





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AIR FORCE PRESENTATION

Summary of Introductory Remarks by Dr. A. E. Lombard, Jr., Scientific Advisor, Office of the Deputy Chief of Staff, Development

The Air Force program of basic research is administered through the Office of Scientific Research, of the Air Research and Development Command (ARDC), located in Baltimore, Maryland. The Commanding General, ARDC, is directly responsible to the Chief of Staff, U. S. Air Force, for the conduct of all Air Force research and development. He exercises direct command over the research and development centers operated by the Air Force. ARDC is delegated virtually the full responsibility for the basic research program, while the Deputy Chief of Staff for Development, in Hq., USAF, deals with the over-all budget, the policy matters, and inter-departmental matters. The Office of Scientific Research (OSR) is a staff organization of the Headquarters of ARDC, and is responsible for the Air Force basic research program. OSR does not operate any laboratories for "in-shop" research but accomplishes its program by the contract support of research at universities and other institutions.

The over-all research and development program of the Air Force (to which the basic research program is broadly relevant) is aimed at the support of the roles and missions assigned by the Joint Chiefs of Staff to the Air Force. Of the Air Force facilities available for the over-all research and development program, the Air Force Cambridge Research Center, at Cambridge, Massachusetts, is the only establishment having a substantial facility for "in-shop" research within the Air Force. Most of the research at the Cambridge Research Center is in electronics and geophysics; the programs, however, are not classified as

basic research. The other research and development facilities operated by the Air Force are primarily devoted to applied research, development and testing of equipment. Wind tunnel facilities make up a major part of the plant investment. Outside of the command structure of ARDC, the Proving Ground Command provides an operational test facility for evaluating the military effectiveness of new weapons and equipment. For a primary source of applied research on aerodynamics and propulsion, the Air Force looks to the NACA, which operates three large aeronautical research centers at Langley Field, Virginia; Moffett Field, California; and Cleveland Airport, Cleveland, Ohio.

Summary of Remarks by Lt. Colonel W. O. Davis, Vice Chief of Scientific Research, ARDC, on Administration of Basic Research by the Office of Scientific Research

The Office of Scientific Research is divided into five divisions for the purpose of administering the research program: Chemistry, Mathematics, Physics, Fluid Mechanics, and Solid State Sciences. Each division is so named as to encompass approximately the same level of effort in terms of funds. OSR has a field office on the west coast for evaluating proposals and maintaining contacts in that area. The Western European Office of ARDC in Brussels, Belgium is also in a position to aid OSR in taking advantage of the facilities and talent of Western Europe. The Brussels Office has a staff of one civilian and three military officers; it makes use of offshore procurement authority in contracting for research abroad.

Proposals are solicited from personnel and institutions interested in and able to contribute to the research effort. In general, work which is of

interest to the Air Force is supported. Proposals are then received, reviewed for merit and relevance to Air Force problems, and coordinated. Coordination is maintained with other governmental agencies; proposals are exchanged with the Office of Naval Research, Office of Ordnance Research, National Advisory Committee on Aeronautics, National Science Foundation, and Atomic Energy Commission. Such coordination serves to prevent duplication of effort and to keep the scientific agencies of the government informed of tasks under consideration.

The process of evaluation of coordinated proposals is similar to that followed by OCR and ONR. Proposals are forwarded to advisers individually for evaluation of merit. The advice of the referees may be followed depending on the weight given in OSR to any extenuating circumstances. Evaluation of proposals for their pertinence to the USAF program is performed largely by the OSR staff through coordination within the ARDC, and with Hq. USAF if policy matters are involved. The decision to support a program is made in OSR by the Division Chief. Responsibility for final approval is vested in the Chief of Scientific Research.

The Office of Scientific Research has a policy of selecting proposals and letting contracts on the basis of pertinence and quality primarily. The larger universities share the bulk of the contracts, resulting largely from the belief that the quality of the work will be enhanced if performed by individuals known to be highly qualified and having available excellent facilities for the conduct of the work. It is recognized, however, that where possible the smaller institutions should be s upported.

The dissemination of information resulting from research contracts is

likewise handled in OSR. Copies of reports are furnished the Armed Services Technical Information Agency and distributed to agencies having an interest in the research reported.

The staff or OSR includes 14 physical science administrators, of which 5 are military personnel and 9 are civilians.

The Division Directors of OSR who made presentations are as follows:

| | |
|---|---|
| Dr. Simon H. Herzfeld | Chemistry Division |
| Dr. M. M. Andrews | Mathematics Division |
| Mr. William J. Otting | Physics Division |
| Major Michael Zubon | Fluid Mechanics Division |
| Mr. Charles F. Yost | Solid State Science Division. |

The presentations are summarized in TABLE I: "Air Force Basic Research Administered by the Office of Scientific Research". Another tabulation is also included, TABLE II: "Supplemental Data on Additional Air Force Research, some of which is Basic Research", to indicate programs that have not been captured in the formal presentations by personnel of the Office of Scientific Research.

AIR FORCE BASIC RESEARCH PROGRAM

TABLE I: Air Force Basic Research Administered by the Office of Scientific Research (OSR)

| FIELD | SUB-FIELD | DIRECT PLANNED SUPPORT**(In $ Million) FY 53* | FY 54* | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Chemistry | (1) Pure chemistry: Composition, structure, properties, and transformation of matter. | 1.48 | 1.40 | 1.29 | (1) In pure chemistry, work is narrowed to elements, compounds, and mixtures, and includes work chemical reactions and the discovery of new reactions. 23 act projects, 14 more under consider |
| | (2) Chemical principles and theories, applications to analysis and measurement. | | | | (2) Chemical principles includes thermodynamics and statistical for chemical equilibrium, and el chemical and photoelectric studi |
| | (3) Chemical energetics. | | | | (3) Energetics is aimed toward knowledge of the rate and manner in which energy is liberated in reactions. Includes Project SQ a joint-service program on propulsion and combustion. |
| | (4) Chemistry of photographic processes | | | | (4) Work in photographic proces is aimed toward exploration of methods as well as re-evaluation standard procedures. |
| Mathematics | (1) Theoretical and applied mathematics: differential equations, variational theory, algebra. | 1.29 | 0.86 | 0.82 | (1) In applied mathematics, pro is slanted toward new techniques rather than the application of mathematics to new problem area |

* Funds reported to RDB as of 9 March 1953
** Projects are supported by funds directly budgeted for basic research; there is no indirect source of funds.

TABLE I: Air Force Basic Research Administered by OSR (Cont'd)

| FIELD | SUB-FIELD | DIRECT PLANNED SUPPORT (In $ Million) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Mathematics (cont'd) | (2) Statistics and probability theory. | | | | (2) Statistics and probability have many potential applications of interest: radar analysis, automatic control systems, gunnery systems. |
| | (3) Computer research. | | | | (3) Joint support with ONR and [redacted] of computer research at Institute for Advanced Study, Princeton. |
| Physics | (1) Atomic physics: extra-nuclear properties of matter, molecular spectroscopy. | 1.85 | 1.30 | 1.09 | (1) Instrumentation is aimed to [redacted] new instruments to measure physical phenomena in new and better ways. Main contract is with Bureau of Standards (joint with other services and AEC). |
| | (2) Nuclear physics | | | | (2) Electromagnetic radiation includes joint service projects in electronics concerned with radiation. |
| | (3) Instrumentation | | | | |
| | (4) Basic physics: quantum electrodynamics, acoustics, dynamics, and genetics. | | | | |
| | (5) Electromagnetic radiation: radio, infrared, x-rays. | | | | |
| Fluid Mechanics | (1) Incompressible flow: turbulence, unsteady flow, drag. | 1.98 | 1.98 | 1.30 | (1) Fluid mechanics program is aimed toward problems associated with high speed, high altitude flight. |

TABLE I: Air Force Basic Research Administered by OSR (Cont'd)

| FIELD | SUB-FIELD | DIRECT PLANNED SUPPORT (In $ Million) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Fluid Mechanics (cont'd) | (2) Viscous Flow: boundary layer, fluid turbulence, skin friction | | | | (2) Not included in funds tabulated is research on aerodynamics and structures sponsored by Aircraft Laboratory at Wright-Patterson AF Base. This is not classified at BR. One project includes work on boundary layer control and is funded at about $1 million per year. |
| | (3) Compressible flow: flutter and vibration | | | | |
| | (4) Internal aerodynamics: flow through pipes, nozzles, diffusers, compressors. | | | | |
| | (5) Aerothermodynamics. | | | | |
| Solid State Sciences | (1) Physical properties of solids. | 1.40 | 0.90 | 1.00 | (1) Major aims of program are the physics of metals (applicable to metallurgy) and infrared photoconductors. |
| | (2) Structure of solids. | | | | |
| | (3) Surface physics. | | | | |
| | (4) Special physical structures: semi-conductors, alkali halides, ferrites. | | | | |
| | (5) Extreme temperature physics | | | | |
| | | 8.00 | 6.44 | 5.50 | |
| | | (6.225) | (4.775) | | – Amounts reported by OSR to Basic Research Group |

**TABLE II:** Supplemental Data on Additional Air Force Research, Some of Which is Basic Research.

| FIELD | SUB-FIELD | PLANNED DIRECT SUPPORT* (In $ Million) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| | **Administered by OSR** | | | | |
| Physical Sciences | Chemistry, physics, mathematics, (see Table I) | 8.00 | 6.44 | 5.50 | Entire program is carried on by contract. OSR reports $6.225 for FY 53 and $4.775 for FY 54 as total effort. |
| | **Cambridge Research Labs.** | | | | |
| Electronics | Fundamental electronics | 1.24 | 1.20 | – | The electronic program is carried under "Basic Research". |
| Geophysics | Meteorology, climatology | 5.17 | 6.44 | – | The meteorology program is about 50% contracted, 50% in-service research. This research is classified under IO-14 as a program pertaining to meteorology. |
| | **Air University** | | | | |
| Medical Sciences | | 2.49 | 2.03 | – | Projects classified principally under "Personnel Operations" rather than "Basic Research." |
| Social Sciences | | 2.22 | 2.21 | – | |
| | **Flight Research Laboratory, WADC** | | | | |
| Physical Sciences | Mathematics, physics | 7.60 | 7.35 | – | Both applied and basic research directed toward solution of specific problems. Includes research on boundary layer control. |

* Source: Tabulations of fiscal data submitted to RDB by the USAF. These figures reflect the situation as of 9 March 1953.





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TABLE II: Supplemental Data on Additional Air Force Research (cont'd)

| FIELD | SUB-FIELD | PLANNED DIRECT SUPPORT (IN $ Million) FY 53 | FY 54 | FY 55 | REMARKS |
|---|---|---|---|---|---|
| Physical & Social Sciences | Proj. Rand encompasses basic and applied research, sub-contracting as required | 6.11 | 6.11 | - | Project Rand encompasses some work in basic research in both the physical and social sciences. Rand is classified under "Intelligence and Planning" rather than under "Basic Research". |
| | TOTALS | 32.73 | 31.78 | | NOTE: Not all of the total can be construed as applicable to the Basic Research Program. |

Research in the Biosciences: The Air Force supports work in the biosciences through the Director of Human Factors in ARDC and the Aeromedical Laboratory at Wright-Patterson AF Base. The human factors program involves psychological and physiological problems associated with flight. About half of the program is carried out in service laboratories, and half on a contract basis. The bulk of this program is carried as "supporting research".