

BIOLOGY AND MEDICINE
PROGRAM BUDGET

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May 1971

CONTRACT W-31-109-ENG-38
SUPPLEMENT NO. 16

1. TITLE
Biology and Medicine Program 728229



2. BUDGET ACTIVITY NO.
AEC 06 Summary
ANL 60300-67500 Summary (BIM, RPY, ERP, CHM, EL-PHY)

3. SCIENTIST RESPONSIBLE R. B. Duffield, W. M. Manning,
R. E. Rowland, and W. K. Sinclair

4. WORK STARTED
FY Continuing

5. RELATED WORK (With Same Contractor or Others) This program is integrated with other AEC programs in this area and is closely correlated with relevant work of other governmental agencies, universities, and research institutions.

6. MANPOWER AND COST DATA ESTIMATED FOR FISCAL YEARS

	FY 1971	FY 1972 PRESIDENT'S BUDGET	FY 1972 INCREMENTAL REQUIREMENTS	FY 1973
6a. DIRECT MANPOWER (Man Years)				
SCIENTIFIC				
REGULAR	146.1	143.4	1.9	146.0
TEMPORARY PAID BY ANL	7.9	12.8	2.0	20.3
TEMPORARY PAID BY OTHERS	15.2	15.7	-	16.1
TOTAL SCIENTIFIC	169.2	171.9	3.9	182.4
OTHER TECHNICAL				
REGULAR	11.5	12.0	0.1	11.6
TEMPORARY PAID BY ANL	0.2	-	-	-
TEMPORARY PAID BY OTHERS	13.1	13.2	-	13.4
TOTAL OTHER TECHNICAL	24.8	25.2	0.1	25.0
TOTAL MAN YEARS	194.0	197.1	4.0	207.4
6b. OPERATING COSTS (In Thousands)				
EFFORT-RELATED COSTS	\$4,948	\$5,251	\$ 86	\$5,726
MATERIALS AND SERVICES	1,954	2,178	81	2,440
MAJOR PROCUREMENTS	287	240	30	260
TOTAL COST	\$7,189	\$7,669	\$197	\$8,426

6c. Cost (Recap of Subactivities) (In Thousands)

06-01 Interaction of Radiation with Biological Systems	\$4,214	\$4,425	\$ 43	\$4,802
02 Assessment, Evaluation and Control of Radiation Exposure to Man and His Environment	2,975	3,244	154	3,624
Total 06 Program	\$7,189	\$7,669	\$197	\$8,426

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6d. Major Procurements (In Thousands)

	FY 1971	FY 1972	FY 1972	FY 1973
		Pres. Bud.	Inc. Req.	
06-02 Assessment, Evaluation and Control of Radiation Exposure to Man and His Environment	\$287	\$240	\$ 54	\$260

See individual 189's for detail.

6e. Equipment Obligations (In Thousands)

	FY 1971	FY 1972 Pres. Bud.	FY 1972 Inc. Req.	FY 1973
General (see below for detail)	\$ 58	\$ 83	-	\$ 88
06-01 Interaction of Radiation with Biological Systems	226	262	-	255
-02 Assessment, Evaluation and Control of Radiation Exposure to Man and His Environment	241	180	-	222
Total 06 Program	\$525	\$525	-	\$565

See individual 189's for detail.

The following equipment items are for general use within the Biological and Medical Research Division and are, therefore, not allocated directly to individual 189's.

	FY 1971	FY 1972 Pres. Bud.	FY 1972 Inc. Req.	FY 1973
Animal Cage Washer	\$30	-	-	-
IBM Key Punch	5	-	-	-
¹⁴ C- ³ H Oxidizer	10	-	-	-
High Level Gamma Beam Cobalt-60 Source and Mechanism	-	\$47	-	-
Steam Sterilizer	-	20	-	-
Cary 21 Spectrophotometer	-	-	-	\$21
Cryogenic Stage for Scanning Microscope	-	-	-	15
Lanthanum Hexaboride Electron Gun for Scanning Microscope	-	-	-	15
Minor Items - Animal Quarters	3	5	-	12
Minor Items - Other General Services	10	11	-	25
Total General Equipment	\$58	\$83	-	\$88

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6e. <u>Equipment Obligations</u> (Contd.)		
<u>Explanation of Equipment Items</u>		
<u>High Level Gamma Beam Cobalt-60 Source and Mechanism</u>		
<p>The present high intensity cobalt-60 source in the high level gamma room was 12,000 curies in 1963 and has decayed to less than half its original intensity. Replacement by a source of similar design would be uneconomical in view of the high cost of high specific activity cobalt-60. It is proposed to retain the present mechanism and sources while adding a further mechanism containing 20,000 curies of cobalt-60. The physical arrangement of the proposed source permits standard cobalt-60 to be used and yet would permit uniform exposures of small samples at higher dose rates than in the present facility. The maximum flexibility and operational convenience would be achieved in a most economic way. The high level gamma room is operated as a facility available to all staff members in the Division. Most users are in programs concerned with the effects of radiation on living organisms; however some are in the molecular and cellular level studies.</p>		
7. <u>Description</u>		
<p>The program of the <u>Division of Biological and Medical Research</u> has been drastically revised and the staff reorganized into seven major groups. These are neutron and gamma ray toxicity (Janus), a new program in carcinogenesis, a new program in aging, biochemistry, biophysics, microbial and mammalian genetics, and the metabolism of fission products in dogs. The separately budgeted activity on Combating Detrimental Effects of Radiation is under the administrative management of the biochemistry group leader. In many of the programs established in the past, substantial revisions in content and orientation have also been undertaken.</p>		
<p>In the budget category, "Effects of Radiation on Living Organisms," all the previously independent effort in toxicology studies, in theoretical biology, in the Janus program, in cell kinetics, and in mechanisms of carcinogenesis have been grouped into one of the following three programs:</p>		
<p>(1) An expanded neutron and gamma ray toxicity program which has as its primary aim the study of late effects (neoplasia, degenerative diseases, and impairment of physiological function) in the mouse and other rodents from neutrons and gamma rays. Studies of radiation effects in chickens and in some other species</p>		
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7. Description (Contd.)

have been phased out. The Janus program is still aimed at establishing results of value in predicting the effects of low level irradiation in small mammals, and eventually in man.

(2) A new program in aging having three principal experimental facets: cellular studies involving the aging of erythrocyte membranes, and immunological phenomena in fish and in mice; studies on the comparative biology of rodents, particularly two species with similar physiological and anatomical characteristics but widely different lifespans; and the testing of mathematical theories of mortality and the perturbations induced by radiation and other stresses.

(3) A completely modified new program in carcinogenesis. The three main approaches to this problem include the biochemical basis for the promoting effect of phenobarbital on AAF-induced hepatocarcinogenesis; the role of differentiation in carcinogenesis; and test systems involving skin carcinogenesis in hairless mice, the role of genetic factors in genetic defect strains, and the potential of in vitro transformation in quantitating carcinogenesis at the cellular level.

Each of the three major programs described above relates intimately to the others and in some cases personnel have responsibilities in all three areas since reduction in lifespan (aging) and induction of tumors (radiation carcinogenesis) are the principal late toxic effects of chronic irradiation. In both of the new programs, investigators have been drawn from other budget activities, notably biochemistry, and the programs so far envisaged are to be regarded as being at a comparatively early stage of development. They are expected to consolidate and form a more focused effort within the next budget year as the participants interact with one another.

The activity formerly described separately as Laboratory Animal Medicine now forms an integral part of several programs.

Molecular and Cellular Level Studies now include only biochemistry and biophysics. The biochemistry program has been greatly reduced by transfer of personnel into other programs. The remaining research activities include several involved in the search for mechanisms of metabolic control and include studies on the kinetics and regulation of enzymes in mammalian cells, physiological and biochemical studies on irradiated yeast, and studies in plant physiology involving hormonal and metabolic aspects of radiation response.

The biophysics program has five well developed research interests which range from investigation of events at the cellular level to those at the molecular level. The former includes one program on the radiosensitivity of cells (especially synchronous cells as a function of cell generation cycle position) and another on circadian rhythms in eukaryotic cells. The molecular level studies include determinations of macromolecular structure using nuclear magnetic resonance spectroscopy, and X-ray crystallographic and chemical methods. Measurement of stable isotopes of hydrogen, carbon, and nitrogen in analytical studies by gas chromatography and mass spectrometry is being developed as a technique for the

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<p>7. <u>Description</u> (Contd.)</p> <p>use of stable isotopes in clinical diagnostic procedures. This was previously a part of the biochemistry program.</p> <p>There are four projects in <u>microbial genetics</u> which utilize bacterial systems to understand <u>genetic mechanisms</u>. One concerns the replication and regulation of cellular DNA in <u>E. coli</u>, another the organization and function of the bacterial chromosome (of <u>B. subtilis</u>), a third the lethal effects of radiation in the genetic material of <u>E. coli</u>, and finally a project on the genetic and physiological effects of ultraviolet and visible light. A smaller effort in <u>mammalian genetics</u> is about to extend studies on radiation-induced sex-linked mutation rates in the mouse from single-marked systems to mutation induction studies with a double marked X chromosome.</p> <p>The project on the metabolism of fission products in dogs has been extensively revised and is being coordinated with other external radiation toxicity programs in this Division. It is expected that these changes will result in a productive effort which will contribute important information toward better predictions of radiation effects in man. The program has been reduced in numbers of both personnel and dogs, while at the same time some experimental aspects have been enlarged. We will concentrate on the external gamma ray exposure of dogs at levels now down to 5 R/day (and soon to reach 2 R/day). At the lower level, lifespan is expected to be reduced by a factor of ~2. This program will serve first as an essential baseline for the toxicity of the fission products, before additional work with cerium-144 and cesium-137 is undertaken; and second as a vital link between the extensive external radiation toxicity studies in the mouse to their eventual exploitation in understanding effects in man, especially after low doses.</p> <p>Work on the toxicity of the actinide elements is continuing at past levels but with some broadening of scope to include studies on the removal of deposited plutonium with chelating agents, using dogs as well as mice.</p> <p>The major revisions of the overall Division program outlined above are expected to result in a more coordinated approach for the Division's research effort, since many formerly fragmented projects have been consolidated into a limited number of aims. Nevertheless, it is intended to preserve the independence of individual investigators by their individual contributions to these aims. The aims also have many common elements, and effective collaboration among groups is expected to result. Loss of personnel due to reduced funding has limited the range of</p> <p style="text-align: right;">(over)</p>	

7. Description (Contd.)

competences available to our programs, and a serious lack has been the loss of vitality resulting from the absence of new personnel and new temporary and post-doctoral visitors. An effort to remedy this situation will be made in FY 1972 and in ensuing years. In addition, student programs have been developed further, and the 1971 summer graduate program in radiobiology will bring a substantial number of graduate students to the Division for a limited time.

Teaching affiliations with various universities in the area have been expanded, and we expect additional joint appointments to develop in both the medical and the basic sciences. A firmer base has been established in the academic community with the development of student programs and visiting lecture series in the AUA universities via the AUA-ANL Biology Committee.

The program of the Radiological Physics Division includes research in four areas: 1) internal emitters, 2) aquatic and terrestrial ecology, 3) atmospheric sciences, and 4) radiation physics.

The internal emitter research, conducted by that portion of the division called the Center for Human Radiobiology, is presently oriented heavily toward evaluation of the effects of internally-deposited radium in man. The toxic effects of thorotrast and the deposition in lung and bone of the radon daughter products encountered in uranium mining are also under consideration, as indeed are all internal emitters.

The aquatic and terrestrial ecology program is oriented in two directions. The largest is the Great Lakes Program, which is concerned with the consequences of thermal and radioisotope additions to Lake Michigan from electrical generating plants and industrial operations sited along the shores of the lake. A smaller program in terrestrial ecology, which has engendered a large number of profitable interactions with surrounding colleges and universities, makes use of the unique facilities of this laboratory, not the least of which is the extensive land available for environmental studies.

The atmospheric sciences section is involved with urban meteorology, air pollution, and the micrometeorology of local heat sources. This latter involves the mechanisms by which heat is transferred from bodies of water or cooling towers into the surroundings.

The radiation physics section is engaging in a new program of electron scattering, and is continuing work on energy transfer processes. The unique strength of this group is derived from its intimate mix of theoreticians and experimental scientists.

The most pressing problem facing the Radiological Physics Division at this time is lack of adequate space. At the present staffing level, the division is sorely pressed to find laboratory and office space. Further increases in manpower are vitally necessary in two areas; the Center for Human Radiobiology and the Great Lakes Program. Both programs need additional manpower in order to fulfill their programmatic requirements, yet space for the additional people is not available.

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<p>7. <u>Description (Contd.)</u></p> <p>Funds for a new addition for the Center for Human Radiobiology, which were authorized and appropriated, were not released. Therefore, steps are being taken to find space within the Laboratory which could be converted for our use at reasonable cost. Specific needs, such as a low background shielded counting facility for low activity samples, will not be available until specific funds are made available for their construction.</p>		

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