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MOUND LABORATORY

- Operated By -

MONSANTO CHEMICAL COMPANY

PROPOSED PROGRAMS AND BUDGETS

FOR

GENERAL RESEARCH AND DEVELOPMENT

AND

BIOLOGICAL RESEARCH

FOR THE FISCAL YEAR OF 1950

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Submitted:

March 7, 1949.

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Malcolm M. Haring,
Laboratory Director.

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PROPOSED RESEARCH BUDGETS

FISCAL YEAR OF 1950

GENERAL RESEARCH

Personnel

Salaries

Pure research	20	\$ 93,730
Applied research	49	225,210
Research service	<u>15</u>	<u>29,538</u>
Subtotal	84	\$ 348,478
Increases at 5%		<u>17,424</u>
Total salaries		\$ 365,902

Supplies

Total direct costs		\$ 152,515
		\$ 518,417

Indirect costs

373,640

Grand total

\$ 892,057

BIOLOGICAL RESEARCH

Personnel

Salaries

Pure research	0	\$	
Applied research	30	\$ 107,616	
Research service	<u>6</u>	<u>15,984</u>	
Subtotal	36	\$ 123,600	
Increases at 5%		<u>6,180</u>	
Total salaries		\$ 129,780	

Supplies

Total direct costs		\$ 72,183
		\$ 201,963

Indirect costs

150,957

Grand total

\$ 352,920

51,244,977

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COMMENTS

The research programs submitted herewith are essentially those submitted previously. Since the General Research Program is undergoing extensive revision, a full outline of the expanded program is included to give a better picture of the whole. A brief discussion of each point is being written and when completed will be sent out as a supplement to this report. It is expected this will be accomplished before June 30, 1949. Although future programs are indicated, the man months per problem refer only to the fiscal year of 1950. Thus, any number of man months greater than twelve means that two or more men will be working simultaneously on the problem. In the case of biological research in particular, all the problems are long range, several years possibly being required for complete solution.

The data used for the budgets were obtained as follows. "Salaries" are based on direct addition of those presently paid and those of personnel needed to complete the various staffs. "Supplies" are based on the cost of supplies to the two fields of work for the period July 1, 1948, to December 31, 1948. The "Indirect Costs" are the result of careful analysis of each cost center to see how a percentage for each could be assigned to each of the two research fields. The dollar values come from the direct costs in each center for the period December 1, 1948, to January 31, 1949. Although they are admittedly not precise for a whole year of operation at Mound Laboratory, they are probably not too far off. The details of the breakdown adopted are given on page 6 et seq.

It should be recognized that the totals of the budgets arrived at are probably more than the reduction in cost to Mound Laboratory if these activities did not exist. This is because (a) there is a big positive intercept on the curve of cost of plant operation vs. number of personnel, and (b) there is an actual reduction in the cost of "production" (not overall) when other activities are added, since facilities can be shared.

From the proposed budgets it can be seen that the cost per man in General Research would be \$12,928, and in Biological Research would be \$13,574. This averages \$13,251 per person actually engaged in research work, which compares very well with general Company experience. These figures were obtained by dividing the total budget in each category by the number of persons in pure and applied research. These are 69 for General Research and 30 for Biological Research.

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One thing that will always make the cost of Atomic Energy Commission plant budgets run high is the necessity for extensive health and security measures. In our own case, the figures are as follows.

	<u>Whole Project</u>	<u>General Research</u>	<u>Biological Research</u>
Health	7.17%	9.40%	8.88%
Security	<u>11.29%</u>	<u>0.66%</u>	<u>0.83%</u>
Total	18.46%	10.06%	9.71%

Under "Health" are included process waste, laundry, decontamination, change house, survey, and instruments.

Certain other facts will be useful in interpreting these budgets. The General Research budget includes some work in each of three divisions as follows: Research Division 80.1%, Health Division 10.1%, and Production Division 9.8%. 42.33% of all costs are indirect, and 57.67% are direct, i.e., salaries and supplies. The proposed General Research budget is 21.0% of the total, and the Biological Research budget is 8.3% of the total.

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DERIVATION OF INDIRECT COSTS

<u>Cost Centers</u>		<u>Method</u>	<u>General Research</u>		<u>Biological Research</u>	
<u>Code</u>	<u>Name</u>		<u>Per Cent</u>	<u>Dollars</u>	<u>Per Cent</u>	<u>Dollars</u>
21	Steam	(a)	11.87	31,098	4.37	11,448
22	Electricity	(a)	11.87	18,540	4.37	6,828
23	Compressed Air	(a)	11.87	318	4.37	114
24	Gas	(o)				
25	Well Water	(a)	11.87	420	4.37	156
26	Building Repairs	(a)	11.87	5,286	4.37	1,944
27	Process Waste	(b)	24.83	11,910	9.15	4,386
28	Design Engineering	(c)				
29	Mechanical	(a)	11.87	45,750	4.37	16,842
30	Air Conditioning	(d)	22.13	2,016	8.15	744
31	Stores and Receiving	(e)	9.96	14,730	5.69	8,418
32	Laundry	(f)	11.51	3,264	4.93	1,398
33	Decontamination	(b)	24.83	21,408	9.15	7,890
34	Yards, Roadways, and Fences	(g)				
35	Photography and Dupli- cation	(h)	9.95	3,984	4.27	1,710
36	Automotive	(h)	9.95	4,650	4.27	1,998
37	Service Building	(i)	15.00	3,840	6.43	1,644
38	Janitors	(j)				
39	Medical	(h)	9.95	2,898	4.27	1,242
40	Survey	(b)	24.83	16,434	9.15	6,054
41	Garage	(h)	9.95	414	4.27	180
42	General Plant Expense	(h)	9.95	20,532	4.27	8,814

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DERIVATION OF INDIRECT COSTS
(Continued)

<u>Cost Centers</u>		<u>Method</u>	<u>General Research</u>		<u>Biological Research</u>	
<u>Code</u>	<u>Name</u>		<u>Per Cent</u>	<u>Dollars</u>	<u>Per Cent</u>	<u>Dollars</u>
43	Electronics	(k)	26.09	33,396	11.18	14,310
44	Cafeteria	(h)	9.95	462	4.27	198
45	Administration	(h)	9.95	38,700	4.27	16,608
46	Accounting	(h)	9.95	6,558	4.27	2,814
47	Personnel	(h)	9.95	2,184	4.27	936
48	Security	(l)	40.00	5,862	20.00	2,931
49	Purchasing and Traffic	(e)	9.96	3,552	5.69	2,028
50	Office Services	(h)	9.95	8,322	4.27	3,570
51	Library	(m)	60.00	5,508	20.00	1,836
52	Fire Protection and Safety	(h)	9.95	2,070	4.27	888
53	Sewers	(h)	11.57	72	4.37	48
55	Health Instruments	(b)	24.83	27,000	9.15	9,948
60	Glass Shop	(c)				
61	Business Division Administration	(h)	9.95	1,668	4.27	714
63	Machine Shop	(n)	25.00	30,794	10.00	12,318
	Total indirect charges			\$373,640		\$150,957
	Average percentage distribution		16.16		6.51	

EXPLANATION OF SYMBOLS

- (a) By volumes of all buildings
- (b) By volumes of B, R and T buildings

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EXPLANATION OF SYMBOLS
(Continued)

- (c) Direct charge only as required.
- (d) By volumes of E, E, I, R and T buildings.
- (e) By number of requisitions.
- (f) By head count, less A building personnel.
- (g) Considered negligible for General and Biological Research.
- (h) By head count.
- (i) By head count, less A and I buildings personnel and troopers.
- (j) None in B and R buildings.
- (k) By head count of B, R and T buildings personnel.
- (l) Central Files plus one trooper. Distributed 2:2:1 to Production, General Research and Biological Research.
- (m) Distributed 3:1:1 to General Research, Biological Research and Production.
- (n) Distributed 13:5:2 to Production, General Research and Biological Research.
- (o) Included as direct charge under supplies.

Note: The distributions given above are not guaranteed to be precise. They are based on the best judgment of the author and on cost figures in the new plant for only two months. Both may be proved in error, particularly the latter, which are somewhat "seasonal," but they are believed to be at least reasonable.

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PROGRAM OF RESEARCH AND DEVELOPMENT

July 1, 1949 to June 30, 1950

PURPOSE

1. To define a broad, general program for research and development activities at the Mound Laboratory.
2. To survey all the work of the Laboratory to date in light of this program to show relative activity in various areas.
3. To analyse present relative activity.
4. To indicate any shift of activity needed to attain a broad research front.
5. To provide a structure of research activities to aid in budgetary consideration.
6. To aid in the planning of a publication program.
7. To provide a possible outline for summary research volumes for the National Nuclear Energy Series.

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MAJOR OUTLINE HEADINGS

- A. Polonium Research
 - I. Applied Research
 - a. Production Research
 - 1. Initial Concentration
 - 2. Final Concentration
 - b. Use Research
 - 1. Urchin
 - 2. Neutron Sources
 - 3. Alpha Sources
 - c. Process Waste-Disposal Research
 - II. Fundamental Research
 - a. Elemental Polonium
 - 1. Physical Properties
 - b. Compounds of Polonium
 - c. Solution Chemistry of Polonium
- B. Instrumentation Research
 - I. Applied Research
 - a. Electronics
 - 1. Radiation Detection
 - 2. Electrometry
 - b. Calorimetry
 - c. Optics
 - 1. Spectroscopy
 - d. Sonics
 - e. Volumetry
 - f. Gravimetry
 - 1. Quartz-fiber Microbalance
 - g. Protection

It will be noted that the following listing of research problems includes a number of items identified as "(future)" and "(completed)". While no dollars are included in the expense schedules for these items, they are included to supply the overall research picture and for conformity with the annual and quarterly research report coding designations.

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A. Polonium Research

I. Applied Research

a. Production Research

1. Initial Concentration

A. Scrubbing

I. Bismuth process

a. Ion complexes in production solutions

1. Bismuth complexes in hydrochloric acid
(6 man-months)

2. Bismuth complexes in nitric acid (future)

b. Thermodynamic properties of production solutions

1. Vapor pressure of hydrochloric acid over
bismuth chloride solutions (6 man-months)

c. Analytical problems

1. Determination of silver in bismuth (completed)

2. Determination of nickel in polonium solutions
(completed)

3. Determination of radioisotopes in slug jackets
(3 man-months)

4. Determination of bismuth in production
solutions (completed)

5. Determination of iron in bismuth solutions
(completed)

6. Turbidometric determination of chloride ion
(3 man-months)

7. Determination of a "volatile" impurity in
polonium deposits (3 man-months)

II. Silver process (completed)

B. Precipitation

I. Lead dioxide process (completed)

II. Tellurium process (completed)

III. Stannous chloride process

a. Behavior of impurities in production solutions
(6 man-months)

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- C. Ion exchange process (future)
- D. Solvent extraction process (future)
- E. Volatilization process (completed)
- F. Metallurgical process (future)

2. Final Concentration

A. Electrolytic process

I. Nitric acid plating process

a. Plate characteristics

- 1. Adherence of polonium deposits (completed)
- 2. Volatilization failure of certain polonium deposits (12 man-months)

b. Decomposition potential of bismuth (6 man-months)

II. Hydrofluoric acid process

a. Conversion from nitric acid to hydrofluoric acid (12 man-months)

b. Engineering of hydrofluoric acid process (12 man-months)

III. Hydrochloric acid process (future)

IV. Backing material for polonium plates

a. Polonium plated on tantalum (6 man-months)

b. Polonium plated on nickel (6 man-months)

V. General plating conditions

a. Temperature effect on polonium plating (12 man-months)

b. Effect of superimposed alternating current on polonium plating (6 man-months)

B. Chemical process

I. Chemical reduction of polonium from a purified solution (12 man-months)

II. Engineering of chemical process (12 man-months)

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b. Use Research

1. Urchin

A. Protective coat

I. Physical characteristics of nickel from thermal decomposition of nickel carbonyl (3 man-months)

B. Distillation and "hold-down"

I. Factors affecting distillation efficiency (12 man-months)

II. Factors affecting neutron count (12 man-months)

C. Photography and trace analysis (future)

D. Sealing and canning (future)

E. Recovery of polonium (future)

F. Engineering of process

I. Mechanization of procedures (12 man-months)

II. Statistical examination of operations data (future)

III. Properties of gasketing materials (future)

2. Neutron Sources

A. Standardization of neutron source production (future)

B. Improvement of source efficiency (future)

C. New types of neutron sources

I. Preparation of standard liquid neutron sources (6 man-months)

II. Preparation of standard solid neutron sources (future)

D. Engineering studies on dry-boxing and shielding (future)

E. Comprehensive study of detection and measurement of neutrons produced by polonium alphas

I. Operating characteristics of the Hanson neutron counter (12 man-months)

3. Alpha Sources (future)

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c. Process Waste-Disposal Research

1. Water Soluble Waste (completed)
2. Combustible Waste
 - A. Steam injector nozzle design and testing (12 man-months)
 - B. Pilot plant construction (24 man-months)
3. Water insoluble non-combustible waste (future)
4. Decontamination
 - A. Decontamination with sonic and supersonic waves (9 man-months)
 - B. Decontamination by electropolishing (3 man-months)
 - C. Decontamination by electroplating (completed)
5. Bismuth Recovery
 - A. Electrolytic recovery of bismuth metal from process wastes (24 man-months)
6. Platinum Recovery (12 man-months)

II. Fundamental

a. Elemental Polonium

1. Physical Properties
 - A. Nuclear Properties
 - I. Determination of the half-life of polonium (6 man-months)
 - II. Energy of polonium alphas (future)
 - III. Energy of polonium gammas (future)
 - IV. Cross section of polonium (future)
 - B. Atomic Properties
 - I. Determination of the X-ray spectrum of polonium (12 man-months)
 - II. Determination of emission spectrum of polonium (24 man-months)
 - III. Magnetic susceptibility of polonium (future)
 - IV. Determination of atomic weight (6 man-months)

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C. Mechanical Properties

- I. Determination of the density of polonium (completed)
- II. Crystal structure

- a. The transition of alpha-polonium to beta-polonium (12 man-months)
- b. The transition of alpha-polonium to gamma-polonium (12 man-months)

- III. Determination of the coefficient of expansion of metallic polonium (12 man-months)

D. Thermal Properties

- I. The melting point of polonium (future)
- II. The boiling point of polonium (completed)
- III. Vapor pressure

- a. The high temperature (sickel gauge region) vapor pressure (completed)
- b. The low temperature (effusion region) vapor pressure (12 man-months)
- c. Determination of molecular state (future)

- IV. The heat of vaporization of polonium (future)
- V. The heat of fusion of polonium (future)

E. Electrical Properties

- I. Determination of the electrical resistivity of polonium (12 man-months)
- II. The photosensitivity of polonium metal (future)

b. Compounds of Polonium

1. Group I Compounds

- A. The compound of polonium with sodium (12 man-months)
- F. The compound of polonium with hydrogen (future)

2. Group II Compounds

- A. The compound of polonium with zinc (future)

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3. Group III Compounds (future)
 4. Group IV Compounds
 - A. Organic polonium compounds (future)
 - B. The compound of polonium with lead (6 man-months)
 5. Group V Compounds (future)
 6. Group VI Compounds
 - A. The compounds of polonium with oxygen
 - I. Polonium dioxide (6 man-months)
 - II. Oxyacids containing polonium (12 man-months)
 7. Group VII Compounds
 - A. The compounds of polonium with fluorine (future)
 - B. The compounds of polonium with chlorine
 - I. Polonium dichloride (3 man-months)
 - II. Polonium tetrachloride (3 man-months)
 - C. The compounds of polonium with bromine
 - I. Polonium dibromide (12 man-months)
 - II. High polonium bromide (12 man-months)
 8. Group VIII Compounds (future)
- c. Solution Chemistry of Polonium
1. Phase Studies
 - A. Nature of Polonium Ions
 - I. Dialysis of polonium solutions (12 man-months)
 - II. Absorption spectra of polonium solutions (12 man-months)
 - III. Diffusion of polonium ions in solution (future)
 - B. Nature of Solid Phase (future)
 - C. Solubilities
 - I. Solubility in nitric acid (12 man-months)
 - II. Solubility in hydrofluoric acid (12 man-months)
 2. Thermochemistry (future)

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3. Colloid Chemistry (future)
4. Chemical Thermodynamics
 - A. A study of the system polonium ion, polonium -- mercury, mercurous sulfate (12 man-months)
5. Chemical Kinetics (future)
- d. Radiation Damage Effects of Polonium Alphas (future)
- e. Associated Special Chemistry
 1. RaD, RaE, RaF equilibrium (3 man-months)
 2. The stable isotope of lead with mass 206 (3 man-months)

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B. Instrumentation

I. Applied (All instrumentation is considered as Applied Research)

a. Electronics

1. Radiation Detection

A. Counter Assemblies

- I. Parallel plate alpha counters (24 man-months)
- II. Air proportional counters (24 man-months)
- III. Gas flow proportional counters (future)
- IV. Geiger-Mueller counters (future)
- V. Scintillation counters (12 man-months)

B. Counter Sub-Assemblies

I. Chambers

- a. Short tube low geometry chamber (future)
- b. Long tube low geometry chamber (future)
- c. Standard low geometry chamber (6 man-months)
- d. Solution counter (6 man-months)
- e. Lead attenuator revolving source gamma chamber (6 man-months)

II. Impedance Matching

- a. Ion tube to amplifier impedance matching (12 man-months)

III. Amplifiers

- a. High rate counter amplifiers (12 man-months)

IV. Trigger Pairs

- a. High rate counter trigger pairs (12 man-months)

V. Scalers

- a. High rate counter scalars (12 man-months)

VI. Rate Meters

- a. Rate meter circuit development (12 man-months)

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- C. Components (future)
 - D. Monitors
 - I. Personnel Monitors (future)
 - II. Area Monitors
 - a. Continuous alpha counter for water soluble wastes (12 man-months)
 - III. Air Monitors
 - a. Spot air monitor (6 man-months)
 - E. Photographic
 - I. Design, construction, installation, and testing of a cloud chamber (12 man-months)
2. Electrometry
- A. Polarography (future)
 - B. Electroanalysis
 - I. Reference Electrodes
 - a. Development of calomel electrodes (3 man-months)
 - b. Investigation of cell $Pt/H_2/HF(xm)/BiF_3/Bi$
3. Thermometry (future)
4. Pneumatics (future)
5. Controllers (future)
- b. Calorimetry
- 1. Resistance Bridge Steady State Calorimeter
 - A. A microcalorimeter to measure 1 millicurie of polonium to 1 per cent (12 man-months)
 - B. Guard-ring heater calorimeter (12 man-months)
 - 2. Rod Calorimeter
 - A. A modified design rod calorimeter (12 Man-months)

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3. Accessories
 - A. General investigation of calorimeter construction materials (6 man-months)
 - B. Ice-bath for temperature control (6 man-months)
- c. Optics
 1. Spectroscopy
 - A. Ultra-violet absorption spectrometry
 - I. A modified circuit for the Beckman spectrophotometer (future)
 - B. Visible absorption spectrometry
 - I. A colorimeter for drybox use (completed)
 - C. Infra-red absorption spectrometry (future)
 - D. Emission spectrometry (future)
 - E. Mass spectrometry
 - I. Design, construction, installation, and testing of mass spectrograph (24 man-months)
 2. X-Ray Diffraction (future)
 3. Microscopy
 - A. Visible light (future)
 - B. Electron microscopy (to be used jointly by R&D and B)
- d. Sonics (future)
- e. Volumetry
 1. Sickle gauges (future)
 2. Micropipets
 - A. An investigation of micropipet calibration (12 man-months)
- f. Gravimetry
 1. Quartz-Fiber Microbalance

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- A. Construction
 - I. Quartz-Fibers
 - a. A mechanism for drawing quartz-fibers (6 man-months)
 - b. Measurement of the properties of quartz-fibers (12 man-months)
 - II. Structures
 - a. Standard torsion equal-arm balance (6 man-months)
 - b. Heavy load torsion equal-arm balance (future)
 - B. Use (future)
2. Modified Ainsworth Semi Microbalance
- A. Modifications to obtained balanced heat gradient from thermal-hot sample (12 man-months)
 - B. Measurement of buoyancy of thermal-hot sample (12 man-months)
3. A modified Ainsworth Vacuum Microbalance (6 man-months)
- g. Protection
- 1. Radiation
 - A. Totally enclosed hoods
 - I. Redesign of totally enclosed hoods(future)
 - B. Shields (future)
 - h. Miscellaneous Physical Instrumentation (future)
 - i. Miscellaneous Chemical Instrumentation (future)

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PROGRAM OF BIOLOGICAL RESEARCH

July 1, 1949 to June 30, 1950

INTRODUCTION

The biological research program at Mound Laboratory is aimed toward learning the practical methods for prevention, diagnosis and treatment of polonium effects on personnel. The program is also concerned with the possible effects of radioactive wastes on modern sewage disposal plants and organisms in the surrounding area. The practical medical applications of this research will be emphasized as is evidenced by its incorporation into the program of the Medical Section of the Atomic Energy Commission.

Biological research with polonium requires animal experimentation. Important specific aspects of such studies are the following:

1. A determination of the mode of entrance of polonium into the body.
2. The establishment of polonium tolerance levels based upon direct animal experimentation.
3. Adequate measurement of the "biological half life" of the product.
4. The identification and enumeration of the clinical symptoms of radiation damage.
5. The investigation of toxic effects on metabolic systems.

The clinical application of results are of major importance. For this purpose, a thorough understanding of the basic principles involved is necessary. For example, why will the body tolerate only so much polonium? What system breaks down when this limit is exceeded? Clinical symptoms and pathological findings offer a locus for the investigation of body organs which are affected. Detailed study of the cells of these organs, or of single celled or simple organisms, will ultimately throw light upon the systems of cellular metabolism which are being disrupted. An understanding of such metabolic effects is the basis for adequate prevention and treatment of possible polonium exposures.

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This work is a direct measurement of the effects of the compound upon the variability of sewage organisms. It is necessary that lethal effects, of a range of product concentrations, upon such organisms be known so that predictions of interference with sewage processes can be made.

- II. Effects of polonium on the biochemical oxygen demand and the direct oxygen utilization of sewage organisms. (15 man months)

These measurements of oxygen utilization are a corollary of the above lethal measurements. They determine the effective activity of the organisms. Again, such knowledge is necessary in estimating possible interference effects.

- III. Polonium effects upon pure cultures of various sewage microorganisms. (20 man months)

To determine accurately the product effects upon sewage organisms, it is necessary that observations under controlled metabolic conditions be made. This necessitates the use of pure cultures. Measurements of effects upon growth, respiration, morphology, and genetic variability will be made. These are a necessary prerequisite to obtaining knowledge of interference with metabolic processes. When metabolic effects are known, adequate preventive and control steps can be employed in handling product wastes.

- IV. The mechanics of the lethal polonium effect. (10 man months)

This phase actually depends upon results secured in Section III. It may be more advantageous to investigate the mechanism of respiratory inhibitions or the mechanism of cell division effects. In any case, quantitative inhibitory relations will be determined, and the locus of the effects will be investigated by the use of suitable chemical inhibitors and enzyme studies. Because of its possible ramifications this phase of the work will obviously continue beyond the present year. It is an important phase in that only on the basis of such knowledge can sufficient practical steps be taken to control the effects of polonium upon sewage organisms.

- C. Toxicity by skin absorption.

It is possible that personnel may be exposed to polonium and its compounds by skin absorption. In order to determine the hazards involved in such accidents, it is important that this project be conducted. The proposed plans are the following.

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- I. Acute toxicity studies by following methods. (30 man months)
 - a. Time of death.
 - b. Rate of absorption.
 - c. Rate and mode of excretion.
- II. Chronic toxicity studies. (30 man months)
 - a. Effects of vehicle.
 - b. Rate of absorption.
 - c. Rate and mode of excretion.
- D. Hematological and pathological effects of polonium on rats, rabbits and dogs. (126 man months)

Up to the present time data on these studies are very meagre. Information from these experiments may be used in order to diagnose, treat and evaluate recovery of personnel that may be exposed to polonium or its compounds.

- E. Development of low activity analytical techniques. (48 man months)

For both routine urine analysis and for the counting of experimental materials it is essential that adequate techniques be used to obtain accurate results. Continual improvement of such counting procedures, especially for the low activity levels encountered in biological materials are necessary for valid measurement.

As a first step a complete determination of the accuracy of polonium assay in urine samples by our present method under varying conditions of stirring, plating times, acid normalities, and types of acid will be made. Such information is imperative in order that the increasing number of urine and research analyses be carried out as rapidly and as accurately as possible.

A second and equally important phase will be the investigation of different methods of analysis. It is very possible that methods both more efficient and more rapid can be worked out. The need for such techniques is obvious.

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FUTURE PROJECTS

Projects planned for execution subsequent to the foregoing are as follows:

- A. Effects of polonium on liver and renal function in dogs.
These studies may be of clinical significance.
- B. Product effects upon the respiration of various tissues.
- C. Polonium effects upon the reproductive system in rats and mice.
- D. Acute and chronic studies on the basal metabolism, blood pressure, cardigraphy, blood and plasma volume changes in dogs.
- E. Study of therapeutic agents and polonium metabolism.

The effects of therapeutic agents in the elimination of polonium from the body will be studied in acute and chronic exposures in dogs and rats. Data obtained from such studies may be used to increase the rate of elimination of polonium from humans, thus reducing the duration of exposure and the time lost by personnel from their jobs.

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PERSONNEL ANALYSIS

The personnel available at present for work on the foregoing projects, as well as personnel which it is necessary to procure are as follows:

A. Present Staff

Division Director (Half time to research)
Assistant Research Biochemist (M.S.)
Biochemist (3) (B.S.)
Research Pathologist (Half time) (M.D.)
Assistant Research Pathologist (2) (B.S.)
Research Physiologist (Animal) (Ph.D.)
Research Physiologist (Plant) (Ph.D.)
Biologist (6) (B.S.)
Assistant Research Statistician (B.S.)
Laboratory Aides (3)

B. Unfilled Staff Positions

Chief of Section (Ph.D.)
Research Biochemist (2) (Ph.D.) (one candidate interviewed)
Assistant Research Biochemist (M.S.)
Biochemist (2) (B.S.)
Laboratory Aides (5)

In addition to the present staff there are four and one half counting room girls and one and one half electronics maintenance men assigned for service to the biological section.

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