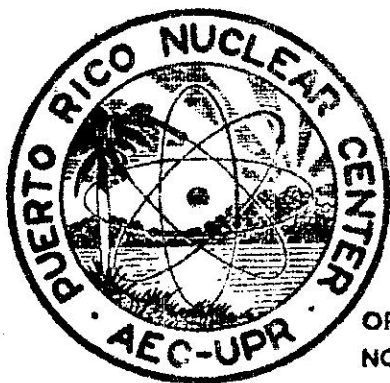


Burton

PRNC 22

PUERTO RICO NUCLEAR CENTER

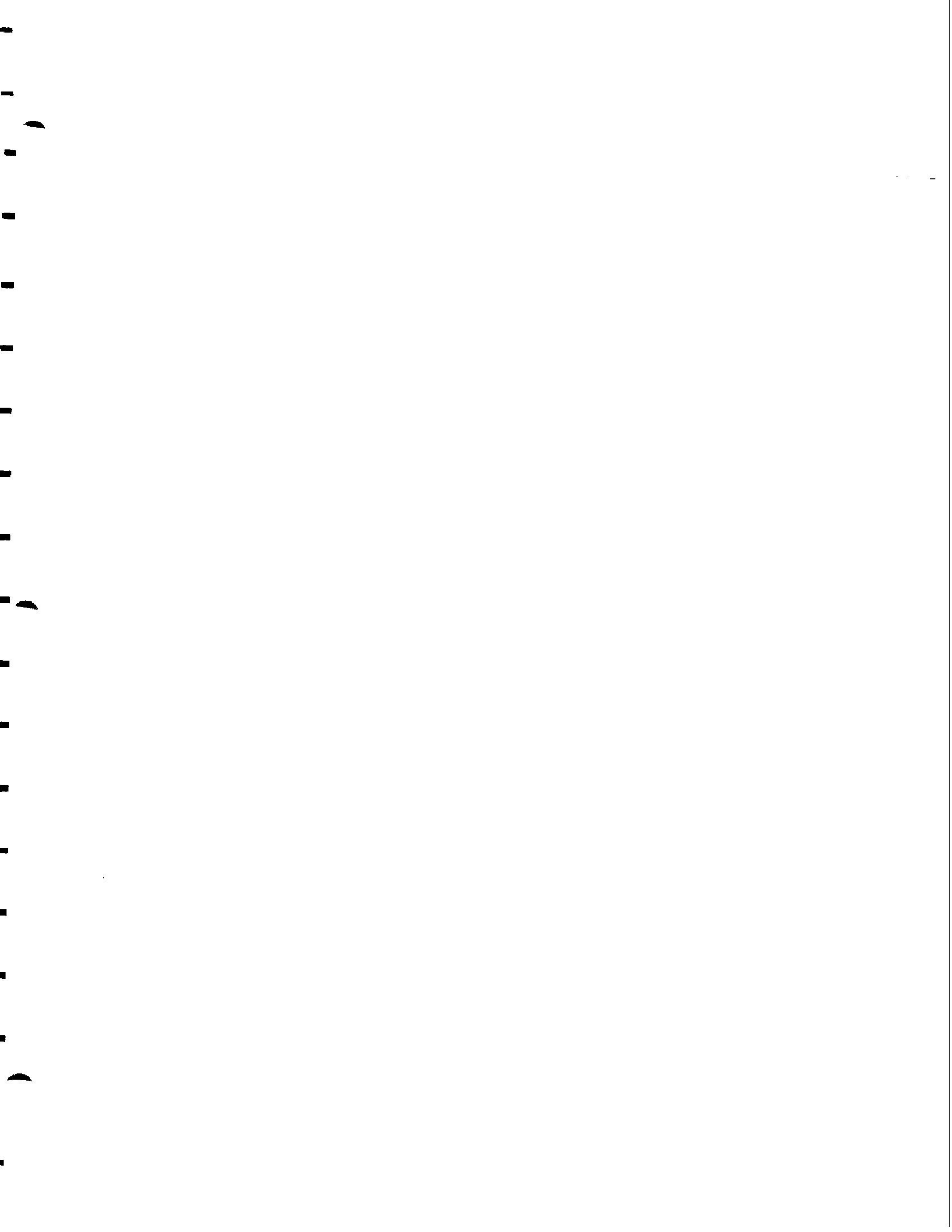
GENERAL INFORMATION

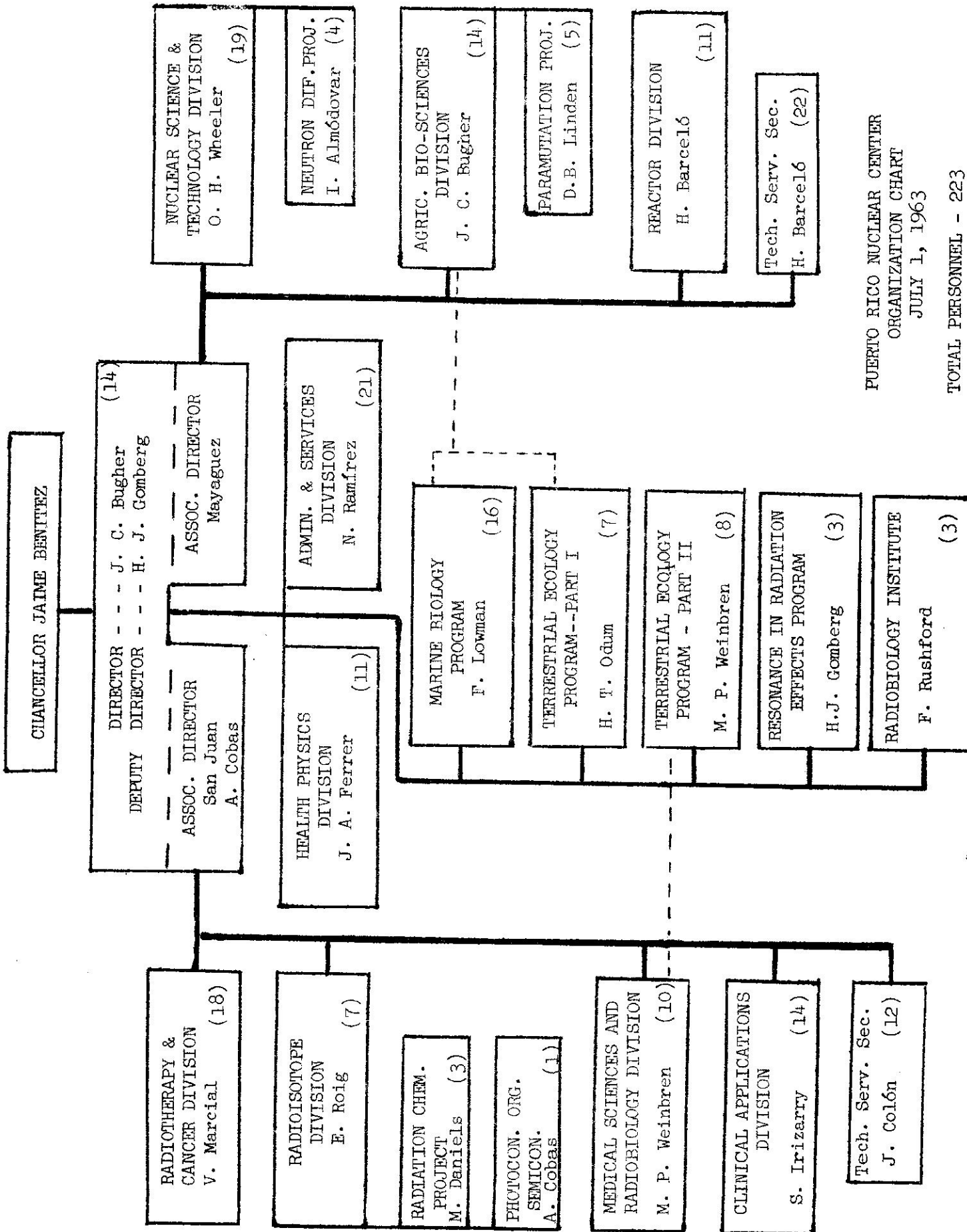


OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT
NO. AT (40-1)-1833 FOR U. S. ATOMIC ENERGY COMMISSION

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PUERTO RICO NUCLEAR CENTER
ORGANIZATION CHART
JULY 1, 1963

TOTAL PERSONNEL - 223

	<u>Salaries</u>	<u>Travel</u>	<u>Materials & Supplies</u>	<u>Other</u>	<u>Sub-total Operations</u>	<u>Equipment</u>	<u>Total</u>
<u>Program 05</u>							
Neutron Diffraction	\$ 6,398	\$ 973	\$ 19,915	\$ 5,596	\$ 32,882	\$ 55,064	\$ 87,946
Solid State Physics	1,956	1,014	1,587	1,406	5,963	2,050	8,013
Total Program 05	\$ 8,354	\$ 1,987	\$ 21,502	\$ 7,002	\$ 38,845	\$ 57,114	\$ 95,959

Total Program 07	\$ 921,550	\$50,668	\$137,443	\$ 71,381	\$1,181,042	\$124,892	\$1,305,934
Total Program 06	87,053	18,568	44,648	67,578	217,847	100,222	318,069
Total Program 05	8,354	1,987	21,502	7,002	38,845	57,114	95,959
GRAND TOTAL	\$1,016,957	\$71,223	\$203,593	\$145,961	\$1,437,734	\$282,228	\$1,719,962

20,223



Program 07 - Training and Education

FY - 1964

	Salaries	Travel	Mat. & Supplies	Other	Subtotal (Operations)	Equipment	Total
<u>Rfo Piedras Campus</u>							
Director's Office	\$103,000	\$25,000	\$ 2,000	\$ 10,000	\$ 140,000	\$ 2,500	\$ 142,500
Radioisotopes	68,000	---	15,000	5,000	88,000	10,000	98,000
Radiotherapy & Cancer	114,000	---	10,000	1,000	125,000	10,000	135,000
Clinical Applications	93,916	---	18,000	13,084	125,000	10,000	135,000
Medical Sciences & Radiobiology	72,000	---	20,000	3,000	95,000	20,000	115,000
Technical Services - R. P.	39,000	---	1,000	1,000	41,000	1,000	42,000
Radiobiology Institute	---	---	---	---	6,000	---	6,000
Subtotal	\$489,916	\$25,000	\$ 66,000	\$ 33,084	\$ 620,000	\$ 53,500	\$ 673,500
<u>Mayaguez Campus</u>							
Nuclear Science & Technology	\$100,500	---	\$ 8,500	\$ 3,000	\$ 112,000	\$ 10,000	\$ 122,000
Reactor	76,751	---	6,000	1,249	84,000	10,000	94,000
Health Physics	60,500	---	3,000	1,500	65,000	10,000	75,000
Agricultural Bio-Sciences	52,000	---	2,000	3,000	57,000	5,000	62,000
Technical Services - Mayaguez	87,000	---	10,000	3,000	100,000	1,000	101,000
Administrative & General Services	93,800	---	12,000	131,500	237,300	2,000	239,300
Subtotal	\$470,551	---	\$ 41,500	\$143,249	\$ 655,300	\$ 38,000	\$ 693,300
Unassigned funds	---	---	---	---	\$ 97,183	\$ 8,500	\$ 105,683
Less overhead charges to Programs 06 and 05	\$960,467	\$25,000	\$107,500	\$176,333	\$1,372,483	\$100,000	\$1,472,483
Less cost of Shop & Reactor Serv. to Programs 06 and 05					-157,883		
					- 33,600		
Total Operating Costs of program 07					\$1,181,000		

Program 06 - FY-1964

	Salaries	Travel	Mat. & Supplies	Other	Subtotal Operations	Overhead (45%)	Total Operations	Equip-ment	Total
Resonance in Radiation	\$ 20,700	\$ 2,000	\$ 3,500	\$ 1,700	\$ 27,900	\$ 9,100	\$ 37,000	\$10,250	\$ 47,250
Marine Biology	80,420	10,000	12,000	12,500	114,920	36,080	151,000	25,000	176,000
Radiation Chemistry	23,718	2,000	3,000	250	28,968	11,032	40,000	9,095	49,095
Paramutation	14,050	1,200	---	2,450	17,700	6,300	24,000	---	24,000
Terrestrial Ecology Part I	45,000	14,000	14,000	3,400	76,400	20,600	97,000	20,000	117,000
Terrestrial Ecology Part II	20,000	2,000	9,000	---	31,000	9,000	40,000	22,000	62,000
Totals	\$203,888	\$31,200	\$41,500	\$20,300	\$296,888	\$92,112	\$389,000	\$86,345	\$475,345

Program 05 - FY-1964

	Salaries	Travel	Mat. & Supplies	Other	Subtotal Operations	Overhead (45%)	Total Operations	Equip-ment	Total
Solid State Physics	\$ 15,000	\$ 2,000	\$ 3,500	\$ 300	\$ 20,800	\$ 6,750	\$ 27,550	\$ 5,200	\$ 32,750
Neutron Diffraction	36,720	6,000	12,000	48,000	102,720	16,524	119,244	10,758	130,002
Totals	\$ 51,720	\$ 8,000	\$15,500	\$48,300	\$123,520	\$23,274	\$146,794	\$15,958	\$162,752

PUERTO RICO NUCLEAR CENTER

GENERAL NARRATIVE

The past year (FY-1963) has been one of unusual financial difficulty for the Puerto Rico Nuclear Center although scientifically it has been more productive than any previous period. The long delay in appropriation action which culminated in an arrest of the development of the project was also necessarily accompanied by an even greater delay in the support of research programs. There resulted a complete suspension of program development and an enforced reduction of the already inadequate staff. This was accomplished by:

- a. Cessation of recruiting of staff.
- b. Suspension of promotions and merit increases of salary.
- c. Assistance to staff members in seeking employment elsewhere.
- d. Suspension of procurement of needed equipment.
- e. Reduction of standards of building operation and maintenance.

It is the established policy of the University of Puerto Rico to give adequate notice to employees if their appointments are not to be renewed. A sharp reduction in budget in the middle of the budget year would not permit notice of termination of employment to meet the administrative standards of the University. Consequently, the problem had to be met by the measures given above rather than by an immediate reduction in force.

There being no other choice, Training and Education had to be reduced sharply. Since PRNC is deeply involved in medical diagnosis and in cancer therapy, these responsibilities could not be evaded. The program reduction was therefore absorbed by the arrest of planned graduate programs in all divisions and in the elimination of work in progress in the fields of nuclear science and engineering, health physics, and agricultural biosciences. At the same time, there was increased emphasis on the development of primary research programs. To some extent, these have absorbed staff that could not be maintained under Training and Education funds, as shown in Fig. 1.

One of the greatest difficulties has been the loss of timing of construction, which is now at least two years behind the planned schedule. To avoid a collapse of the program, the University and other agencies have responded beyond their obligations and have made available laboratory space in many locations to the following approximate amounts:

University Hospital	950 sq. ft.
Cancer Hospital	800
Physics Dept., Rio Piedras Campus	450
Chemistry Dept. " " "	650
Biology Dept. " " "	500
Agricultural Experiment Station (UPR)	250
Forestry Department (U. S. Forestry Service)	300
Physics Dept., Mayaguez	1,000
College of Engineering, Mayaguez	<u>2,000</u>
Total	6,900
Temporary animal quarters, Rio Piedras	<u>1,500</u>
Grand Total	8,400

To this we can add:

This results in a fragmented and widely scattered operation but without the additional space it would be necessary to discontinue key portions of the program.

Not all of the picture is gloomy. Student interest, especially at the graduate level, has been the highest to date. Of special significance has been the raising of the standards of qualification so that much more of the work has been conducted at a desirable graduate level than has been possible heretofore. In the area of isotope techniques and application, new courses have been introduced. A new program of radiation

health has been introduced in the School of Public Health. All residents in Medicine are now being given an orientation in the diagnostic uses of radiation and radioisotopes.

At Mayaguez, old courses have been given new and advanced content. A rapidly growing graduate program in nuclear physics is in existence. The new research program in neutron diffraction is already attracting post-doctoral scientists from other countries so that the available capacity for participating scientists in this field is already practically saturated.

More reactor operators have been trained in FY-1963 than in all previous years. The L-77 reactor (10 watts power level) has been returned to service in the new annex building and is being used for training and teaching of reactor principles. The research reactor (1,000 kilowatts) has been used for research at an increasing tempo so that at any one time about one half of the beam tube capacity has been occupied by experiments while others have been going on in the thermal column and in containers at various points in the pool. Activation analysis has been established as a routine operation and is expected to increase many fold with each year.

The program in marine biology and oceanography became fully operative in FY-1963 as far as the availability of laboratory space would permit. The motor vessel Shimada was reconditioned and the necessary equipment and laboratories were installed. The ship is now in use for collection of samples and for those measurements at sea which require a floating station.

At Rio Piedras, construction of the various elements of the Medical Center has proceeded on schedule. Three new hospitals have been completed. One of these, the I. G. Martfnez Oncologic Hospital is in operation with 105 beds exclusively for cancer patients. Two other hospitals and a large central clinic building have been started and should be in operation before the end of FY-1964. The only element in this large medical complex that has been unable to meet its program obligations in full has been the Nuclear Center which is also the only unit which is entirely supported and managed by the Federal Government.

The FY-1963 has seen the establishment of vigorous cooperative programs with various other institutions and agencies. Among these are the Cancer Hospital, the University Hospital, the University Agricultural Experiment Station, the Federal Agricultural Experiment Station, the Army Tropical Medicine Research Laboratory and the U. S. Forestry Service. In all of the fields represented by these organizations, the Nuclear Center has contributed to the scientific strength and has made possible the initiation of advanced research programs having substantial future prospects in medicine and agriculture.

In the area of Training and Education (07), the program presented for FY-1964 and FY-1965 has been adjusted to predetermined financial limits and does not reflect the levels set forth in the Five Year Plan of 1961 nor the best judgement of the Director concerning the requirements of a program oriented to the needs of Latin America. FY-1963 and FY-1964 are budget years wherein support of the Training and Education program has been seriously inadequate so that the program not only has had to be arrested in its development but also has had to be sharply curtailed in important segments. The program plans for FY-1965 are essentially those originally advanced for FY-1963 and do not represent any significant growth. The level can be said to be the minimum below which the multidisciplinary character of the project cannot be sustained and disintegration of the program can be anticipated.

The special research projects supported by the Division of Physical Research (05) and the Division of Biology and Medicine (06) have become active in FY-1963 and will attain their planned operational levels in FY-1964. Each project involves work which can be conducted to substantial advantage at PRNC, either because of its tropical location or because of the availability of unusually competent scientists, or both. The support is in project form and in the Division of Biology and Medicine, it is included with the Off-Site Program.

PUERTO RICO NUCLEAR CENTER

DIVISIONAL NARRATIVE

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Director's Office: The Director's Office operates at both Rio Piedras and Mayaguez with most of the staff being at the former location. Accounting and procurement are based at Mayaguez. The separation of program and administrative activities results in a considerable burden of communication costs. During the FY-1963 a microwave telephone link has been in use between the two parts of the Nuclear Center at an estimated annual cost of \$31,000. Staff travel between the two locations requires \$25,000 per year for proper program integration.

Weekly staff seminars have been held at both Rio Piedras and Mayaguez as an established activity. These will continue indefinitely and have added substantially to the scientific background of the staff.

Special training for staff members has been emphasized so that an increasingly large fraction of the staff has had basic training in radioisotope techniques, statistical analysis, experimental design, etc.

The staff of the Director's Office, in addition to its administrative duties, participates in the teaching and research of several Divisions, and organizes and directs several special conferences and courses such as the Summer Institute of Radiobiology for science teachers. It is responsible for the production of special reports concerning the activities of the Center and generally serves as the focus of internal communication.

Administration and General Services: As expected, the tempo of the administrative activities as well as the cost of the various services has risen steadily in FY-1963 and the same tendency is expected to continue through FY 1964 and FY 1965. Beginning with FY 1964, separate accounting will be kept of what is purely administrative and what represents services to the individual divisions and programs.

PRNC- April 1963

The need for this additional record keeping has been more evident with the approval of new research projects. The keeping of complete and up to date inventory records now requires a greater and closer effort. On the other hand it has been determined that the Rio Piedras activities of this division can be readjusted and carried out with a somewhat smaller personnel force. The changes proposed will be made effective in FY 1964.

Reactor: In FY-1963 the hazards report for the Swimming Pool Reactor has been completely revised and updated. Changes have been made where the measured characteristics of the reactor, as calculated by the fabricator, differed from those experimentally determined by PRNC staff. Written procedures were completed, approved and adopted for all important operations of the Reactor Division.

A different core configuration has been tested during the year. Due to its symmetrical arrangements and the combination of partial and standard elements it has been possible to provide a core with an improved flux distribution providing the maximum flux of thermal neutrons at the beam tubes.

Much emphasis has been given to the improvement of electronic equipment of the reactor control as a result of which the number of unscheduled shutdowns have been effectively decreased.

The thermal column was redesigned and restacked with the purpose of optimizing thermal fluxes at the vertical port.

Two 6 inch beam tubes are occupied by the neutron spectrometry program, and one 8 inch beam tube is occupied by an experiment in thermal emissivity of graphite. Open pool side irradiations are continuously increasing in demand.

The L-77 Homogeneous Reactor was reinstalled in its new building, was reloaded and is in operation. Most of its use is for training, although some research activity is already developing.

A gamma loop is under study and will be tested in the L-77 Reactor for the determination of various parameters prior to the final presentation of the proposal.

The trend in FY-1964 and FY-1965 will be towards the complete occupancy of the reactor facilities, the increase in operation time from one shift to two shifts and the increase in power from one to two megawatts.

Retraining of Six Bonus Reactor Supervisors has been carried out for a 7 week period starting March 17, 1963.

Arrangements have been made for cooperative participation by Division staff on the Safety Review Committee for the Bonus Reactor.

A potentially serious exposure to gamma radiation of some laboratory staff members occurred on July, 1962. Continuous follow-up, correction, and improvement of methods of operation and of equipment have been carried out to help insure against recurrence of such an incident.

Nuclear Science and Technology: The Division is responsible for graduate teaching and research in the programs for the Masters Degree in Nuclear Technology, Health Physics and Radiochemistry offered through the University. A proposal to establish a M. S. degree in Physics to commence in the Fall of 1963 has been submitted to the University authorities and the Division will cooperate in this program. Many of the graduate students at present doing research in fields of applied physics within the Nuclear Technology program will now be accommodated in this new program in Physics. Another proposal is being prepared to create a department of Nuclear Engineering. Through it, the University will take full responsibility for the academic program needs of its students.

An increase in the research activities of the Division is anticipated, while still maintaining the present level of teaching. The principle fields of research will be in Neutron Diffraction (covered in a following section), in Solid State Physics and in Hot-atom Chemistry.

Present research project activity in the division includes studies of the effect of radiation on the emissivity of graphite to as certain if any change occurs on extended neutron exposure, and radiation effects in fluorocarbons, to determine

their suitability as solvents in homogeneous reactors, will be continued.

A solid state physics program has been initiated dealing with the effect of X-ray, gamma and neutron radiation on ferroelectric crystals. It will include measurements over a range of temperatures to detect transition points, and at frequencies up to the microwave region. Ferroelectric hysteresis measurements afford a sensitive method of detecting crystal damage.

The study of the neutron flux in the thermal column has led to a proposed design for an addition to this facility. The present configuration provides a satisfactory distribution in the vertical access hole, but a badly skewed distribution at the horizontal beam outlet. A movable extension of the column, about 5 feet long has been designed, which will produce a more uniform flux over a larger volume.

The studies on the ceric dosimeter has lead to the important discovery that the addition of cupric ion stabilizes this system, making it as convenient as the commonly used Fricke (ferrous) system. Further work will investigate the effect of other cations on the ceric dosimeter and the mechanism of the cupric stabilization.

A threshold gamma detector using deuterium and responsive to gamma radiation of above 2.25 Mev has been developed and used to measure the half-lives of a number of gamma emitters. This detector is also being used to calibrate the reactor control rods and offers a possibility for the automatic control of the power level of the reactor.

Among student thesis problems which have developed very well are the following:

Detailed measurement and theoretical correlation of the moderation and diffusion of neutrons in water.

Determination of Isotope Half Life by High Energy Gamma measurement using the threshold gamma detector.

Development of a Graphical Method for Determining Critical Mass of a Bare Homogeneous Reactor.

The present studies on Szilard-Chalmers reactions in antimony oxides will be continued to cover the effects of thermal and gamma annealing on the distribution of radioactive antimony between the three and five valence states.

A new program on the hot-atom chemistry of organic sulfur and phosphorus compounds is planned. The object of this work is to provide information on the mechanism of hot-atom reactions in large molecules and the nature of the radioactive organic and inorganic products formed will be determined.

The mechanism of reactions following gamma radiation of organic compounds will also be studied in relation to reactions produced photo-chemically. At present the gamma-induced hydroxylation of estrogenic steroids is being investigated and the results will be compared to those found in chemical hydroxylation (Fenton's reagent) and biochemical (in vivo) hydroxylations.

Neutron Diffraction Program: The first long range research commitment, using the reactor, is in the field of neutron diffraction. For the initial development stage of our program we are working very closely with the Brookhaven National Laboratory. Two beam tubes of the PRNC reactor have been assigned for this work, and a neutron spectrometer is now in research operation at one of these. A second spectrometer is near completion and installation is expected soon.

The instrument in use at present is a rather simple machine, but it is suitable for a wide range of problems on which standard diffraction techniques may be employed, and for which a high degree of accuracy in angle settings is not necessary. The second spectrometer is being built to the same specifications as the newest Brookhaven spectrometers and will provide PRNC with a highly accurate and versatile instrument. A spectrometer of somewhat similar design and of comparable quality was donated recently to the University of Puerto Rico by the Westinghouse Research Laboratories, and plans are now under consideration to use this to replace the simple spectrometer.

In addition to the PRNC staff members working on this program, there have been three guest scientists who have helped considerably in getting the program off to a fine start.

One of these is a senior staff member from Brookhaven, who is staying for one year. Another is an excellent x-ray crystallographer who has been sent to PRNC by the German Government for a year to gain experience in the planning, installation, and use of neutron diffraction equipment. The third man is a neutron diffractonist sent for about two months by the Georgia Institute of Technology to make use of PRNC facilities while the reactor in Atlanta is being completed. He has had previous experience at Brookhaven and at the Kjeller reactor in Norway.

The first experiment carried out was on the crystal structure of CaWO_4 . The oxygen positions in the structure cannot be located directly by X-rays because of the intense tungsten scattering. This turned out to be quite an easy problem using neutrons. Work is now in progress on the crystal and magnetic structures of BaNiO_2 and Fe_2SiO_4 . Preliminary data on both of those compounds have been taken at room and liquid nitrogen temperatures, and preparations are now underway for experiments using liquid helium. The two general research areas of continuing interest for future problems are the determination of the role of hydrogen in structures of importance in chemistry and solid state physics, and the magnetic structures of transition metal inorganic salts.

Neutron Shutter Program: As part of our intramural research and development program, we are working on the creation of a neutron shutter assembly which will permit irradiation of experimental animals or other material with precisely timed thermal neutron beams which are relatively free of gamma rays and fast neutrons. Such a facility will permit critical evaluation and study of such problems as neutron capture therapy using boron compounds which are selectively absorbed in malignant tissue.

Two possible approaches are available. One is the development of a relatively massive shutter which will attenuate all radiation incident upon it, followed by selective filters and moderators, so that a relatively pure beam of thermal-neutrons emerges when the shutter is open. There are severe disadvantages in

trying to use a massive shutter when short precisely timed neutron exposures are needed. We are, therefore, studying a different approach.

Thermal-neutrons are easy to absorb and to control with relatively light materials. We, therefore, would like to bring out a beam of pure thermal-neutrons and then use a shutter of light weight to regulate this beam. Two attacks are being used on the problem of bringing out a beam of thermal-neutrons into an area in which research can be carried on.

1. The first of these is the use of a diffusion tube. A hollow pipe of small diameter is inserted into the pool, so that it runs along side one of the reactor faces. The pipe is evacuated and extends from the bottom of the reactor core up to bridge height. Previous experience and also calculations indicate that thermal-neutrons should diffuse readily up along this pipe, whereas fast neutrons and hard gamma rays will pass through its volume freely. Since the pipe does not look directly at the core there will be no direct transmission of fast neutrons or hard gamma rays. The pipe and the accessory equipment are now ready for test and will be installed in the reactor pool shortly.
2. It has been demonstrated that thermal-neutrons may be efficiently reflected from highly polished metal surfaces on which they are incident at a glancing angle. High energy neutrons, on reaching the same surface will pass right through. This is also true of higher energy gamma rays. Design has been completed for a neutron mirror and filter which will favor passage of thermal-neutrons by multiple reflection from curved collimator surfaces while the mirror remains relatively transparent to the undesired radiation. In this case the mirror system will be used to guide radiation from the reactor core into an open transmission tube. The guided radiation should be fairly pure thermal-neutrons. The other radiation will simply pass through the mirror, to be attenuated in shielding.

We expect to start on shop construction of the mirror system in the near future. In this work we have had extensive assistance from the Department of Mechanical Engineering.

Health Physics: The Health Physics Division has continued rendering its services on personnel and area monitoring, environmental surveillance, waste disposal, calibration, decontamination and handling of radioactive material. In addition it has continued participating in teaching and training of students in Radiological Physics as well as training of PRNC personnel in general safety. All these services have been extended also to the divisions of PRNC at Rfo Piedras where we have now a Health Physics Section under the direction of a health physicist.

Three new facilities have been added to the division. One is a permanent calibration facility provided with a gamma well for calibration of high intensity reading instruments and a table for the calibration of low intensity reading instruments. Another is a room for decontamination both of personnel as well as equipment. It is furnished with showers and a lavatory, a 100 gallon stainless steel tank and a preparation area. The third facility is a storage room for radioactive material and solid radioactive waste.

As a result of the reorientation of PRNC policy, the division is now vested with the responsibility for supervision of all safety; radiation, industrial and fire, while each division is responsible for safe operation of all facilities under its control.

A dispensary for use in emergencies has been added at Mayaguez under the supervision of a physician and attended by a graduate nurse.

The division is participating actively in a cooperative medical plan that is being developed for PRNC and Bonus. The enlargement of the personnel monitoring services to include the processing of our own monitoring film paid off when we were able to carry out satisfactorily the dosimetry phase of the accident of July 24, 1962, in which seven persons were exposed to whole body gamma radiation. We were able to get the exposure doses received by these persons within 8 hours after the accident occurred.

Plans are being made for the installation of two Nuclear Accident Dosimetry Systems to be used jointly by PRNC and Bonus.

During fiscal year 1963 the following publications have been issued:

1. Revised Health Physics Guide and Regulations (PRNC 2)
2. Area Monitoring Procedures Manual (PRNC 4)
3. Fire Plan (Mayaguez) (PRNC 5)

4 Personnel monitoring procedures manual is ready for submittal to the Safety Committee.

A first draft on a General Safety Guide and Regulations is being written. Plans are being made for a partial revision of the environmental survey procedures manual.

On the educational and training program side, this has been a very active year. Twenty students enrolled in the course Biology 501, Radiological Physics I during the first semester. Five students are presently enrolled in Biology 502, Health Physics II. Three students are expected to get their Master Degree in Health Physics next June. The thesis titles are: Determination of Free and Conjugated Phenols in Irradiated Plants - Acute Full Body Irradiation of Human Beings; A Report of Seven Cases; and Evaluation of Some Medical Facilities.

Two staff members took additional training. Mr. J. Parrilla attended a four weeks institute at the University of Kansas on Radiation Shielding as Applied to Civil Defense and Mr. P. Cruz attended a two weeks institute on Industrial Hygiene offered by the U.S.P.H.S. at Rfo Piedras, Puerto Rico.

For fiscal year 1964 a significant increase in services and a moderate increase in supervision is expected.

We feel that the caliber of instruction in the Health Physics curriculum has been improving steadily by frequent revision of it and the use of scientific staff that was not available before. In order to match the class room quality we are planning to improve also on the laboratory side by the addition of new equipment such as a multichannel analyzer and a low level system both of which are now widely used in the field.

For FY-1965, the Health Physics Division will continue the general operations outlined above and will also be involved in a program of ecological study oriented to the Bonus plant area.

Agricultural Bio-sciences: In FY-1963 the programs and objectives of this division have been reevaluated. The teaching activities have remained stable, with each staff member offering one course a year. The graduate program in Biology has been approved. There are six students from the division working toward Master of Science in Biology degrees.

Several research projects have been discontinued, among them the radiation preservation of tropical fruits. Emphasis in some of the research programs has been changed. A new program for investigation of the toxic properties of tropical legumes and the development of non-toxic mutants was initiated. This program will also employ the mutagenic and the radiobiological effects of fast neutrons, slow neutrons, and gamma rays. The services of a geneticist, cytogeneticist and biochemist will be used in this

program. In addition, we will be working in cooperation with the staff of the Federal Experiment Station in Mayaguez, which has done substantial pioneering work on this problem.

The study of the sugar cane borer has been expanded to a cooperative program involving the Federal Experiment Station, Puerto Rico Agricultural Experiment Station and this Division. A cooperative agreement outlining respective areas of responsibility has been prepared. Methods of rearing on a laboratory scale and development of optimum radiation sterilization techniques are the problems of particular concern to PRNC.

Biochemical investigations of sugar cane with the objective of increasing sucrose content has not become as large a scale program in FY-1963 as has been anticipated due to personnel reduction. However the program is progressing and the availability of an auto analyzer will enhance the possibilities of mass screening for biochemical mutants.

The study of the fundamental mechanism involved in backmutation has been continued. Gamma and thermal neutron induced mutations have been obtained and are now being treated for selecting backmutations. This project is designed to provide information of basic genetic interest.

Project proposals on sugar cane stalk borer control and the mechanism of backmutation have been submitted to Division of Biology and Medicine for support as off-site research projects.

The study of radiation effects on paramutation has been part of the research program of the division. This project is now supported by AEC Division of Biology and Medicine. It has been found that the interaction of the regulator and the gene undergoing a paramutational change has a very high radio sensitivity. The changes are such that they indicate an inactivation type process rather than a mutational event. The survey of South American races revealed additional sources of paramutation inducers. Some of these have distinctly different types of changes and further studies are in progress to determine the explanation of this genetic phenomenon.

The investigation of the radioecology of a tropical rain forest is a new program in this division that will become active in FY-1964. This program will be supported by AEC, Division of Biology and Medicine.

Resonance in Radiation Effects Program: This work is in effect a continuation of research in Resonance in Radiation Effects started at the University of Michigan. With Dr. Gomberg's transfer to the Puerto Rico Nuclear Center a program in this field was established in Puerto Rico in addition to the Ann Arbor program which is continuing under the direction of Dr. Hoyt Whipple.

The program is concerned with the search for possible action spectra in the X-ray region analogous to those observed for ultra-violet. The hypothesis on which the program is based is the existence in molecules containing trace amounts of heavy metal special sensitivity to radiation near the k-absorption edge of the heavy metal. An example of such a system is catalase containing iron.

Preliminary results obtained in Ann Arbor indicated that, in the critical dose region, catalase was at least an order of magnitude more sensitive to 100 electronvolts of monochromatic X-rays with energy just above k-absorption edge as compared to the sensitivity below the k-absorption edge of iron. These results had been obtained prior to the establishment of the Puerto Rico project.

During the past year Dr. Robert Luse and Dr. Vázquez Martínez set out to make an independent check of the catalase resonance effect. A suitable X-ray spectrometer was available, along with laboratory space, in the Physics Department of the University at Mayaguez. Dr. Vázquez Martínez succeeded in preparing and adjusting the spectrometer so that it became an effective adjustable source of monochromatic X-rays. Dr. Robert Luse independently developed techniques for irradiating and assaying catalase activity. The existence of resonance peak in radiation damage to catalase by X-ray photons with energy above the iron k-edge was confirmed.

A joint meeting of the two groups working on this problem is scheduled for April 1963 in Puerto Rico. Work is continuing on the study of catalase to obtain more detailed information on the action spectrum. In addition, research has started on the zinc containing enzyme carboxypeptidase and on the zinc bearing bacterium *e. coli*. Also work is in progress in the laboratory shops on an experimental X-ray spectrometer for very low energy work and negotiations are under way for a high intensity spectrometer of commercial manufacture.

To help understand some of the physical processes involved in the resonance phenomenon, a study of the effect of monochromatic X-rays on crystal structure is being initiated by Dr. Vázquez Martínez. Initially, the effect of selected radiation on the crystal lattice spacing of alkali halides will be studied.

The next major step in investigation of the resonance effects in biological systems will be establishment of continuous observation of the optical absorption spectrum while the radiation is taking place. From these studies we hope to obtain more information on the dynamic processes which occur during radiation. Future plans include studies of electron spin resonance in spectra of compounds while undergoing radiation with monochromatic X-rays and studies of the X-ray action spectrum of living cell systems using tissue culture techniques.

Marine Biology and Oceanography Program: A special program, supported by the Division of Biology and Medicine, was started in January, 1962. The program is designed to define the movements of selected trace elements from a land mass into the sea water, marine organisms, and bottom sediments and to investigate the cycling of these elements in the food webs and in the open sea environment, far removed from the effects of added material in river outflows. The movements of the trace elements will be correlated with measurements of biological productivity, movement of organic components through the food webs, and with physical and chemical oceanographic measurements.

An integrated study of the inter-relation of biological productivity and trace element distribution in a limited area of the sea and its neighboring land mass has not been done before now, primarily because of the difficulty of determining trace amounts of these elements in samples of marine origin. Adequate techniques have been developed in the present program and are being used.

The first program budget for marine biological studies was approved in January, 1962 and the acquisition of facilities, equipment, and research staff was started at that time.

Equipment has been designed and constructed for use in studies of the uptake of radioactive tracers in sea water by marine organisms. Depletion of the trace element in the water, resulting from uptake by the organisms, does not occur because of the large volume capacity

of the equipment and the uptake of the radioelement can be measured without disturbing the organism. The equipment has been used for two species of animals with Sc⁴⁶ and Zr⁹⁵ - Nb⁹⁵ tracers in the water.

Methods have been developed and are in use for the determination of stable scandium, antimony, and phosphorus by means of activation analysis.

The separation yields are quantitative and the limits of detection in grams for these elements are as follows:

Scandium, 5×10^{-9} , antimony, 5×10^{-9} , phosphorus, 5×10^{-8} . The method is applicable to marine biological samples, sea and river water, bottom sediments, beach sands, soils, rocks, and minerals.

Background studies on world-wide fallout have been done on a continuing basis in rainwater samples and in selected marine organisms. The disintegration rates per unit mass have been calculated.

The research vessel "Shimada" has been used for the collection of water and plankton samples with depth. The vessel has been in use for a limited time due to the necessity of installing and testing operational and scientific equipment and ship maintenance. A full operational schedule will be started in May, 1963.

Investigations have been started to compare the observed uptake of C¹⁴ by photosynthetic processes in marine phytoplankton with the amounts of C¹⁴ incorporated into the lipids, carbohydrates, and proteins of these organisms. The measurements are needed to determine the effects of catabolic processes upon the measurements of biological productivity determined by the C¹⁴ method.

In February of 1962 an experiment was conducted to determine the pattern of sea water dilution of effluent from the Bonus Power Reactor at Rincón, Puerto Rico. Rhodamine-B dye, released at the outflow, was followed for three hours by means of aerial photographs and analyses of water samples by fluorescence emission under ultra violet light. The rate of southerly movement of the water mass along the shore and the dilution factors were determined with increasing time after

release of the dye. The analyses were completed this year.

A major part of the work during the past year has been that of developing facilities and equipment. A chemistry laboratory and low background counting laboratory have been constructed in rooms originally used for storage. High resolution gamma detectors and a coincidence gamma spectrometer have been assembled.

The work on the "Shimada" has included the installation of three shipboard research laboratories, over-side work platforms and an oceanographic A-frame, a power take off unit for powering the hydraulic oceanographic winch, a radiotelephone and radio direction finder, compasses, clocks, fire extinguishers, and sleeping quarters.

The research program proposed for this year will be continued. The work on the correlation of biological productivity measurements with stable element transfer within the ecosystem will be expanded but the measurements of radioactive contamination from world wide fallout and naturally occurring radioelements will be decreased except in the event of an unforeseen increase in fallout in the area of Puerto Rico. The measurements of concentration factors by selected marine organisms for given radioelements will be continued to help evaluate the stable element data. An experiment to determine the short range effect of biological transport of radioelements is planned.

The areas of investigation, now under way, which will be expanded depend upon the results of this year's work.

Radioisotope Applications: This Division continues to offer training in the use of radioisotopes in the physical and biological sciences. There will be an indefinitely continuing demand for this training, especially for students of the University of Puerto Rico. The basic course is offered five times a year and it will probably not be necessary to expand it. With time, a larger proportion of students coming from Latin America will have already had the equivalent in their own universities.

The expansion of graduate work in chemistry related to radiation and nuclear reactions has been well

Clinical Radioisotope Applications: The Clinical Applications Division is currently offering two types of courses for training physicians at an introductory level; maintains diagnostic services at the Puerto Rico Nuclear Center to support its teaching program while rendering service to 10 different sources of patient referrals in the community; operates the Radioisotope Laboratory at the University Hospital for the Medical Staff of this Hospital; supports with diagnostic supplies the San Juan City Hospital Radioisotope Laboratory on a reciprocal relationship of mutual interest; collaborates in investigative work with other institutions according to the general policies of PRNC and conducts its own research program characterized by work of clinical nature on problems of local and general interest.

During the past year a new Biochemistry Section was added to the Division and is currently approaching full operational status. This facility will broaden the scope of the teaching program within the Division in that there will be available for demonstration a number of research procedures not hitherto carried out here. In addition to this, several procedures will be placed in current use which will constitute useful adjuncts to the established diagnostic procedures using radioactive isotopes.

Micro-autoradiographic technique was introduced in the Division and the possible uses of this tool were explored. Micro-autoradiograms were obtained from bone-marrow aspirates, pleural cell suspensions and parasitic larvae. The technique will be applied, from now on, mainly to the study of aspects related to proliferation of intestinal epithelium in Tropical Sprue and related disorders.

Radiotherapy and Cancer: The main purpose of this program is the training of physicians and allied personnel in all aspects of the application of nuclear energy to cancer. Another purpose is the development and carrying out of a program of research activities conducted with the purpose of improving our knowledge in the cancer and radiation fields.

The following functions are carried out to accomplish these purposes:

1. Formal instruction to physicians who want to become qualified radiation therapists. This residency training lasts three years with the addition of a year of supervised practice in the specialty.
2. Formal instruction is also offered to experienced physicians in radiation therapy who have been engaged in this field for a considerable length of time, which permits them to conduct specific research projects in their field and participate in all teaching activities.

3. Training of fourth year medical students to familiarize them with cancer and radiotherapeutic techniques.
4. In-service training for nurses, technicians, and radiological physicists.

The other function carried out to accomplish the purposes of the program is the research program in the division, which is oriented towards making contributions in the clinical aspects of radiotherapy and also in the fundamentals of radiotherapy and cancer as a medical science.

By the end of fiscal year 1963 the training yield in radiotherapy will be as follows: five long term trainees (residents) at various stages of radiotherapy training for twelve months each; and twelve fourth-year medical students for one month in-service training in cancer and radiation therapy.

Instruction in exfoliative cytology for technicians and pathologists, offered in the Cytology School and operated in the Nuclear Center as a joint project with the Puerto Rico Department of Health and the University of Puerto Rico Medical School, has been discontinued in the Nuclear Center due to budget restrictions.

During fiscal year 1963 the following research projects have been continued or begun: The evaluation of radiation response by means of cytology in cancer of the cervix uteri, the bio-chemical investigation of blood constituents in patients with cancer prior to and after irradiation, the study of the micro-biology of the vagina in patients with cancer of the cervix uteri prior to and after irradiation, the effect of partial renal shielding on incidence and severity of radiation nephritis, the effects of triiodothyronine in altering the response of kidneys to Cobalt-60 irradiation, the effect of radiotherapy on intestinal absorption; the changes on the Hippuran I-131 renogram in the acute phase of the radiation nephritis correlating it with the histopathologic changes; the evaluation of mammography and laryngography in the localization of tumors submitted to radiation therapy; the effects of irradiation of kidneys, including some partially shielded on the Hippuran I-131 renogram; fractionation in radiotherapy of cancer of the oral cavity; adjuvant therapy in cancer of the breast; leukemia incidence in cases with cancer of the cervix uteri treated with radiation and a research project on the radiosensitiveness of the crystal lens under hyperoxygenation.

During the fiscal year four clinical projects were finished that will serve as basis for publications: Cancer of the Testis, Cancer of the Conjunctiva, Reticulum Cell Sarcoma and Ewing's Sarcoma of Bone, and Hodgkin's Disease.

The following papers have been published during fiscal year 1963 in different scientific magazines: "Carcinoma of the Penis"; Editorial: "Our Cancer Problem"; "Cancer Control in Puerto Rico," and "Unfavorable Response of Radiation Nephritis to Administration of L-triiodothyronine".

This Division continues with its need of additional staff for its extensive training and research program. As there are no available radiotherapists these must be trained in the Division.

The clinical service, teaching and research activities of this Division have been enhanced considerably with its move to the Biomedical Building facilities and with the use of the adjoining new Cancer Hospital. Future growth will be in the data processing and radiobiological areas. A basic tissue culture course will be offered to the staff at the end of fiscal year 1963; this will be the starting point for cellular radiobiology activities. Animal radiobiology work will be expanded as soon as the animal house facilities are made available in the Medical Center.

Medical Sciences and Radiobiology: This, the youngest of the Rio Piedras Divisions, was formed on July, 1962 by amalgamation of the Division of Medical Sciences with the older Division of Radiobiology. The actual content of the field of radiobiology has been divided in a natural manner between Agricultural Bio-Sciences, Health Physics, Medical Sciences and Radiotherapy and Cancer. It can be said that radiobiology is oriented to plant science in Mayaguez and to medical science in Rio Piedras. In the latter location the small program which existed in the Division of Radiobiology is being continued.

I. Tissue Culture Program

The first phase in the program is the development of a central tissue culture facility. It has been evident for some time that several divisional programs have a requirement for the employment of tissue culture techniques. It was also obvious that the size of this project would not permit

the successful development of several tissue culture laboratories. The most logical solution to the problem seemed to be the establishment of a single tissue culture laboratory to serve the needs of all programs but in which the various members of the staff might have affiliations with other divisions and be directly interested in their special problems.

A series of unforeseen difficulties over the acquisition of space for this program has resulted in some delay in its progress and also in a contraction in the magnitude of the overall activity. We have however, achieved sufficient space to initiate the Tissue Culture Program which will, in due course be able to carry out all the proposed studies, though probably one after the other, rather than several simultaneously as previously envisaged.

Beginning in FY-1963 and extending through FY-1964 several radiobiological studies will be instituted with tissue culture cell lines. Chief among these will be the studies of the intracellular capture of neutrons by organic compounds containing B-10. The organic chemistry section of the Radioisotope Applications Division has begun the preparation of a series of new boron compounds which are described in the associated Form 189.

These studies will be directed to several questions as follows:

1. How toxic are the boron compounds themselves, for the tissue culture cells?
2. What is the wall permeability to large organic molecules containing boron, and if permeable, what is the distribution of such compounds within the components of the individual cells?
3. How many neutron capture events by boron are required to kill a cell? (In case more than one is required, the data should yield information on the time intervals which must exist between the events in order that they be lethal.)
4. What is the specific cellular selectivity for the various boron compounds? Depending upon the results of these biological studies it is proposed to investigate the use of neutron capture reactions with boron (and possibly also Uranium 235) chelates in the therapy of transplanted animal cancers. These studies should begin by the end of FY-1964 and continue throughout FY-1965. It is expected that this research will then form the basis for a sound application to human cancer therapy. This final development is unlikely before the beginning of FY-1966.

II. Indigenous Viruses and their Radiation Induced Genetic Variability

As part of a broad program of terrestrial ecology, a search for new viruses is planned in the arthropod fauna of Puerto Rico and a research proposal requesting funds to implement this has been submitted. Particular attention will be paid to the emerging possibility that DNA of a virus may fuse with the genetic material of a host cell and remain silent for a considerable time, only to reappear under the stress of one or possibly several environmental stresses acting singly or in combination, among them radiation. It is anticipated that this research may uncover information of great public health significance.

III. The use of gamma radiation to modify Schistosoma Mansoni cercariae so that they induce immunity to attack instead of causing disease.

At least three groups of workers have made use of radiation to damage the cercariae form of schistosomes in such a way that, although metamorphosis is prevented, sufficient activity is still permitted in the environment of the definitive host to stimulate a protective immunity against overt disease. One of these groups, which was previously located at the University of Michigan has now been transferred to the Puerto Rico Nuclear Center and is attached to this division. To date the cost of this program to the division has been relatively light, as it still had a certain amount of support from the funds remaining in the Phoenix budget. Now, however, these are exhausted and a research proposal has been prepared to seek independent financing for it.

Recently the group concerned decided that the project had reached the stage at which an immunological approach was indicated, and to this end invited the head of the division to become a participating member of the team. The invitation was accepted and after surveying and discussing the information available, what is thought to be a hitherto untried approach to assessing effects in the schistosomiasis field has been suggested. It may be mentioned that the innovations, although new to this field, are based on standard virological techniques.

Although the different groups have all produced encouraging results, no finite assessments of the degree of protection have been made. The methods used have varied widely.

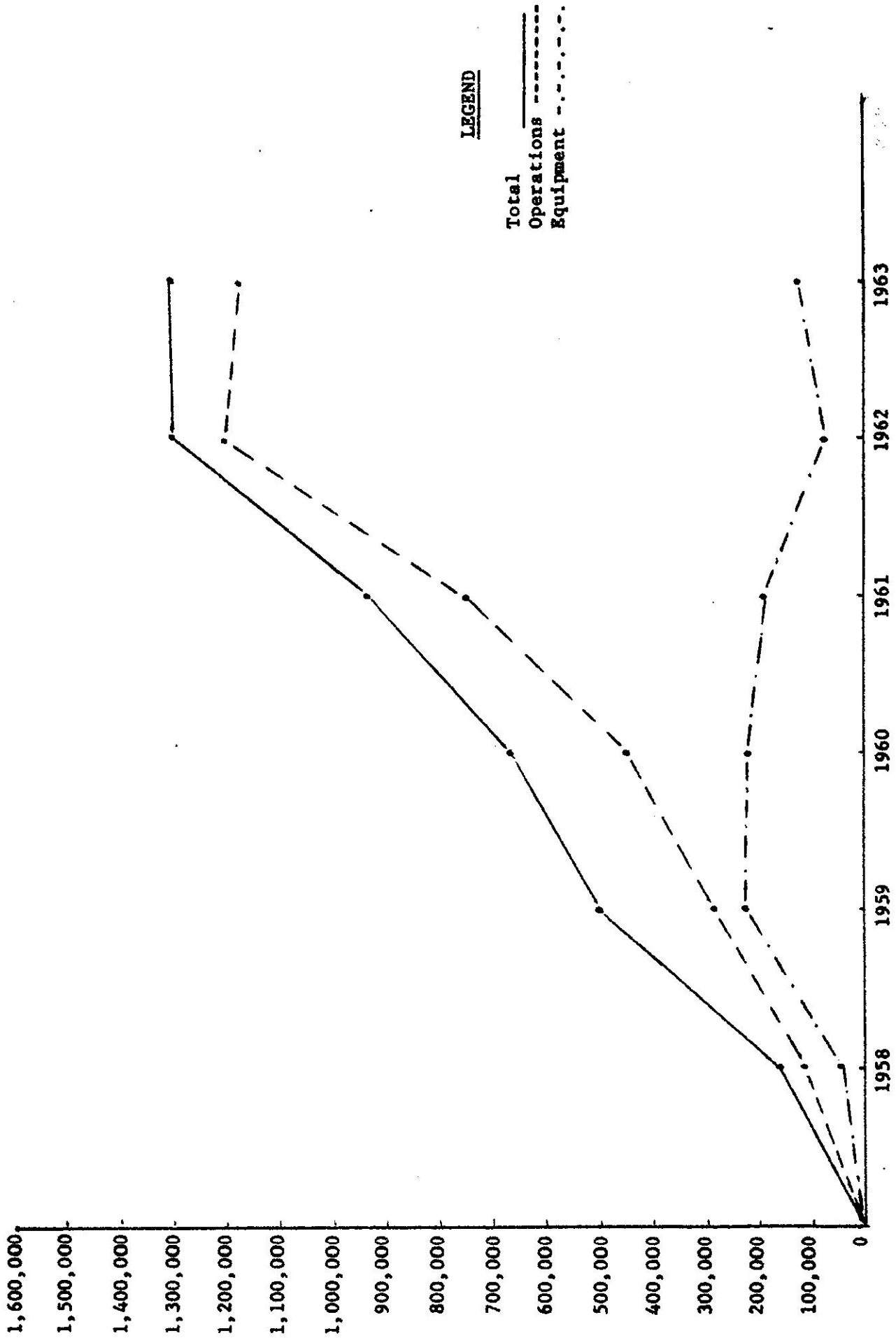
The procedures outlined in the proposal are, at this stage, directed towards: (1) defining useful parameters for assessing the effects produced and (2) comparing the effectiveness of different approaches to the problem. This program is scheduled over a two year period, by which time it will be possible to decide along what lines any further research might best be pursued, the hoped for end result being a contribution to knowledge which may eventually help in combating the disease.

Technical Services (Mayaguez): This operation, which originally was part of Reactor Division, is now separated in the new organizational structure of PRNC.

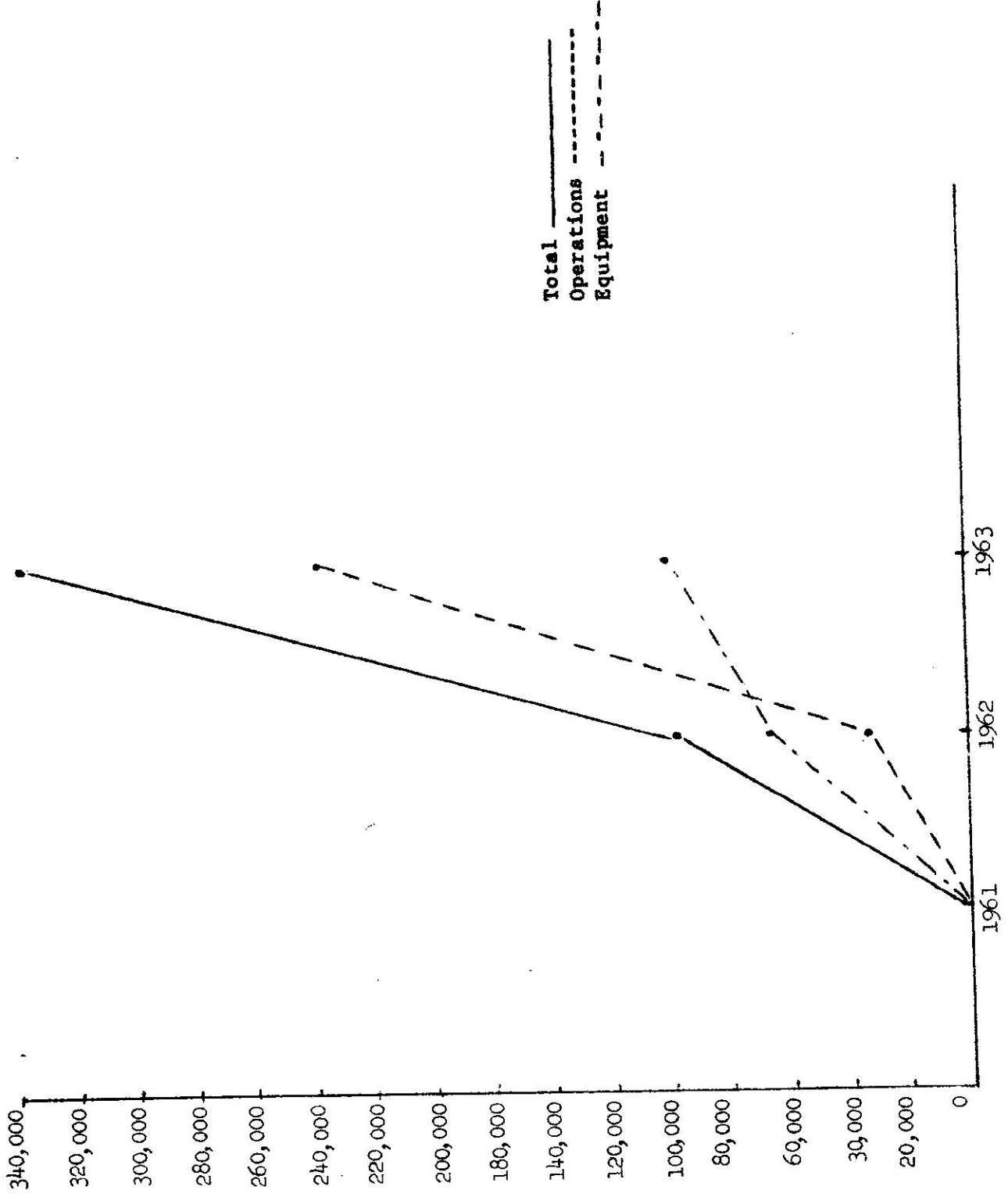
Technical Services carries the responsibility for: buildings and grounds maintenance, machine shop, electronic shop; and the glass blowing shop. With the exception of buildings and grounds, the Mayaguez Technical Services, through its shops, serve the entire PRNC and must be prepared to meet a considerable variety of demands. The variety of jobs performed by these shops range anywhere from general maintenance and construction work up to the most specialized precision jobs such as: construction of Ionization Chambers, Crystal String Saws, High Frequency Microphones, or X-ray Spectrometers.

The number of jobs have continuously increased and at this moment the shops are performing an average of 100 jobs per month. It is expected that by the end of FY-1964 the number of jobs should be at least doubled. It is expected that by middle FY-1964 the shops will be installed in the new building that is to be constructed for them, removing in this way one of the main holdbacks which is space, both for work and storage. Much emphasis is being given, specially in electronics shop, to the development of highly skilled personnel for the construction of equipment. It has already been demonstrated and proved practical that the work of the equipment built in our shops cost less than that bought outside and that by the same better quality control can be maintained.

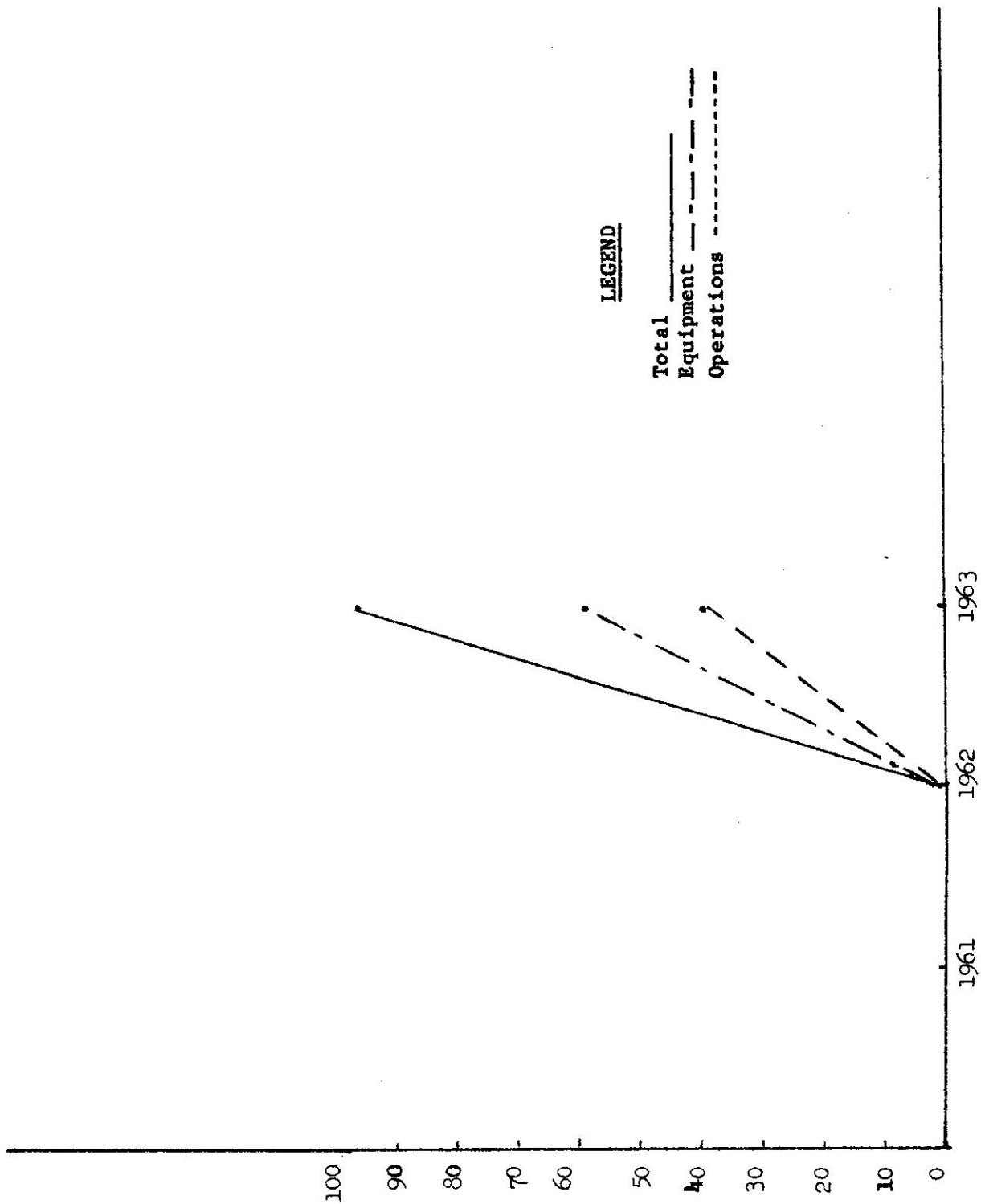
EXPENDITURES FOR OPERATIONS AND EQUIPMENT
PROGRAM 07
1958-1963



EXPENDITURES FOR OPERATIONS AND EQUIPMENT
PROGRAM 06
1962-1963



EXPENDITURES FOR OPERATIONS AND EQUIPMENT
PROGRAM 05
1962-1963



PUERTO RICO NUCLEAR CENTER
 Operated by
 University of Puerto Rico
 for
 U.S. Atomic Energy Commission

EXPENDITURES FOR OPERATIONS AND EQUIPMENT
 (Program 07)

Quarter	FY - 1958			FY - 1959			FY - 1960		
	Operations	Equipment	Total	Operations	Equipment	Total	Operations	Equipment	Total
1st	-	-	-	\$ 40,290	\$ 3,274	\$ 43,564	\$ 82,340	\$ 29,992	\$ 112,332
2nd	\$ 30,267	-	\$ 30,267	59,253	31,651	90,904	91,699	15,513	107,212
3rd	43,097	\$ 16,094	59,191	76,401	4,251	80,652	107,163	12,065	119,228
4th	45,704	24,458	70,162	107,236	187,017	294,253	169,061	165,036	334,097
Total	\$119,068	\$ 40,552	\$159,620	\$ 283,180	\$226,193	\$ 509,373	\$ 450,263	\$222,606	\$ 672,869

Quarter	FY - 1961			FY - 1962			FY - 1963		
	Operations	Equipment	Total	Operations	Equipment	Total	Operations	Equipment	Total
1st	\$148,249	\$ 4,276	\$152,525	\$ 244,338	\$ 26,317	\$ 270,655	\$ 362,497	\$ 66,002	\$ 428,499
2nd	165,737	3,360	169,097	316,422	28,758	345,180	308,614	37,362	345,976
3rd	173,633	14,934	188,567	317,333	30,222	347,555	262,864	5,730	268,594
4th	266,145	166,113	432,258	330,500	12,108	342,608	247,067	15,798	262,865
Total	\$753,764	\$188,683	\$942,447	\$1,208,593	\$ 97,405	\$1,305,998	\$1,181,042	\$124,892	\$1,305,934

EXPENDITURES FOR OPERATIONS AND EQUIPMENT
(Program 06)

Quarter	FY - 1962			FY - 1963		
	Operations	Equipment	Total	Operations	Equipment	Total
1st	-	-	-	\$ 21,149	\$ 8,337	\$ 29,486
2nd	-	-	-	30,460	(1,561)	28,899
3rd	-	-	-	54,854	2,482	57,336
4th	\$31,503	\$67,146	\$98,649	111,384	90,964	202,348
Total	\$31,503	\$67,146	\$98,649	\$217,847	\$100,222	\$318,069

EXPENDITURES FOR OPERATIONS AND EQUIPMENT
(Program 05)

Quarter	FY - 1962			FY - 1963		
	Operations	Equipment	Total	Operations	Equipment	Total
3rd	-	-	-	\$ 15,033	\$ 28,663	\$ 43,696
4th	-	-	-	23,812	28,451	52,263
Total	-	-	-	\$ 38,845	\$ 57,114	\$ 95,959



PUERTO RICO NUCLEAR CENTER
 Operated by
 UNIVERSITY OF PUERTO RICO
 for
 U. S. ATOMIC ENERGY COMMISSION

CAPITAL INVESTMENT
 Building and Grounds
 As of Date of Actual Completion

RIO PIEDRAS DIVISIONS

Fiscal Year 1961	\$ 586,956
Fiscal Year 1962	10,807
Fiscal Year 1963	<u>446,776</u>

Total Rio Piedras Divisions \$1,044,539

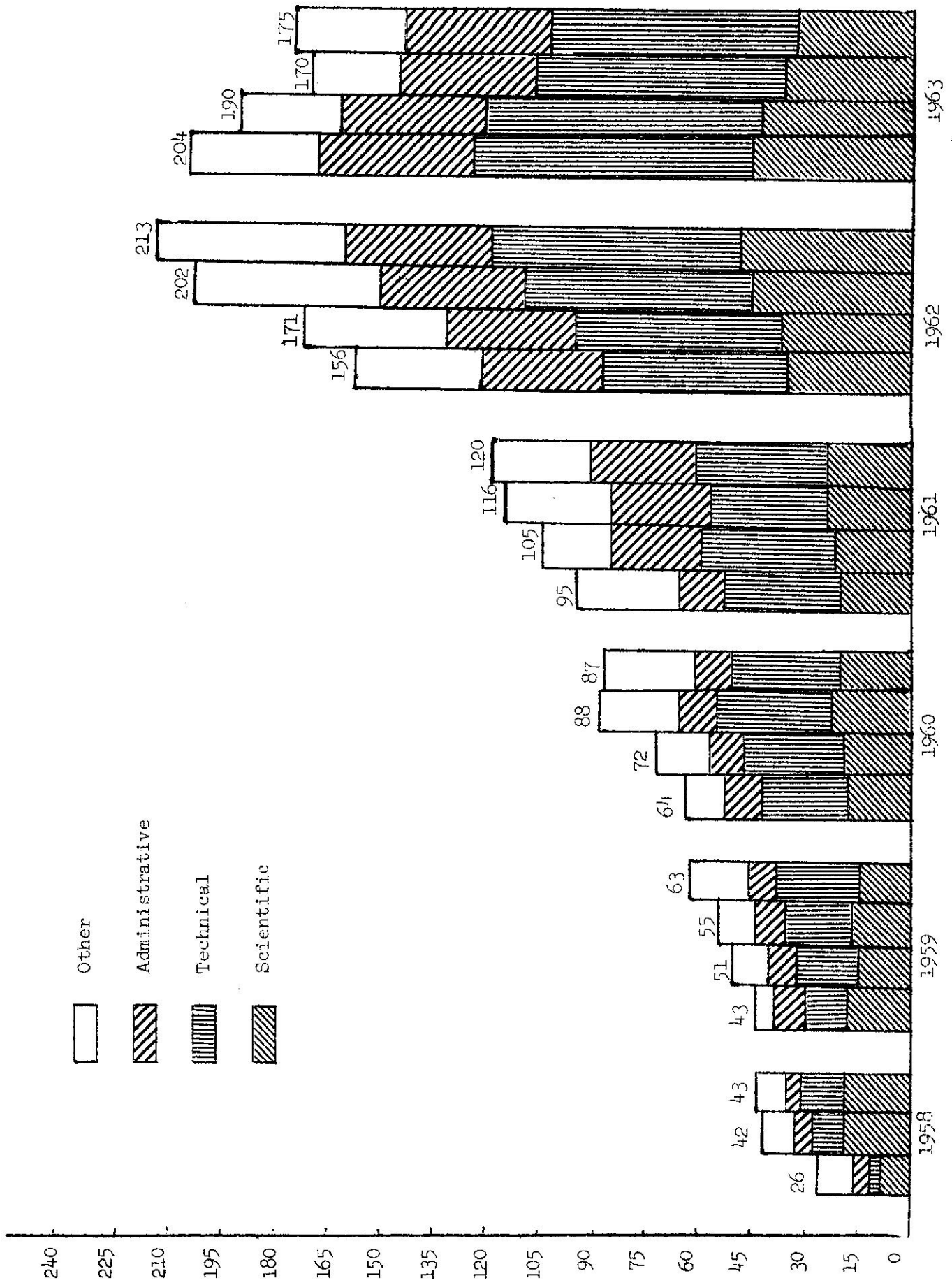
MAYAGUEZ DIVISIONS

Fiscal Year 1960	\$2,957,890
Fiscal Year 1961	93,061
Fiscal Year 1962	23,583
Fiscal Year 1963	<u>593,154</u>

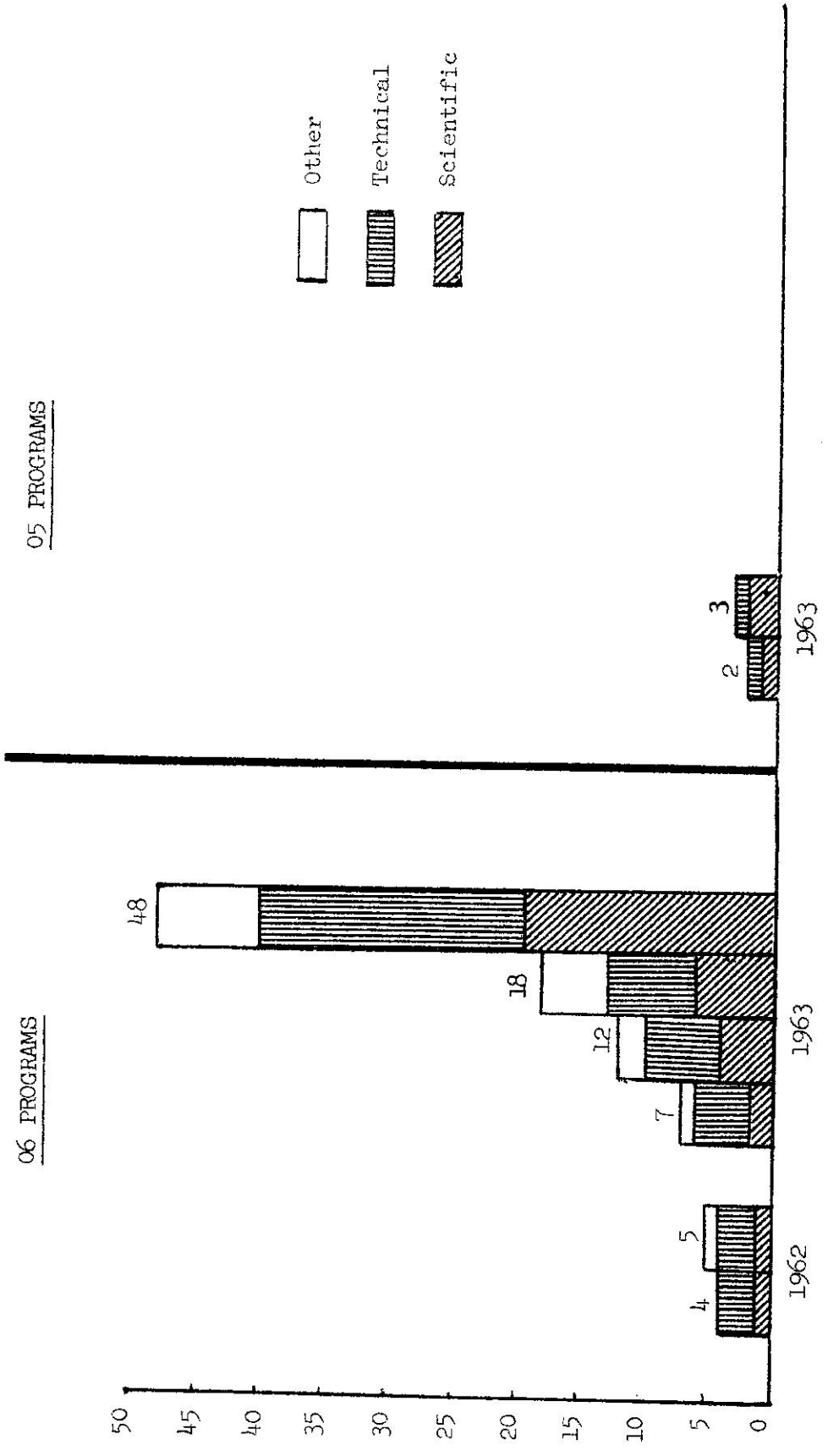
Total Mayaguez Divisions 3,667,688

GRAND TOTAL \$4,712,227

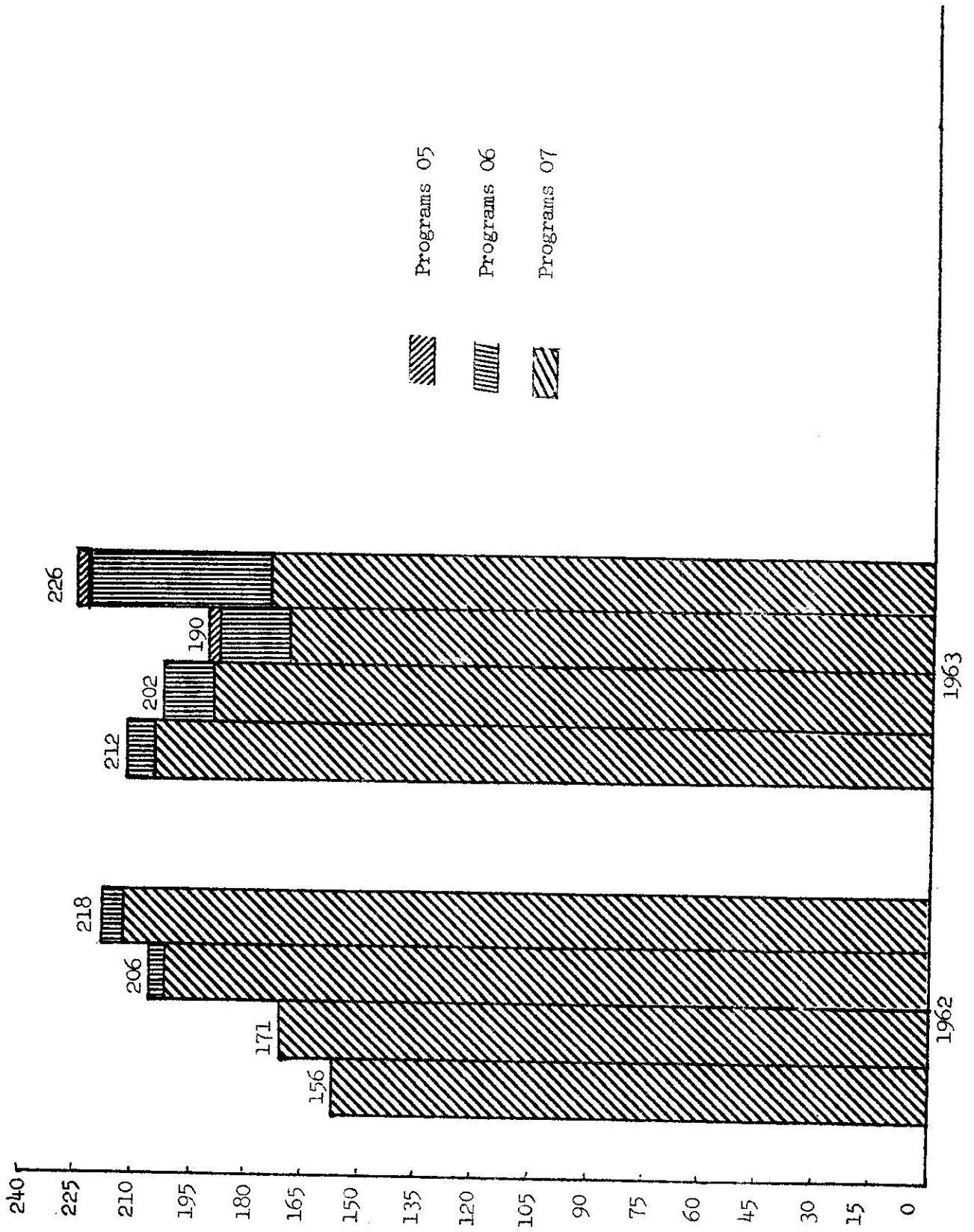
PUERTO RICO NUCLEAR CENTER EMPLOYMENT
07 PROGRAMS



PUERTO RICO NUCLEAR CENTER EMPLOYMENT
PROGRAMS 06 and 05



ANALYSIS OF EMPLOYMENT BY PROGRAMS
 FY 1962-1963



PUERTO RICO NUCLEAR CENTER
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Employment Statistics - Program 07 - FY 1958-1963

Category	FY - 1958				FY - 1959				FY - 1960			
	Sept.	Dec.	March	June	Sept.	Dec.	March	June	Sept.	Dec.	March	June
Scientific	-	9	19	19	19	16	18	16	19	20	23	21
Technical	-	3	9	12	12	17	19	23	24	28	33	31
Administrative	-	5	5	5	8	8	8	8	10	10	11	10
Other	-	9	9	7	4	10	10	16	11	14	21	25
Total	-	26	42	43	43	51	55	63	64	72	88	87

Category	FY - 1961				FY - 1962				FY - 1963			
	Sept.	Dec.	March	June	Sept.	Dec.	March	June	Sept.	Dec.	March	June
Scientific	21	22	25	25	35	36	45	48	45.50	42.50	36	32.50
Technical	33	37	33	37	52	59	64	71	79	79	71	70.50
Administrative	13	26	28	30	34	36	40	41	44	40	38	41
Other	28	20	30	28	35	40	53	53	36	28	25.25	31.25
Total	95	105	116	120	156	171	202	213	204.50	189.50	170.25	175.25

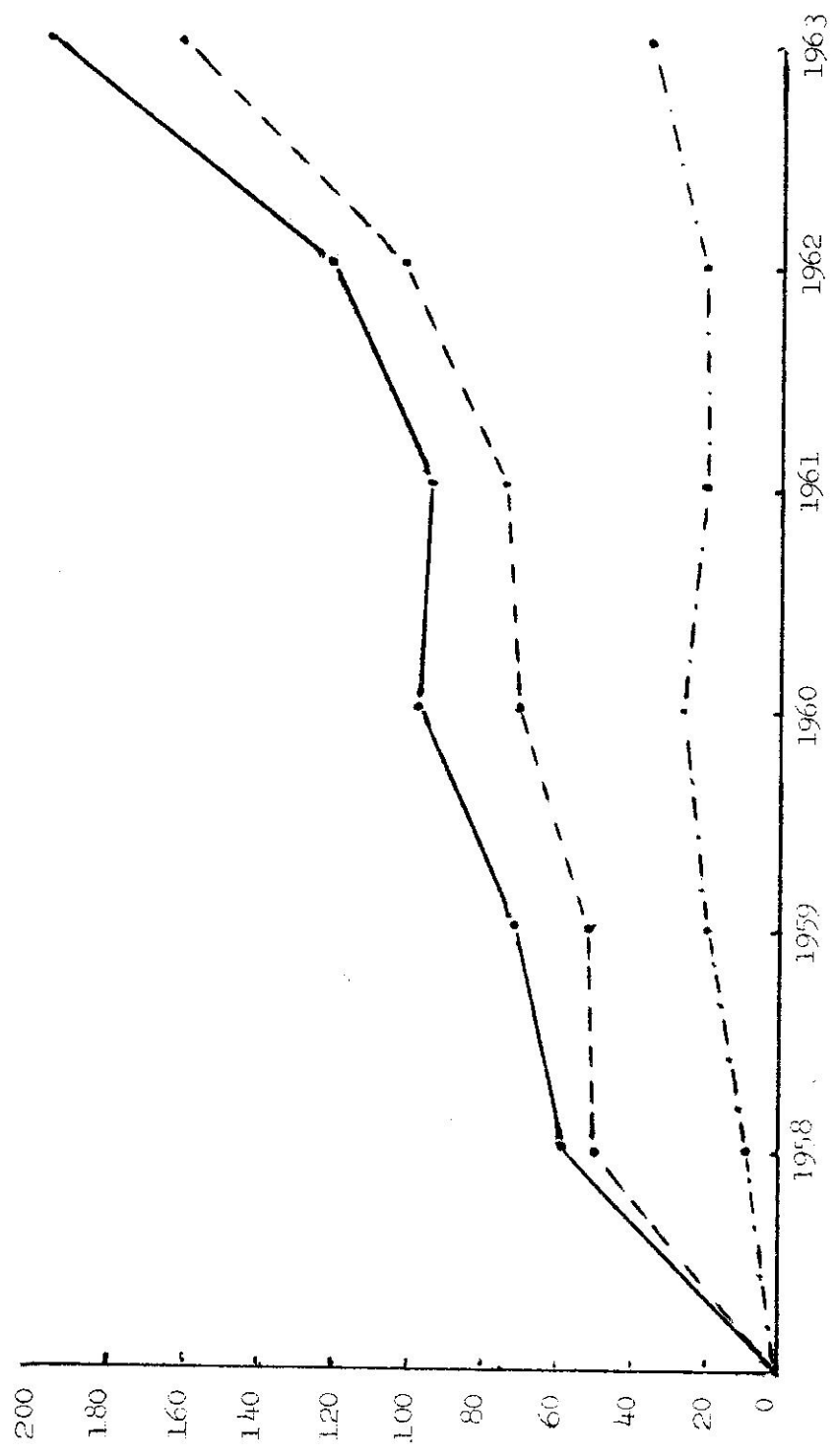
Employment Statistics - Program 06 - FY 1962-1963

Category	FY - 1962					FY - 1963						
	Sept.	Dec.	March	June	Sept.	Dec.	March	June	Sept.	Dec.	March	June
Scientific	-	-	1	1	2.50	4.50	6	19.50				
Technical	-	-	3	3	4	6	7	20.50				
Administrative	-	-	0	0	0	0	0	0				
Other	-	-	0	1	1	2	4.75	7.75				
Total	-	-	4	5	7.50	12.50	17.75	47.75				

Employment Statistics - Program 05 - FY 1963

Category	FY - 1962					FY - 1963						
	Sept.	Dec.	March	June	Sept.	Dec.	March	June	Sept.	Dec.	March	June
Scientific	-	-	-	-	-	-	-	2			1	2
Technical	-	-	-	-	-	-	-	1			1	1
Administrative	-	-	-	-	-	-	-	0			0	0
Other	-	-	-	-	-	-	-	0			0	0
Total	-	-	-	-	-	-	-	2			2	3

NUMBER OF U.S. AND NON-US CITIZENS IN TRAINING AT PRNC
BY FISCAL YEARS



LEGEND

Total
U. S.
Non-U. S.

Note: Individuals are counted only once each fiscal year

PUERTO RICO NUCLEAR CENTER
University of Puerto Rico

Student Enrollments at PRNC by Fiscal Years
from FY-1958 Through FY-1963

	FY-1958		FY-1959		FY-1960		FY-1961		FY-1962		FY-1963	
	Stu- dents	Credit Hours	Stu- dents	Credit Hours	Stu- dents	Credit Hours	Stu- dents	Credit Hours	Stu- dents	Credit Hours	Stu- dents	Credit Hours
MAYAGUEZ PROGRAMS												
Nuclear Science & Tech.	5	141	4	88	13	308	8	196	11	168	11	178
Reactor Training	-	-	-	-	-	-	-	-	12	240	-	-
Health Physics	-	-	1	3	8	183	7	120	7	52	4	51
Radiochemistry	-	-	-	-	-	-	-	-	1	6	3	11
Agricultural Bio-Sciences	-	-	-	-	-	-	17	51	35	105	7	46
Individual Courses	14	42	27	143	30	199	8	51	47	202	26	89
Radiobiology Institute	-	-	-	-	19	114	21	126	20	120	-	-
Sub-Total	19	183	32	234	70	804	61	544	133	893	51	375
RIO PIEDRAS PROGRAMS												
Radioisotopes	46	138	42	126	34	102	25	75	33	99	44	132
Clinical Applications	-	-	5	54	1	6	5	30	5	30	6	36
Radiotherapy & Cancer	3	90	6	141	8	249	5	138	5	180	5	162
Radiobiology Institute	-	-	-	-	-	-	-	-	-	-	12	72
Individual Courses	-	-	-	-	-	-	-	-	-	-	84	102
Sub-Total	49	228	53	321	43	357	35	243	43	309	151	504
TOTAL	68	411	85	555	113	1,161	96	787	176	1,202	202	879

June 25, 1963

TABLE SHOWING PRNC STUDENTS BY COUNTRY*

From FY-1958 through FY-1964 **

Country	1958	1959	1960	1961	1962	1963	1964**	TOTAL
Argentina	1	-	2	1	4	1	-	9
Bolivia	1	-	-	-	1	4	-	6
Chile	1	1	2	2	-	-	-	6
Colombia	1	5	3	6	3	6	3	27
Costa Rica	-	2	-	-	-	7	-	2
Cuba	-	1	3	-	-	-	1	5
Ecuador	3	-	1	1	-	-	1	6
El Salvador	-	-	1	-	1	1	1	4
Great Britain	-	-	-	-	1	-	-	1
Guatemala	-	-	-	1	-	1	1	3
Haiti	-	-	1	-	-	-	-	1
India	1	-	-	-	1	-	-	2
Mexico	-	5	1	1	2	1	1	11
Nicaragua	-	-	1	1	-	-	-	2
Panamá	-	-	-	-	-	1	-	1
Paraguay	-	-	-	-	1	3	-	4
Perú	-	1	3	1	1	1	-	7
Philippine Islands	1	-	-	-	-	-	-	1
Santo Domingo	-	-	1	-	-	14	-	15
South Africa	-	-	-	-	1	-	-	1
Spain	-	1	3	3	3	2	-	12
Uruguay	-	1	1	1	-	1	-	4
Venezuela	-	3	4	3	2	-	-	12
Total Non-U. S. Citizens	9	20	27	21	21	36	8	142
U. S. Citizens	50	52	71	74	101	161	50	559
TOTAL STUDENTS	59	72	98	95	122	197	58	701

* An individual is counted once each Fiscal Year he is in training.

** Figures for FY-1964 cover courses offered during Summer 1963.

August 15, 1963

NON U. S. STUDENTS AT PRNC

1957-1962

ARGENTINA

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BOLIVIA

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CHILE

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William Rafael Jerez Brito	Santomé Núm. 72
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Alejandro Rivera Irizarry Puerto Rico

1958-59

Miguel Angel Feyjoó Puerto Rico
Jaime Toro Gutiérrez Colombia

1959-60

Jorge Alsina Alonso Cuba
Néstor Azziz Jozami Uruguay
José Roberto Bravo Silva Nicaragua
Pedro Cruz González Puerto Rico
Jorge Justiniano Bayrón Puerto Rico
Juan Lartigue Gordillo Mexico
Vernón Tan Yuk Godoy Venezuela
Julio A. Velázquez Rivera Puerto Rico

1960-61

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Juan A. Bonnet Diez Puerto Rico
Luis Alberto Guerrero Almonacid Colombia
José E. Sandoval Sandoval Colombia
Raúl McClín Escalera Puerto Rico

1961-62

Richard Brown Campos Puerto Rico

Nuclear Science and Technology

1962-63

Heriberto Plaza Rosado	Puerto Rico
Juan R. López Alonso	Puerto Rico
Anneliese Kraft de Pérez	Puerto Rico
Guillermo Rodríguez Figueroa	Colombia
Santiago Pinto Vega	Colombia

Health Physics

1959-60

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José R. Martínez Martínez Venezuela
Earl W. Robinson United States

1960-61

Carlos Figueroa Otero Puerto Rico
Oscar Hidalgo Salvatierra Nicaragua
Alberto Jiménez Sánchez Colombia
Ricardo Muñoz Burgos Ecuador

1961-62

Alicia Carlo de Net Puerto Rico

1962-63

Rosa Julia Santiago de Morales Puerto Rico
James B. McCandless United States

Nuclear Chemistry

1962-63

Vicente Julio Medina Uruguay

Milagros Miró Villarini Puerto Rico

SCIENTIFIC PAPERS PRESENTED BY PRNC STAFF AT
SCIENTIFIC MEETINGS

1958

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Amador Cobas	Plans for a Health Physics Training Program at the Puerto Rico Nuclear Center	Symposium on Health Physics in Biology and Medicine - May, 1958 San Juan, Puerto Rico
Dr. Víctor Marcial	Cancer Morbidity in Puerto Rico	International Cancer Congress, July, 1958 London, England
	Cancer in the Puerto Rican Woman	Meeting of the Puerto Rico Medical Society September 16, 1958 San Juan, Puerto Rico
	The Importance of Cobalt Teletherapy in a Radiotherapy Dept.	Inter-American Congress of Radiology - Nov., 1958 - Lima, Perú
	Cobalt Teletherapy in Cancer	Symposium on Health Physics in Biology and Medicine - May, 1958 San Juan, Puerto Rico

1959

Dr. Angel A. Cintrón Rivera	Hematology	2nd. Interamerican Anti-for-Peace Symposium May, 1959 - Buenos Aires, Argentina
	Vitamin B-12 Absorption in Tropical Sprue	Regional Meeting of the American College of Physicians - Oct., 1959 San Juan, Puerto Rico
	Serium Electrophoretic Patterns in 1,100 cases of Schistosoma mansoni	56th Annual Meeting of the Medical Association of P. R. - Nov., 1959 San Juan, Puerto Rico
Dr. Juan D. Curet	The Absorption of Gamma and Beta Rays by Weakly Paramagnetic Substances	Seventh Latin American Chemical Congress March 29-April 3, 1959 Mexico City, Mexico

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Víctor Marcial	Cancer of the Tongue	1st. Latin American Cancer Congress October, 1959 - Buenos Aires, Argentina
	Cancer Control in P. R. - Ten Years Experience	56th Annual Meeting of the Medical Association of P. R. - Nov., 1959 San Juan, Puerto Rico
Mrs. Irma Rieckehoff Mrs. Consuelo Russo Dr. Juan D. Curet	The Demonstration of Chemical Principles by the Use of Radio-isotopes	Seventh Latin American Chemical Congress March 29-April 3, 1959 Mexico City, Mexico
Dr. Fred V. Soltero	Training in Radio-chemistry in the Puerto Rico Nuclear Center	Seventh Latin American Chemical Congress March 29-April 3, 1959 Mexico City, Mexico

1960

Dr. Ismael Almodóvar Mr. T. P. Kohman	The Thorium Isotopes Method for Dating Marine Sediments	Meeting of the American Chemical Society September, 1960 - N. Y.
Dr. I. Almodóvar Rev. I. Cantarell	An Experimental Study of Fatigue in Photomultipliers	Meeting of the American Chemical Society Sept., 1960 - New York
	A Practical Method for the Compensation of Fatigue Effects	Meeting of the American Chemical Society Sept., 1960 - New York
Dr. A. M. Andino Dr. A. L. Rodríguez	Radioactive Iodine Treatment in Hyperthyroidism (a review of the experience of Radioiodine therapy in 50 cases of hyperthyroidism)	10th Annual Meeting of the P. R. Chapter of the American College of Physicians - Oct., 1960 San Juan, Puerto Rico
Dr. Víctor Marcial	Treatment of Cancer of the Tongue	Sectional Meeting P. R. Chapter of the American College of Surgeons August, 1960 - San Juan, Puerto Rico
	Socio-economic Aspects of the Cancer Incidence in Puerto Rico	Conference on Society Culture and Health in the N. Y. Academy of Sciences - June, 1960 New York

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Warren Miller Dr. Eddie Ortiz	Beta Spectra with a Plastic Scintillator	29th Conference of the American Society of Physics Teachers - Jan., 1960 - New York
	Instructional Laboratory Experiments with a Neutron Source	29th Conference of the American Society of Physics Teachers - Jan., 1960 - New York
	Compton Spectra	29th Conference of the American Society of Physics Teachers - Jan., 1960 - New York
Dr. A. L. Rodriguez Dr. Ernesto Marchand	Experience with and Integration of the Diodrast Renogram (a summary of the experience of 70 renograms)	10th Annual Meeting of the P. R. Chapter of the American College of Physicians - Oct., 1960 San Juan, Puerto Rico
Dr. A. L. Rodriguez	Serial In-Vitro Uptake of Fe-59 by Bone Marrow Suspensions in Different Hematologic States	P. R. Medical Association Meeting - November, 1960 San Juan, Puerto Rico

1961

Dr. John C. Bugher	The Puerto Rico Nuclear Center Research Reactor: Characteristics and Program Plans	Symposium on the Programming and Utilization of Research Reactors October 16-21, 1961 Vienna, Austria
Rev. I. Cantarell Dr. Ismael Almodóvar	Fatigue in Photomultiplier Tubes and its Relationship to the Matter Effect	Meeting of the American Nuclear Society - June, 1961 - Pittsburg, Penn.
Dr. John C. Bugher	"Health Perspective of our Radioactive World" - The First Annual Bronfman Lecture	Second General Session of the American Public Health Association, Eighty-Ninth Annual Meeting; Nov. 16, 1961; Detroit, Michigan
Dr. J. L. García de Quevedo	La Educación y los Centros de Investigaciones	IAEA, Regional Symposium on Educ. and Nuclear Energy - November, 1961 San Carlos, Bariloche, Argentina

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Henry J. Gomberg	Fission, Fusion and Radiation Energy in a new Dimension	Samuel Sackett Series of lectures on Nuclear Energy (1st. lecture) - Oct. 1961 Chicago, Illinois
Dr. Victor A. Marcial	Cancer of the Esophagus	Annual Meeting P. R. Chapter of the American College of Surgeons, Feb., 1961 - San Juan, Puerto Rico
	Valor de la Citología para el Pronóstico del Cáncer Cérvico-Uterino	1er. Congreso Nacional de Cáncer - Séptimas Jornadas Radiológicas - Aug., 1961 - Bogotá, Colombia
	Radioterapia del Cáncer Avanzado: Programa de Control del Cáncer en Puerto Rico	1er. Congreso Nacional de Cáncer - Séptimas Jornadas Radiológicas August, 1961 - Bogotá, Colombia
	Cancer of the Tongue	American Roentgen Ray Society Meeting - Sept., 1961 - Miami, Florida
	Carcinoma of the Esophagus	7th Interamerican Cong. of Radiology - Sept., 1961 Sao Paulo, Brazil
	Isótopo Teleterapia	7th Interamerican Cong. of Radiology - Sept., 1961 Sao Paulo, Brazil
	Cancer Control in Puerto Rico, 12 years Experience	Instituto Nacional de Cáncer de Guatemala - Nov., 1961 - Guatemala City
	Treatment of Cancer of the Tongue	XII Congreso Nacional de Medicina del Colegio de Médicos y Cirujanos de Guatemala - Nov., 1961 Guatemala City, Guatemala
	Cancer of the Esophagus	XII Congreso Nacional de Medicina del Colegio de Médicos y Cirujanos de Guatemala - Nov., 1961 Guatemala City, Guatemala

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Victor A. Marcial	Carcinoma of the Penis, Therapeutic Problems	Annual Meeting of the Radiological Society of North America - Nov. 1961 Chicago, Illinois
Mrs. I. Rieckehoff	Common Ion Effect on Solubility - A Demons- tration with Radio- isotopes	Caribbean Chemistry Conference - April, 1961 University College of the West Indies, Kingston, Jamaica
Dr. A. L. Rodríguez	The Role of Calcium on the Intestinal Ab- sorption of Vitamin B-12 in Tropical Sprue	Second Annual Meeting of the University of P. R., School of Medicine - June, 1961 - San Juan, P. R.
Dr. Edwin Roig	The Thallous-Thallic Exchange at Various Acidities in Perch- lorate Media	Caribbean Chemistry Conference - April, 1961 University College of the West Indies - Kingston, Jamaica
Dr. H. H. Szmant	Chemistry in Latin America	1st. Interamerican Cong. of Chemical Engineers October, 1961 - San Juan, Puerto Rico
Dr. Howard J. Teas	Application of Atomic Energy in Agriculture	Presented in Lincoln, Ne- braska, October 1961 at the joint invitation of the AEC and the Governor of Nebraska
Dr. José M. Tomé	Carcinoma of the Anterior Two-Thirds of the Tongue	Annual Meeting of the P. R. Medical Association November, 1961 - San Juan Puerto Rico
Dr. Mario Vuksanovic Dr. J.A. del Regato	Carcinoma of the Skin Overlying Cartilage	Annual Meeting of the Ra- diological Society of N.A. - November, 1961 Chicago, Illinois

1962

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Mr. Héctor Barceló	Comparison of Rod Worth by Period and Analog Computer Methods	Conference on Light Water Moderated Research Reactors - June, 1962 Oak Ridge, Tennessee
	Elimination of Control Rod Vibration Caused by Water Flow	Conference on Light Water Moderated Research Reactor - June, 1962 Oak Ridge, Tennessee
Dr. Antonio Bosch	Effects of L-Triiodothyronine in Altering the Response of Kidneys to Cobalt-60 Irradiation	48th Annual Meeting of the Radiological Society of N.A. - November, 1962 Chicago, Illinois
Dr. Malcolm Daniels	Photochemistry of Thymine Solutions	Colloquium on Photochemical Transformation of Natural Products, 2nd. Int. Symposium September, 1962 Prague, Czechoslovakia
Dr. Juan Facetti	Distribution of Radioactive Antimony Formed by Nuclear Transformation in Antimony Oxides	Eastern Regional Meeting American Chemical Society November, 1962 Gatlinburg, Tennessee
Dr. Henry J. Gomberg	Utilization of Nuclear Energy for Civilian Purposes	VII Convention of the PAU of Engineering Societies - Aug., 1962 San Juan, Puerto Rico
Dr. Sergio Irizarry	Case Report of Patient with Carcinoma of Thyroid Treated with I-131	59th Meeting of the P.R. Medical Association November 14, 1962 San Juan, Puerto Rico
	The Use of Renogram in the Clinical Evaluation of Carcinoma of the Cervix Uteri	4th Interamerican Symposium on the Peaceful Applic. of Nuclear Energy - April, 1962 Mexico City, Mexico
Dr. Francis K.S. Koo	Polygenic Variability Induced by Thermal Neutron Irradiation	Annual Meeting of the Radiation Research Soc. May, 1962 - Colorado Springs, Colorado

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Duane B. Linden	Effects of Ionizing Radiation on Paramutation	Sociedad Americana de Ciencias Agrícolas October, 1962 Mayaguez, Puerto Rico
Dr. Frank G. Lowman	Accumulation of Radionuclides in Marine Plankton and their Passage through Food Chains	3rd. International Symposium on Water Pollution - Aug., 1962 Cincinnati, Ohio
Dr. Victor Marcial Dr. Pablo L. Morales	Prognostic Factors in Cancer of the Esophagus	Annual Meeting of the Radiological Soc. of P.R. and the American College of Radiology February, 1962 San Juan, Puerto Rico
Dr. Victor Marcial	Cancer Mortality in Puerto Rico	59th Annual Meeting Puerto Rico Medical Association - Nov., 1962 San Juan, Puerto Rico
Dr. Andrew Maretzki	Aspects of Ascorbic Acid Metabolism in Acerola	Sociedad Americana de Ciencias Agrícolas October, 1962 Mayaguez, Puerto Rico
	Ascorbic Acid Synthesis	59th Meeting of the P.R. Medical Association November 14, 1962 San Juan, Puerto Rico
Dr. Vicente J. Medina	The Influence of Copper, Iron, and Form of Nitrogen on Mo ⁹⁹ Uptake in <i>Cajanus indicus</i>	Sociedad Americana de Ciencias Agrícolas October, 1962 Mayaguez, Puerto Rico
Dr. Eddie Ortiz	Inelastic Scattering of Iron Using a Neutron Source	Meeting of the American Physical Society January, 1962 - New York City, New York
Dr. Edwin Roig	The Thallous-Thallic Exchange at Various Acidities in Perchlorate Media	8th Latin American Congress of Chemistry September, 1962 Buenos Aires, Argentina

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. H. Harry Szmant	Scientific Documentation in the Field of Chemistry	Seminar on Scientific Documentation in Latin America sponsored by UNESCO, September, 1962 Lima, Perú
	The Structure of Beta-Hydroxysulfides Obtained by the Oxidative Addition of Thiols to Olefins	8th Latin American Congress of Chemistry September, 1962 Buenos Aires, Argentina
	The Synthesis of Intramolecularly Coordinated Boron Compounds	8th Latin American Congress of Chemistry September, 1962 Buenos Aires, Argentina
	Scientific and Technological Resources of Latin America	Seminar on Chemical Industry of L. A. and the Common Market, 8th Latin American Congress of Chemistry - Sept., 1962 - Buenos Aires, Argentina
Dr. William Stucki	The Scientific and Technological Resources of L. A. and the Alliance for Progress	The Johns Hopkins University - April, 1962 Baltimore, Maryland
	An Investigation of the Carotenoid Pigments of Achote	Sociedad Americana de Ciencias Agrícolas October, 1962 Mayaguez, Puerto Rico
Dr. Howard J. Teas	Keto Acids in Some Tropical Plants	Annual Meeting of the Society for Economic Botany - June, 1962 Washington, D. C.
	Inhibition of Banana Fruit Ripening by Gamma Radiation	2nd. International Congress of Radiation Research - Aug., 1962 Harrogate, England
Dr. José M. Tomé	Hodgkin's Disease: Our Experience at the Dr. I. González Martínez Oncologic Hospital	59th Annual Meeting Puerto Rico Medical Association - Nov., 1962 San Juan, Puerto Rico

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Jeanna Ubifias	Carcinoma of the Tonsil	Annual Meeting of the Radiological Society of Puerto Rico and the American College of Radiology, Feb., 1962 San Juan, Puerto Rico
Dr. John Villella	Immune Responses to Irradiated Cercariae of Schistosoma Mansoni	American Society of Parasitologists and the Helminthological Society - June, 1962 Washington, D. C.
Dr. J. A. Wethington	Dosimetry from Photon Spectra and Pulse-Height Distributions	2nd. International Congress of Radiation Research - Aug., 1962 Harrogate, England
<u>1963</u>		
Dr. Charles Frazer	Magnetic Ordering in Some Related Orthorhombic Cmcm and Pnma Structure	Symposium on Ferromagnetism and Ferroelectricity - May 30 to June 5, 1963 Leningrad, Russia
Dr. Sergio Irizarry	Fat Absorption Study with I-131 Labelled Oleic Acid in Patients with Cancer of the Cervix Uterine Receiving Cobalt Radiation to the Abdomen	Thirty Second Annual Meeting of the Puerto Rico Dietetic Assoc. June 6, 1963 San Juan, Puerto Rico
Dr. Duane B. Linden	Effects of Radiation on Paramutation	Eleventh Annual Meeting of the Radiation Research Society - May 27-29, 1963 Milwaukee, Wisconsin
Dr. Robert A. Luse	Basic Mechanisms in the Radiation Chemistry of Proteins and Nucleic Acids in Aqueous Media	Conference on Basic Mechanisms in the Radiation Chemistry of Aqueous Media - May 8-10, 1963 Gatlinburg, Tennessee
	Resonance Radiation Effects of Low-Energy Monochromatic X-rays on Catalase	Eleventh Annual Meeting of the Radiation Research Society - May 27-29, 1963 Milwaukee, Wisconsin

<u>Author</u>	<u>Title</u>	<u>Place Presented</u>
Dr. Victor Marcial Dr. José M. Tomé	Radiotherapy in Carci- noma of Cervix Uteri	Annual Meeting of the Western Branch of the P. R. Medical Assoc. April 4, 1963 Mayaguez, Puerto Rico
Dr. Eddie Ortiz Dr. Juan Facetti	High Energy Gamma Photons-Neutron Conversion Device for Half Life Measurements	American Physical Society - Jan. 23-26, 1963 - New York City

PUBLICATIONS BY PUERTO RICO NUCLEAR CENTER RESEARCH STAFF

1958

Nuclear Engineering Handbook by Charles F. Bonilla, former Director of PRNC, McGraw-Hill Book Company, New York, (1958) Chapter 9-2 "Fluid Flow in Reactor Systems" and Chapter 9-3 "Heat Removal from Nuclear Reactors" 86 pages.

Inheritance of Yield Components in an Interspecific Hybrid of Cotton by Dr. José A. Ferrer Monge, Head of Health Physics Division of PRNC (Ph. D. Dissertation), Louisiana State University, August 1958).

Panel Discussion on Mediastinal Tumors with Presentation of Cases by Dr. Victor A. Marcial, Head of Radiotherapy and Cancer Division of PRNC, published in "Boletín de la Asociación Médica de Puerto Rico", Vol. 50, No. 10, Oct. 1958.

1959

Carcinoma of the Base of the Tongue by Dr. Victor A. Marcial, Head of Radiotherapy and Cancer Division of PRNC, American Journal of Roentgenology 81, No. 3.

The Puerto Rico Nuclear Center by Dr. José L. García de Quevedo, Revista del Colegio de Ingenieros, Arquitectos y Agrimensores de Puerto Rico 9 No. 1, 42-4 (1959).

Symposium on Tumors of Bone by Dr. Victor A. Marcial, Raúl M. Marcial-Rojas, Rafael Díaz Bonet, José Dávila López, Enrique Pérez Santiago, published in "Boletín de la Asociación Médica de Puerto Rico", Vol. 51, No. 2, Feb. 1959.

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Ultraviolet Spectra of Some Substituted Styrene by Dr. Owen Wheeler, Head of the Nuclear Science and Technology Division of PRNC, and C. B. Covarrubias, of the "Instituto de Química" of the Universidad Autónoma de Mexico", published in Canadian Journal of Chemistry, 40, 1224 (1962). (Work for this paper was done at the "Instituto de Química").

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Distribution of Radioactive Antimony formed by Neutron Capture in Antimony Compounds by Dr. J. Facetti, Miss E. Trabal, Mr. S. Torres, published in "Branched Chain" - Publications of the Eastern Division of the American Chemical Society 18, 84 (1962).

Symposium on Effects of Progestational Agents by María S. de del Campo, published by Acta Citológica, Vol. 6, pages 278-309 (1962).

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On the Anti-Ferromagnetic Structure of Anhydrous CUSO_4 by Dr. Ismael Almodóvar, P. J. Brown and B. C. Frazer (to be submitted to ACTA CRYST).

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Unfavorable Response of Radiation Nephritis to Administration of L-Triiodothyronin e by Dr. W. L. Caldwell, Dr. R. W. Thomassen, and Dr. Antonio Bosch, published in Nature, No. 4863, Jan. 12, 1963.

Photochemistry of Thymine by Dr. Malcolm Daniels and Dr. Alec Grimison, published in Nature 197, 484 (1963)

Ultraviolet Spectra and Polarographic Reduction Potentials of Some Cinnamic Acids by Dr. Owen Wheeler and Mrs. C. Covarrubias, accepted for publication in the Journal of Organic Chemistry.

Fatigue in Photomultiplier Tubes -- An Effect of the Malter Type by Father Ignacio Cantarell and Dr. I. Almodóvar, accepted for publication in Nuclear Instruments and Methods, Institute of Physics, Uppsala, Sweden.

Basic Mechanisms in the Radiation Chemistry of Proteins and Nucleic Acids in Aqueous Media by Dr. Robert A. Luse, to be published as part of Supplement 4, Radiation Research.

The Deuterium Isotope Effect in the Hydrogen Bonding of Imidazole in Naphthalene Solutions by Dr. Alec Grimison published in Journal of Physical Chemistry, Vol. 67, 962 (1963).

Effects of Radiation on Paramutation by Dr. Duane B. Linden, Radiation Research, Volume 19, May, 1963.

Resonance Radiation Effects of Low Energy Monochromatic X-rays on Catalase by Dr. Henry J. Gomberg and Dr. R. A. Luse, Radiation Research, Volume 19, May, 1963.

Effect of Copper Sulfate on the Ceric Dosimetry System by Fausto J. Muñoz Ribadeneira and Miss Milagros Miró, accepted for publication in the International Journal of Applied Radiation and Radioisotopes.

Recent Literature in Photobiology and Photochemistry - III, by Dr. Robert A. Luse, Agricultural Bio-Sciences Division of PRNC, Journal of Photochemistry and Photobiology, 1963, Vol. 2, pp. 73-79.

Direct and Optical Assay of Leaf Mass of the Lower Montane Rain Forest of Puerto Rico by H. T. Odum, B. J. Copeland, and R. Z. Brown, published in the Proceedings of the National Academy of Sciences, Vol. 49, No. 4, pp. 429-434, April, 1963.

PAPERS PENDING PUBLICATION

Thermal Hysteresis in Barium Titanate by Julio A. Gonzalo, submitted for publication to the "Physical Review".

Automatic Elimination of Fatigue Effects in Photomultiplier Tubes by Father I. Cantarell and I. Almodóvar.

Prediction, Acceleration, and Correction of Fatigue Effects in Photomultiplier Tubes by Father I. Cantarell and Dr. I. Almodóvar.

Neutron Diffraction Studies at the Puerto Rico Nuclear Center by Dr. Ismael Almodóvar.

Action of 5-Bromouracil deoxyriboside on Plant Chromosomes by Dr. Francis K. S. Koo (XI International Genetics Congress - Sept., 1963) The Hague, Netherlands.

Radiation Induced Modification of Paramutation Expression by Dr. Duane B. Linden (XI International Genetics Congress - Sept., 1963) The Hague Netherlands.

Modification of the Neutron Flux Distribution in the Thermal Column of the Puerto Rico Nuclear Center Reactor by Orlando Angleró and J. A. Wethington.

Theoretical and Experimental Study of Fatigue in Photomultiplier Tubes by Father I. Cantarell.

Synergistic Effect of 5-Bromodeoxyuridine and Gamma Rays on Chromosomes by Dr. Francis K. S. Koo, submitted to SCIENCE for publication.

Additional Sources of Paramutation Induction Ability from South American Races with Variegated Aleurones by Dr. Duane B. Linden, submitted to Genetics Society of America, 1963.



PRNC WEEKLY SEMINARS AT REACTOR BUILDING

Mayaguez, Puerto Rico

1961

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Nov. 29	Dr. John C. Bugher Director*	Observations on Nuclear Energy Research in Europe
	Dr. J. L. Garcia de Quevedo Associate Director*	Report on the IAEA Regional Symposium on Education and Nuclear Energy Held in Argentina
Dec. 6	Dr. J. A. Wethington Reactor Division*	Neutrons
13	Dr. Ronald D. Macfarlane University of California Berkeley, California	Study of the n, a Reaction with the PRNC Reactor
20	Dr. Henry J. Gomberg Deputy Director* Dr. J. Villella Medical Sciences & Radiobiology Division*	Radiation in Control of Parasitic Disease Cycles
<u>1962</u>		
Jan. 10	Dr. Francis Koo Agricultural Bio-Sciences Division*	Mutation and Backmutation
17	Dr. Leopoldo R. Gerecedo School of Medicine, U.P.R.	Tumor-Host Relationship Studies <u>in vivo</u> and <u>in vitro</u>
24	Dr. Herminio Brau Radioisotopes Application Division*	Applied Research in Alcohol Technology
31	Mr. J. Parrilla Calderón Health Physics Division*	Dosimetry of X and Gamma Radiation
Feb. 7	Dr. Louis Krumholz Dept. of Biology University of Louisville	Aquatic Radioecology
14	Dr. David Copson College of Agriculture & Mechanic Arts, Mayaguez	Some Aspects of Darcy's Law and Microwaves

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Feb. 21	Dr. Mahendra Singh Agricultural Bio-Sciences Division*	Effects of Ionizing Radiation on Chromosome Aberrations
28	Mr. F. Muñoz Ribadeneira Nuclear Science & Technology Division*	Dosimetría Química de Radiaciones Nucleares
March 7	Mr. Héctor Barceló Head, Reactor Division*	Reactor Parameters
14	Dr. Duane B. Linden Agricultural Bio-Sciences Division*	Paramutation
21	Dr. J. A. Facetti Nuclear Science & Technology Division*	Chemical Effects of Nuclear Transformation
28	Dr. J. Maldonado Capriles Director, Biology Dept. CAMA	Studies on the Reproductive System of Anthocoridae
April 4	Dr. Robert A. Luse Agricultural Bio-Sciences Division* Miss M. M. Palacios Radiotherapy & Cancer Div.*	Glass Dosimetry
11	Dr. Norman E. Delfel Federal Experiment Station Mayaguez	Distribution of C ¹⁴ labelled Butazolidin in the Rat
18	Dr. R. B. Knight Nuclear Science & Technology Division*	Ionizing Radiation-Effect on Emissivity
25	Dr. Frank G. Lowman Marine Biology Program*	Marine Contamination
May 2	Dr. V. V. Raman Physics Dept., College of Agriculture & Mechanic Arts Mayaguez	Principles of Quantum Field Theory
9	Dr. J. A. Rivero Biology Dept., CAMA Mayaguez	The Role of Sound in the Behavior of Frogs

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
May 16	Dr. D. Walker Biology Dept., CAMA Mayaguez	Control of Insects by Sterilization
23	Prof. Elmer Olivieri Cintrón Civil Engineering Dept. CAMA, Mayaguez	Hormigón
30	Dr. M. García Morín Head, Chemistry Dept. U.P.R.	Aplicación de la Resonancia Magnética del Protón en la Determinación de Estructuras Moleculares
June 6	Dr. Peter Glynn Marine Biology, CAMA Mayaguez	Reproductive Cycles and the Dynamics of Marine Communities
20	Dr. Eddie Ortiz Nuclear Science & Technology Division*	Método Experimental para Determinar la Energía de Enlace del Deuterón
27	Dr. Frank G. Lowman Marine Biology Program*	Marine Contamination
July 11	Dr. M. García Morín Chemistry Dept., U.P.R.	Aplicación de la Resonancia Magnética del Protón en la Determinación de Estructuras Moleculares
18	Dr. M. Díaz PiFerrer Biology Dept., CAMA Mayaguez	Asociaciones más Comunes en la Flora Marina de la Costa Oeste de Puerto Rico
Aug. 1	Dr. H. Harry Szmant Radioisotopes Application Division*	Radio Protective and Radio Sensitizing Agents
8	Mr. Rubén Freyre Federal Experiment Station Mayaguez	Research Investigation with Tephrosia Vogelii
22	Dr. M. Díaz PiFerrer Biology Dept., CAMA Mayaguez	Asociaciones más Comunes en la Flora Acuática de la Costa Oeste de Puerto Rico
29	Dr. W. P. Stucki Agricultural Bio-Sciences Division*	Investigations on N ₂ Excretion in Monogastric Animals

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Sept. 5	Dr. O. H. Wheeler Nuclear Science & Technology Division*	Isotope Effect in Chemical Kinetics
12	Dr. B. C. Frazer Nuclear Science & Technology Division*	Neutron Diffraction
19	Mr. Gonzalo González Nuclear Science & Technology Division*	Histéresis Térmica en Cristales Ferroeléctricos
26	Mr. O. Angleró Nuclear Science & Technology Division*	Modificación de un Flujo de Neutrones que Emergen de la Parte Superior de una Columna Termal Horizontal
Oct. 3	Mr. Carlos Figueroa Health Physics Division*	Radiation Safety in the Develop- ment and Use of Nuclear Energy for Rocket Propulsion
10	Dr. Carlos Aguayo Biology Dept., College of Agriculture & Mechanic Arts Mayaguez	Distribución de los Moluscos Terrestres de Puerto Rico y Cuba
17	Mr. Raúl McClin Marine Biology Program*	Determinación de I ¹³¹ en Leche
24	Mr. J. Parrilla Calderón Health Physics Division*	Shielding Against Fallout Radiation
31	Mr. Juan G. González Biology Dept., CAMA Mayaguez	The Importance of Phytoplankton and Microscopic Algae in the Productivity of Quahog Pond, Salmouth, Mass.
Nov. 7	Dr. H. H. Smith Biology Dept., Brookhaven National Laboratory	Comparative Cytogenetic Studies with Neutrons
14	Dr. F. Vázquez Nuclear Science & Technology Division*	Técnicas Empleadas en el Estudio de Resonancia en los Efectos de Radiación con Rayos X
21	Mr. S. Pinto Vega Nuclear Science & Technology Division*	Determinación de Mediavida de Fuentes de Fotoneutrones

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Nov. 28	Dr. Morris Rockstein University of Miami	Aging as Influenced by External Factors (Radiation, etc.)
<u>1963</u>		
Jan. 24	Dr. W. Gordon Director Arecibo Ionospheric Observatory	Radioastronomy and the Terrestrial Ionosphere
30	Mrs. R.J. Santiago de Morales Health Physics Division*	Determinación de Fenoles Libres y Combinados en Plantas Irradiadas
Feb. 6	Dr. Philip Sadtler Pres., Sadtler Research Laboratories, Pennsylvania	Infrared - A Powerful Tool
14	Dr. Joseph H. Simons Professor of Chemistry University of Florida	Space, Time and Energy
20	Mr. J. Parrilla Calderón Research Associate Health Physics Division*	Calorimetric Determination of Energy Absorption Buildup Factor
28	Dr. H. J. Gomberg Deputy Director*	Resonance in Radiation Effects
March 6	Dr. David Walker Associate Professor Biology Dept., U.P.R.	Sterilization of Insects
14	Dr. Frank Martín Federal Experiment Station Mayaguez	A Theory of the Physiological and Genetic Control of Unilateral Incompatibility
20	Miss Milagros Miró Nuclear Science & Technology Division*	Efecto del Sulfato Cúprico en la Estabilidad del Dosímetro de Sulfato Cérico
28	Dr. John D. Weaver Professor, Geology Section CAMA, U.P.R.	Changing Sea Levels in the Caribbean
April 3	Mr. S. Pinto Vega Instructor, Physics Dept. U.P.R.	High Gamma Energies Neutron Conversion Device for Half Life Measurement

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
April 11	Dr. Robert A. Luse Agricultural Bio-Sciences Division*	Isotope Dilution in Sugarcane Research
17	Dr. Juan Colón Avilés Agronomy Dept., CAMA U.P.R.	The Nitrogen Fraction of Soils
25	Dr. George W. Miskimen Federal Experiment Station Mayaguez	Zoogeography of the Coleopterous Family Chauliognathidae
May 1	Father Ignacio Cantarell Nuclear Science & Technology Division*	Método para Controlar la Fatiga en Tubos Fotomultiplicadores
9	Dr. Carlos Aguayo Biology Dept., CAMA U.P.R.	Los Orígenes de la Fauna Antillana
June 13	Mr. Arturo Riollano Isabela Sub-station U.P.R.	The Improvement of Pigeon Peas Through Breeding and Crop Management

* Puerto Rico Nuclear Center

PRNC WEEKLY SEMINARS AT THE BIO-MEDICAL BUILDING

Río Piedras, Puerto Rico

1961

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Sept. 1	Dr. John C. Bugher Director*	Some Probability Considerations in Experimental Biology
8	Dr. Howard J. Teas Head, Agricultural Bio- Sciences Division*	DNA Genes and Radiation
15	Dr. Sergio Irizarry Head, Clinical Applications Division*	Total Body Counting in Metallic Research and Clinical Diagnosis
22	Dr. José A. Ferrer-Monge Head, Health Physic Div.*	Chemical Changes on Leaves and their use in Dosimetry
29	Dr. Robert A. Luse Associate Scientist Agricultural Bio-Sciences Division*	Enzyme Inactivation by Ultra- violet Radiation
Oct. 6	Dr. Amador Cobas Associate Director*	Physico-Chemical Aspects of the Interaction of Radiation with Matter
13	Dr. Conrado F. Asenjo Dept. of Biochemistry and Nutrition, School of Medicine, U.P.R.	Fecal-Fat and Tropical Sprue
20	Dr. Carlos Garcia Benítez Dept. of Biology, U.P.R.	On the Increase of Sites for Chromosome Exchange Formation After Chromosome Duplication
27	Dr. Herminio M. Brau Radioisotopes Division*	Applied Research in Alcohol Technology
Nov. 3	Padre Ignacio Cantarell Nuclear Science & Technology Division*	Multi-Channel Pulse Height Analyzer
10	Dr. Ismael Almodóvar Head, Nuclear Science & Technology Division*	Tritium Labelling of Organic Compounds

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Nov. 17	Mr. Alfonso Riera and Mr. Julián Roldán Agricultural Experiment Station, Rio Piedras	Radioactive Iron 59 in Tropical Crops
24	Capt. Charles R. Angel U. S. Army Tropical Medicine Laboratory	Biological Dosimetry
Dec. 1	Dr. Leopoldo R. Cerecedo School of Medicine, U.P.R.	Tumor-host relationship studied <u>in vivo</u> and <u>in vitro</u>
8	Dr. Edwin Roig Head, Radioisotopes Application Division*	Kinetics of the Tl (I)-Tl (III) Exchange in Perchlorate Media
15	Dr. Victor Marcial Head, Radiotherapy and Cancer Division*	Exfoliative Cytology in the Evaluation of Radiation Response of Cancer of the Cervix Uteri
<u>1962</u>		
Jan. 12	Dr. J. A. Bonnet Agricultural Experiment Station, Rio Piedras	Recent Investigations on the maturity of sugar cane in Puerto Rico
19	Dr. Juan D. Curet Dean, Faculty of Natural Sciences, U.P.R.	The Concept Temperature
26	Dr. W. Van Sciver Dept. of Physics College of Natural Sciences U.P.R.	The Physics of Radiation Detection and Measurements
Feb. 2	Dr. J. Oliver González School of Medicine, U.P.R.	Serological Diagnosis of Bilharziosis
9	Dr. Raul Marcial Dept. of Pathology School of Medicine, U.P.R.	Irradiation Injuries to Elastic Arteries
16	Dr. L. del Rosario Dept. of Physics College of Natural Sciences U.P.R.	The Van de Graaff Generator and its Applications

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Feb. 23	Dr. R. García Palmieri School of Medicine, U.P.R.	Coronary Artery Disease
March 2	Miss M. Palacios Radiotherapy & Cancer Division*	Phosphate Glass Dosimeters; Theory and Application
9	Dr. J. L. García de Quevedo Associate Director*	PRNC 1 Megawatt Research Reactor
16	Dr. Gustavo Candelas Dept. of Biology, U.P.R.	Mechanism involved in the association of the cells of sponges
30	Dr. R. Córdova Biology Department, U.P.R.	Bacterial Viruses
April 6	Dr. G. T. Blasini	Experimental Studies in Histoplasmosis
13	Dr. L. Haddock Dept. of Medicine School of Medicine, U.P.R.	Mode of Activation of Thyroid Hormones
27	Dr. O. Ramírez Torres Dept. of Chemistry, U.P.R.	The Inadequacy of the Present Long Form Periodic Chart
May 4	Dr. A. Pomales Dept. of Microbiology School of Medicine, U.P.R.	Fluorescence Techniques in Biological Research
11	Dr. J. Tomé Radiotherapy and Cancer Division*	Blood Biochemical Changes in Cancer Patients
18	Dr. H. H. Szmant Radioisotopes Application Division*	Radio Protective and Radio Sensitizing Agents
25	Dr. Leo Lathroum College of Pharmacy, U.P.R.	Cyanogen with Grignard Reagents
June 1	Miss H. Pabón Radioisotopes Application Division*	Determination of Maximum Permissible Exposure

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
June 8	Dr. F. Ramos Morales School of Medicine, U.P.R.	The Meaning of the Bilharzia Infection
15	Mr. José Janer Dept. of Health of P. R.	Demographic changes in Puerto Rico and their implications in the socio-economic development of the Commonwealth
22	Dr. Ricardo Méndez Bryan Dept. of Medicine School of Medicine, U.P.R.	Towards a geography in Rheumatoid Arthritis
29	Dr. R. Santini School of Medicine, U.P.R.	Precursors of the Folic Acid Active Factors of Blood
July 6	Dr. José del Castillo Dept. of Pharmacology School of Medicine, U.P.R.	Impulse Transmission across the Nerve-Muscle Junction
13	Dr. Duane Linden Agricultural Bio-Sciences Division*	Paramutation
20	Dr. Maurice P. Weinbren Head, Medical Sciences & Radiobiology Division*	Quantitative Aspects of Single-Cycle Virus Replication in an Intact Animal
Aug. 3	Dr. Frank Lowman Agricultural Bio-Sciences Division*	Cycling of Elements in the Sea
10	Mrs. S. del Campo Radiotherapy & Cancer Div.*	Fluctuations in Sex Chromation during the Menstrual Cycle
17	Dr. Owen Wheeler Nuclear Science & Technology Division*	Kinetic Isotope Effect
24	Dr. Barbara Weinbren Clinical Applications Div.*	Study of the Serum Protein of Hippopotamus Linnacus
31	Mr. Héctor Barceló Head, Reactor Division*	Core-Physics Studies of PRNC Swimming Pool Reactor
Sept. 7	Dr. R. Levins Dept. of Biology Faculty of Natural Sciences U. P. R.	Optimum Genetic Systems

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Sept. 14	Dr. Paul Weinbren Head, Medical Sciences & Radiobiology Division*	Discussion of Arthropod-borne Viruses
21	Dr. José Maldonado School of Medicine, U.P.R.	Biological Studies on Schistosoma Mansoni
28	Dr. H. Heatwole Biology Dept., Faculty of Natural Sciences, U.P.R.	Detection of Hosts and mates by Megarhyssa a genus of parasitic insects
Oct. 5	Dr. Malcolm Daniels Radioisotopes Division*	Radiation Chemistry of Aqueous Solution, a Survey
19	Dr. Evelina Ortiz Biology Dept., Faculty of Natural Sciences, U.P.R.	Pigments in Lizards
26	Miss M. M. Palacios Radiotherapy & Cancer Div.*	Analog Dosimetry
Nov. 2	Mrs. Graciela Candelas Dept. of Biology, U.P.R.	CO ₂ Fixation in Marine Invertebrates
9	Dr. H. Harry Szmant Radioisotopes Division*	Modern Concepts of Organic Chemistry
16	Dr. Robert Luse Agricultural Bio-Sciences Division*	Sucrose in Sugarcane by Isotope Dilution
23	Dr. John C. Bugher Director*	Intracellular Atomic Nuclear Events and Lethality
30	Mr. F. Sánchez Nieva Agricultural Experiment Station, U.P.R.	The Polarographic Determination of Dissolved Oxygen in Nectars
Dec. 7	Dr. Víctor Marcial Head, Radiotherapy & Cancer Division*	Cancer of the Penis
14	Dr. C. García Benítez Dept. of Biology, Faculty of Natural Sciences, U.P.R.	CO ₂ Effect on Chromosome Aberrations
21	Dr. Andrew Maretzky Agricultural Bio-Sciences Division*	Aspects of Ascorbic Acid Metabolism in Acerola

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
Dec. 28	Dr. Marcelo Bertholds Clinical Applications Div.*	Potentialities of Autoradiography in Medical Research in Puerto Rico
<u>1963</u>		
Jan. 4	Dr. E. Toro Goyco Radioisotopes Service Veterans Administration Hospital, San Juan	The Uptake of Radioactive Triiodo-thyronine by erythrocytes: uses and limitations
18	Dr. Juan D. Guret Dean, College of Natural Sciences, U.P.R.	Weak Paramagnetism of Inorganic Salts of the Type K_nXO_4
25	Dr. Oriel Alva Radiotherapy & Cancer Div.*	Radiobiology of the Eye
Feb. 1	Dr. John A. Wehington Reactor Division*	Dosimetry from Photon Spectra and Pulse-Height Distribution
8	Dr. Andrew Maretzky Agricultural Bio-Sciences Division*	Aspects of Ascorbic Acid Metabolism in Acerola
15	Dr. J. H. Simons Professor of Chemistry University of Florida	Space, Time and Energy
March 1	Dr. Marcelo Bertholds Clinical Applications Div.*	Potentialities of Autoradiography in Medical Research in Puerto Rico
8	Dr. Julio V. Rivera Radioisotopes Service Veterans Administration Hospital, San Juan	Triolein Absorption
15	Dr. Sergio Irizarry Head, Clinical Applications Division*	Introduction to Human Gamma- Radiography
29	Dr. Antonio Bosch Radiotherapy & Cancer Div.*	Nephritis Post-radiation
April 5	Mrs. Graciela Candelas Dept. of Biology, U.P.R.	CO ₂ Fixation in Marine Invertebrates

<u>DATE</u>	<u>LECTURER</u>	<u>TITLE OF LECTURE</u>
April 19	Dr. A. Grimison Chemistry Dept., U.P.R.	The Photochemistry of Thymine Solutions
26	Dr. H. J. Gomberg Deputy Director*	Investigation of Resonance in Radiation Effects
May 3	Miss Zenaida Frias Radiotherapy & Cancer Div.*	Statistics in a Nutshell
8	Dr. I. V. Khanolkar Director Emeritus Tatta Cancer Research Institute, Bombay, India	Cancer Research in India
17	Dr. Edwin Roig Head, Radioisotopes Div.*	Szilard Chalmers Reactions in Solids
24	Dr. José M. Tomé Radiotherapy & Cancer Div.*	Hodgkin's Disease
31	Dr. Amador Cobas Associate Director*	Electrical Conductivity in Organic Solids
June 7	Mrs. M.M. Palacios de Lozano Radiotherapy & Cancer Div.*	Radiotherapy Analog Dosimetry
14	Dr. H. H. Szmant Radioisotopes Application Division*	Organic Chemistry Research Projects in the Radioisotopes Division
21	Dr. Richard Biebl Plant Physiology Institute University of Vienna Austria	The Effects of Ionizing Radiation in Plants
28	Dr. Charles Gifford Professor of Comparative Physiology, Alfred Univ. New York	Regulation of Blood Concentration of the Land Crab, <i>Cardosoma</i>

* Puerto Rico Nuclear Center



PUERTO RICO NUCLEAR CENTER

SUMMARY OF RESEARCH ACTIVITIES

Tabulated September, 1963

Director: John C. Bugher (M. D., University of Michigan)

Deputy Director: Henry J. Gomberg (Ph. D., University of Michigan)

I. MAYAGUEZ DIVISIONS AND PROGRAMS

A. Nuclear Science and Technology Division - Owen H. Wheeler (Ph. D., London)

1. Hot Atom Chemistry of Organic Phosphorus Compounds - Investigator: Milagros Santos Sánchez under the guidance of Owen H. Wheeler (Ph. D., London) (Thesis Research)
2. Reactivity of Ring Compounds and the Ease of Ring Formation - Investigator: Rosita Báez Galib under the guidance of Owen H. Wheeler (Ph. D., London) (Thesis Research)
3. Pile Radiation Effects on Fluorocarbons - Investigators: John A. Wethington (Ph. D., Florida), Owen H. Wheeler (Ph. D., London), and Ferdinand Rosa González (Thesis Research)
4. Thermal Aromatic Rearrangements - Investigator: Owen H. Wheeler (Ph. D., London) and Ileana Casanova (Thesis Research)
5. Sulfur Derivatives of Steroids - Investigator: Owen H. Wheeler (Ph. D., London) with Hilda Batlle and César Reyes (Thesis Research)
6. Ferroelectric Behavior of Triglycine Sulfate - Investigators: Julio Gonzalo (Ph. D., Madrid) and Francisco Ruiz (Thesis Research)
7. Photomultiplier Fatigue - Investigator: Rev. Ignacio Cantarell (Lic. Physics, Madrid) and Efraín Rosario (Thesis Research)
8. Design of a Thermal Neutron Shutter. This will be used for irradiating experimental animals and other materials with thermal neutrons - Investigator: Eddie Ortiz (Ph. D., Texas A. and M.) and Carlos V. Wheeler (Thesis Research)
9. Effect of Radiation on the Thermal Emissivity of Graphite - Investigator: Kenneth Soderstrom (M. S., Univ. Florida) and Carlos Reoyo (Thesis Research)
10. Differential Energy Range of Fission Products on Aluminum - Investigators: Ismael Almodóvar (Ph. D., Carnegie Inst. Tech.) and Edgar Páez (Thesis Research)
11. Range Energy Relations of Fission Products in Different Materials - Investigators: Ismael Almodóvar (Ph. D., Carnegie Inst. Tech.) and Nyole Páez (Thesis Research)
12. Gamma Radiolysis of Organic Compounds - Investigator: Owen H. Wheeler (Ph. D., London) with Rafael Montalvo (Thesis Research)

13. Spin-Spin Proton Coupling in Aromatic Compounds - Investigator: Owen H. Wheeler (Ph. D., London) in co-operation with Dr. J. L. Mateos (National University of Mexico)
 14. Compton Scattering - Investigator: Eddie Ortiz (Ph. D., Texas A. and M.)
 15. Chemical Dosimetry - Investigators: Fausto Muñoz (B.S.C.E. Polytech. Inst. Quito, Ecuador) assisted by Pedro Osorio
 16. Ultrasonics and Mass Transfer - Investigators: Fausto Muñoz (B.S.C.E. Polytech. Inst., Quito, Ecuador), Rafael Muñoz Candelario (Ph. D., Brooklyn Polytech. Inst.) and David González.
 17. Szilard-Chalmers Reaction in Inorganic Compounds - Investigator: Juan F. Facetti (Ph. D., Asunción) with Elisa Trabal
 18. Search for New Nuclides - Investigator: Juan Facetti (Ph. D., Asunción) with Elisa Trabal and Sigfredo Torres
 19. Radiation Effects in Ferroelectric Properties of Rochelle Salt - Investigators: Kenkichi Okada (Ph. D., Kyota), and Ricardo Vega
 20. Relaxation Frequencies in Ferroelectric Crystals - Investigators: Julio Gonzalo (Ph. D., Madrid) and Rev. J. M. Brusi (Thesis Research)
- B. Neutron Diffraction Program - Principal Investigator: Ismael Almodóvar (Ph. D., Carnegie Inst. Tech.) with guest scientists Helmut Bielen (Ph. D., Bonn) and Kenkichi Okada (Ph. D., Kyota) in cooperation with Dr. B. C. Frazer and Dr. Walter Hamilton of Brookhaven National Laboratory, Dr. J. Martínez Picó (Chemistry Department, College of Agriculture and Mechanic Arts), and Dr. Mortimer Kay (Georgia Tech.)
1. Crystal Structure Determination of Inorganic Compounds
 2. Magnetic Structure Determination of Compounds of Transition Metals
 3. Low Temperature Crystal Structure Determination of Substances That Are Liquids at Room Temperature
- C. Resonance in Radiation Effects Program - Principal Investigator: Henry J. Gomberg (Ph. D., Univ. Michigan) with the collaboration of Robert A. Luse (Ph. D., Univ. California), Florencio Vázquez (Ph. D., Madrid), and Rosa Santiago de Morales (M. S., U.P.R.)
- D. Agricultural Bio-Sciences Division - John C. Bugher (M. D., Univ. Michigan)
1. Acerola Metabolism - Investigator: Andrew Maretzki (Ph. D., Penn.State)
 2. Mechanism of Back Mutation - Investigator: Francis K. S. Koo (Ph. D., Univ. Minnesota)
 3. Radiation and Chemical Effects in Plant Chromosomes - Investigators: Francis K. S. Koo (Ph. D., Univ. Minnesota) and Edith Robles de Irizarry (Thesis Research)

4. Synthetic Enzymes - Investigators: Robert A. Luse (Ph. D., Univ. California) and H. Harry Szmant (Ph. D., Purdue Univ.)
 5. Biochemistry of Sugar Cane - Investigator: Robert A. Luse (Ph. D., Univ. California)
 6. Insect Control by Induced Sterility - Investigator: David Walker (Ph. D., Washington State Univ.)
 - a. Rearing, and Radiation Studies of Diatraea Saccharalis - Investigators: David Walker (Ph. D., Washington State Univ.) and Adela V. de Alemañy and Miguel Figueroa (Thesis Research)
 7. Trailing Indigo Project - Investigator: Jean Garcia (Ph. D., Univ. Wisconsin)
 8. Radioisotope Applications in Plant Study - Investigator: Robert A. Luse (Ph. D., Univ. California) and Fernando Luna
- E. Paramutation Research Program - Investigator: Duane B. Linden (Ph. D., Univ. Minnesota)
1. Survey of South American Races of Maize for Paramutation Ability - Investigators: Duane B. Linden (Ph. D., Univ. Minnesota) and Vicente Rodríguez (Thesis Research)
 2. Radiation Effects on Paramutation - Investigators: Duane B. Linden and José Cuevas Ruiz (Thesis Research)
- F. Marine Biology Program -Principal Investigator: Frank G. Lowman (Ph. D., Univ. Washington)
1. Biological Productivity by C-14 Method Correlated with Trace Element Metabolism
 2. Stable Trace Element Analysis in Sea Water, Marine Organism and Bottom Sediments - Investigators: Milagros Miró (M. S., College of Agr. and Mech. Arts), Lydia Quiñones, and Vilma Román de Vega
 3. Uptake Studies of Marine Organisms - Investigators: Edgar Ramos Seda, Iraida Oliver de Padovani
 4. Background Radiation Levels in the Marine Environment - Investigators: Edgar Ramos Seda and Carlos Folch
 5. Background Oceanographic Measurements - Investigators: Frank G. Lowman (Ph. D., Univ. Washington) and Edgar Ramos Seda
 6. Rincón Ecological Studies - Investigators: Robert A. Stevenson (Ph. D., Univ. Hawaii) and Frank G. Lowman (Ph. D., Univ. Washington)

G. Health Physics Division - José Ferrer Monge (Ph. D., Louisiana State Univ.)

1. Determination of Radiation Exposure to the Gonads During Diagnostic Examinations - Investigator: Amalia Vélez Paradis under the guidance of J. Parrilla Calderón (M. S., College of Agr. and Mech. Arts) (Thesis Research)
2. Determination of Background Radiation Levels in the Vicinity of the BONUS Reactor Site - Principal Investigator: José Ferrer Monge (Ph. D., Louisiana State Univ.) with the assistance of Pedro Cruz (M. S., College of Agr. and Mech. Arts), Fernando Vallecillo, and María Luisa Cruz
3. Ecological Study of the Western Zone of Puerto Rico - Principal Investigator: José Ferrer Monge (Ph. D., Louisiana State Univ.)
4. Theoretical Study of Reactor Engineering - Investigator: J. Parrilla Calderón (M. S., College of Agr. and Mech. Arts)

H. Reactor Division - Héctor Barceló (M. S., College of Agr. and Mech. Arts)

1. Reactor Development and Monitoring Studies - Investigator: Héctor Barceló (M. S., College of Agr. and Mech. Arts)

II. RIO PIEDRAS DIVISIONS AND PROGRAMS

A. Radioisotopes Division - Edwin Roig (Ph. D., Univ. Penn.)

1. Organic Chemistry Research - Principal Investigator: H. Harry Szmant (Ph. D., Purdue Univ.)
 - a. Synthesis of Organic Boron Compounds-Potential Use in Neutron Activation Therapy -
 - (1) Derivatives of Boric Acid - Investigator: A. Carrasquillo
 - (2) Derivatives of Diboron - Investigator: J. F. Pazos
 - b. Substitution of Hydroxyl Groups in Polyfunctional Alcohols-Potential Use as Antimetabolites
 - (1) Imidate Reactions - Investigator: E. P. Olavarría
 - (2) Reactive Dichloro Compounds - Investigator: L. Ortiz
 - c. Organic Sulfur Compounds-Potential Use as Radiation Protective Agents
 - (1) Beta-hydroxy sulfoxides - Investigator: J. J. Rigau
 - (2) Reduction of Sulfoxides - Investigator: O. Cox
 - (3) Association of Sulfoxides - Investigator: R. Figueroa
 - (4) Sulfocarbene Reaction - Investigator: L. Fernández

(5) Sulfocarbene Reaction - Investigator: R. Cabrera

d. Chromic Acid Oxidation of Hydrocarbons

Project approved - Research Assistant not appointed so far

e. Solvent Effects in Chemistry

(1) Wolff-Kishner Reaction - Investigator: M. Román

(2) Absorption Spectra - Investigator: Y. Vaillant

2. Photochemistry and Radiation Chemistry* - Principal Investigator: Malcolm Daniels (Ph. D., Durham)

a. Photochemistry of Aqueous Nitrate Solutions at 3130 \AA - Investigator: R. Vicki Meyers (M. S., Wisconsin)

b. Absorption Spectrum and Photochemistry of Periodate - Investigator: E. V. Belardo (B. S., Philippines) and J. J. Rabelo (B. S., U.P.R.)

c. Photochemistry and Radiation Chemistry of Alkaline Permanganate - collaborator to be appointed

d. Construction and Testing of Flash Photolysis Apparatus - Investigator: Ronald Collins (Honor Program Physics, U.P.R.)

e. Photochemistry of Thymine at 2537 \AA and 1849 \AA - Investigators: Alec Grimison (Ph. D., London) and A. Román de Sandoval (B. S., U.P.R.)

f. Photochemistry of Uracil and Cytosine - Investigators: Alec Grimison (Ph. D., London) and Marie Adele Mouakad (U.P.R.)

g. Hyperchromicity and Viscosimetric Studies on D.N.A. - Investigators: Alec Grimison (Ph. D., London), A. Lugo Vázquez and Germán Santiago (U.P.R.)

h. Fluorescence and Phosphorescence Studies on Pyrimidines and D.N.A. - Investigator: E. V. Belardo (B. S., Philippines) temporary. Full time collaborator to be appointed.

* Note: These activities are supported by A.E.C. program divisions and the D.N.A. work is supported by an N.I.H. grant to the University of Puerto Rico.

3. Solution Chemistry of Thallium - Principal Investigator: Edwin Roig (Ph. D., Univ. Penn.) with the collaboration of Raúl Figueroa (B. S., U.P.R.)

4. Solid State Physics of Organic Crystals - Principal Investigators: Amador Cobas (Ph. D., Columbia Univ.) and H. Harry Szmant (Ph. D., Purdue Univ.) with the collaboration of Concepción Zuazaga (B. S., U.P.R.)

B. Clinical Applications Division - Sergio Irizarry (M. D., Univ. Buffalo)

1. Study of Thyroid Gland Function Under the Influence of a Combination of Estrogenic and Progestational Substances in Puerto Rican Women - Investigators: Sergio Irizarry (M. D., Univ. Buffalo), Dr. Gregory Pincus (Director of Research, Worcester Foundation for Experimental Biology), Dr. Manuel E. Paniagua (P. R. Family Planning Association) and Mr. José L. Janer (Biostatistics Div., School of Public Health, School of Medicine, U.P.R.), and Zenaida Frías (MPH, Univ. Michigan)
2. Isotope Localization Studies - Investigator: Sergio Irizarry (M. D., Univ. Buffalo)
 - a. Equipment Modification
 - b. Tumor Localization and Organ Visualization
3. Fat Absorption Studies:
 - a. Intestinal Absorption of Patients Undergoing Radiotherapy - Investigators: Víctor Marcial (M. D., Harvard), Sergio Irizarry (M. D., Univ. Buffalo), and A. A. Cintrón Rivera (M. D., Univ. Michigan)
 - b. Triple Simultaneous Measurement of Intestinal Absorption with Vitamin A, Radio-Oleic Acid, and Xylose - Investigators: Sergio Irizarry (M. D., Univ. Buffalo) and A. A. Cintrón Rivera (M. D., Univ. Michigan)
 - c. The Effect of the Unblocked Hyperthyroid Gland on Radio-Oleic Acid Blood Levels (Absorption Curve) - Investigator: Sergio Irizarry (M. D., Univ. Buffalo)
4. Studies on the Use of In Vitro Tests for the Assessment of Thyroid Function Investigator: Barbara Weinbren (B.M.B.Ch., London) and Sergio Irizarry (M. D., Univ. Buffalo)
5. Renogram Follow Up Studies Cancer of the Cervix - Investigator: Sergio Irizarry (M. D., Univ. Buffalo)
6. Studies of Blood Biochemical Changes in Patients Undergoing Radiation - Investigators: Barbara Weinbren (B.M.B.Ch., London), Sergio Irizarry (M. D., Univ. Buffalo), and Víctor Marcial (M. D., Univ. Harvard)
7. Thyroid Function Studies With In Vitro Techniques Using Red Cells and Resin for the Uptake of I-131 Triiodothyronine - Investigator: Barbara Weinbren (B.M.B.Ch., London)
8. Experimental Exudative Gastritis in Dogs Induced by "Diol" - Investigators: Dr. A. Rodríguez Olleros (Prof. of Biochemistry, U.P.R.) and Sergio Irizarry (M. D., Univ. Buffalo)
9. A Comparative Study of In Vitro Thyroid Function Test Using Resin Uptake Method and Red Cells Triiodothyronine and Uptake by Red Cells - Investigators: Dr. E. Toro Goyco (Biochemistry Dept., Veterans' Administration Hospital) and Sergio Irizarry (M. D., Univ. Buffalo)

- C. Radiotherapy and Cancer Division - Víctor A. Marcial (M. D., Harvard Univ.)
1. Evaluation of Radiation Response in Cases with Cancer of the Cervix Uteri Treated with Radiotherapy by Means of Exfoliative Cytology - Investigator: Víctor A. Marcial (M. D., Harvard Univ.)
 2. Use of Fluorods for Radiation Dosimetry - Investigator: María P. Lozano (Univ. Rochester)
 3. Leukemia Study - Investigator: Víctor Marcial (M. D., Harvard Univ.) in collaboration with the Department of Epidemiology of the School of Public Health, Harvard University)
 4. Irradiation of the Eye - Investigator: Oriel Alva (M. D., Univ. Buenos Aires)
 5. The Influence of Whole Body Radiation on the Enzyme Activity of the Intestine - Investigators: Víctor Marcial (M. D., Harvard Univ.), José M. Tomé (M. D., Spain), Antonio Bosch (M. D., Mexico) in collaboration with M. Dacquisto (Lt. Colonel, M. C., of the U. S. A. Tropical Research Medical Laboratories)
 6. A Study of the Changes Detectable in the Serum of Cancer Patients Receiving Irradiation to the Lower Abdomen, With Special Reference to Lipid and Protein Levels - Investigators: Barbara Weinbren (B.M.B.Ch, London), Sergio Irizarry (M. D., Univ. Buffalo), Víctor Marcial (M. D., Harvard Univ.), Zenaida Frías (MPH, Univ. Michigan), Leonor Gilestra, and Carmen Villodas
 7. Cancer of the Esophagus - Investigators: Víctor Marcial (M. D., Harvard Univ.) in collaboration with Dr. Pablo Morales (Div. of Radiology, Dr. I. González Martínez Oncologic Hospital), and Dr. Raúl Marcial Rojas (Head of Department of Pathology, School of Medicine, U.P.R.)
 8. Hodgkin's Disease - Investigators: José M. Tomé (M. D., Spain) with the collaboration of Dr. Eduardo de León (Pathology Department, School of Medicine, U.P.R.)
 9. Carcinoma of the Anterior Two Thirds of the Tongue - Investigators: José M. Tomé (M. D., Spain) and Víctor Marcial (M. D., Harvard Univ.)
 10. Irradiation of the Kidney - Investigators: Antonio Bosch (M. D., Mexico) with the collaboration of Dr. William Caldwell (Rodríguez Army Hospital)
 11. Fractionation in Radiotherapy of Cancer of the Oral Cavity - Investigators: José M. Tomé (M. D., Spain), Antonio Bosch (M. D., Mexico), and Oriel Alva (M. D., Univ. Buenos Aires)
- D. Medical Sciences and Radiobiology Division - Paul Weinbren (M. D., Univ. of Witwatersrand, S. A.)
1. The Mechanisms of Antigen-Antibody Reactions Following the Inoculation of Mice with Irradiated and Normal Schistosoma mansoni Cercariae - Investigators: Paul Weinbren (M. D., Univ. of Witwatersrand, S. A.) and John B. Villella (Ph. D., Univ. Michigan)

2. Intracellular Effects of Neutron Capture Reactions - Investigators: John C. Bugher (M. D., Univ. Michigan) and Paul Weinbren (M. D., Witwatersrand, S.A.)
 3. The Study of Human Chromosomes in Normal and Irradiated Subjects and Those Having Sprue - Investigators: M. Dacquisto (M. D., Univ. Vermont) and Paul Weinbren (M. D., Witwatersrand, S. A.) with the collaboration of José M. Tomé (M. D., Zaragoza, Spain)
 4. The Response of Selected Small Intestine Enzymes to Ionizing Radiation - Investigator: M. Dacquisto (M. D., Univ. Vermont) with the collaboration of Antonio Bosch (M. D., Univ. Mexico)
 5. Etiology of Obscure Acute Neurological Syndromes in Children - Principal Investigator: Dolores Méndez Cashion (M. D., Univ. Virginia). Virus isolation program of this research project is being carried out by the staff of this Division
- E. Terrestrial Ecology Program - Part I - Radioecology of a Tropical Rain Forest at El Verde, Puerto Rico - Principal Investigator: Howard T. Odum (Ph. D., Yale Univ.)
- F. Terrestrial Ecology Program - Part II - Radiation Induced Variability in Indigenous Arthropod-Borne Animal Viruses of Puerto Rico - Principal Investigator: Paul Weinbren (M. D., Witwatersrand, S. A.)

