

# PRNC047

PRNC-47

PUERTO RICO NUCLEAR CENTER

GENERAL INFORMATION

(Revised July 1965)

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PUERTO RICO MUCLEAR CENTER

GENERAL, NARRATIVE

?The budget proposal for FI-1967 reflects a modest increase in the O7 budget commensurate with a healthy conservative development of the Program, Tt marks the beginaing of a secont phase for PRNC in which the training anc research areas, having been stabilized, will seek depth and maturity.

The second phase may be tied to the favorable report on PRNC by the AEC

?Ad Hoc Committee which made its evaluation at the end of calendar 1965

Subsequent action by the Commission in accepting the committee's report, including the shift of supervision to the Division of Training and Education gave assurance of the greater stability of PANIC necessary for sound development.

Programmatic support for specific research projects by the Divisions of Biology and Medicine, Research, and Isotope Development has also shown a noierate healthy increase in keeping with the development of staff and facilities

As facilities improve, PRIC will be able to take on the solution of additional problems of direct interest to the AEC program divisions. By virtue of its location in the island tropics, PRNO can offer a unique environment, particularly in the life sciences, which makes possible solution of important special problems under the most favorable conditions. Particularly noteworthy in this regard are the programs in terrestrial

and marine ecology, and their relationship to the possible use of nuclear explosives for the proposed Isthmus Canal?

Administrative buildings can offer more useful support than AEC programs which is now being used. The new Animal Quarters Building in Flo Piedras, and Administration and shop Buildings in Mayaguez will take handling of

current programs more effective. However, there will continue to be severe crowding in the Ro Piedras building which will be relieved only by construction of the proposed extension of the Bio-Medical building. We urgently solicit support for this construction project.

Important results achieved within the Divisions and Programs are very briefly stated in the Division and Program narratives. They are summarized in greater detail in the 189's and Renewal Proposals which accompany the Budget Proposal. Complete Progress Reports have been written for each program receiving support from the Divisions of Biology and Medicine and of Research.

The following list includes a brief selection of highlights taken from the Division and Program Reports:

2, The completion of the irradiation phase of the Terrestrial Ecology T Program, The three-months exposure in the Lugoillo Experimental Forest

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was completed without incident and the program now enters its initial phase of irradiation studies in the forest

2, During the irradiation a virus made its appearance among the vats and  
mosquitoes of the arr Studies leading to the identification of this  
virus are now in progress, this is the first discovery of an indigenous  
arthropod-borne virus in Puerto Rico

3, Studies of <sup>131</sup>I iodine uptake by human thyroids have shown that persons  
of the tropically adapted population of Puerto Rico have normal values  
that differ from those of northern latitudes. Uptake is consistently  
less in Puerto Rico than in continental United States

1, Laboratory colonization of the Sugar Cane Sorer *Darres saccharalis* was  
achieved as a necessary step in the exploration of radiation as a  
controlling this parasite.

5. The completion of a new building to house experimental animals, principally mice, and laboratories devoted to virology and cancer will permit the full activation of (6 and O7 programs in Radio-biology and Virology.

6. By incorporating bromine in the DNA of onion root tips by feeding

Baconnuridice, it was found that the frequency of chromosome breaks per cell constant. The number of chromosome breaks per cell was substantially increased at the L<sub>α</sub> absorption edge of bromine (13.08 KeV). This extends the results

Results with other elements in metalloenzyme systems.

7. Agricultural Bioscience: This division, which had been practically inactivated because of insufficient funds for fiscal year 1965, received the benefit of an overhead adjustment in programs O5 and C6 and was again

made operative in the second half of fiscal year 1965, the increase  
shown for fiscal year 1966 represents the level of the agricultural portion  
of the program must achieve 15 PRIC 1s to be effective in this vital area  
by fiscal year 1967.

8, Nuclear Engineering: Graduate work in nuclear engineering has achieved  
a high level of activity with approximately twenty students through the  
year. The great interest is a reflection of the imaginative plans of the  
Puerto Rico Water Resources Authority for the next  
twenty years.

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PUERTO RICO NUCLEAR CENTER

DIVISIONAL NARRATIVE

Director's Office: The Director's Office operates at both Rio Piedras and Mayaguez 99 does the Administration and Services Division. Separation of programs and administrative activity results in high communication

and land travel costs. In both instances expenditures will be greater due to a recent increase in telephone rates granted by the FCC and the increase in local air rates,

Weekly staff seminars at both Rio Piedras and Mayaguez are an established part of our scientific program. Visiting scientists and consultants are scheduled as guest lecturers whenever feasible and their contribution has added substantially to the scientific background of the staff.

PRNG has been host to several scientific groups which chose to meet in Puerto Rico because of interest in the programs of the Center. It was host to the first Inter-American Power Reactor Conference sponsored by the OAS at which were discussed the generation of electricity by nuclear energy, desalting of sea water, and the construction of canals by use

of nuclear explosives.

At the invitation of the ABC Division of Special Projects, PRIC in collaboration with the Oak Ridge Institute of Nuclear Studies participated in the "Atoms-at-Work Exhibit" in El Salvador. Personnel are scheduled to participate in this project in other Central American countries during the next fiscal year.

The Sumner Institute of Radiobiology was suspended for the purpose of conducting a survey of task participants to evaluate the use being made of their training and of the equipment acquired under this program.

Staff in the Director's office has been increased for the purpose of improving the Center's operation in relation to needs of Latin American countries and especially their universities. It is planned to resume staff travel to Latin America to encourage institutional interrelationships.

Administration and Services: Three major changes have been instituted in the methods of rendering accounting service. First, to correct previous deficiencies, cashier services and accounting have been completely separated. There is now no overlap in work assignments. Second, ac-

counting operations using IBM 1620 equipment of the University have been initiated. It is now possible to give the Director's Office and the Division and Program Heads prompt information on their fiscal status, Third, new personnel have been added so that the necessary services can be rendered promptly and effectively.

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In cooperation with the Technical Service Divisions and the Reactor Division, all service operations are charged on a monthly basis. ALL Divisions and Programs now pay, for non-overhead services such as reactor irradiations, shop services (machine, carpenter, electronic and glass), Long-distance phone calls, etc.

The Administration and Services Division in Mayaguez has been operating in scattered space and under very crowded conditions. In 1965 ground was cleared for a new building to house all these services. Appropriately, and in order to release space in the main building for research use.

Reactor: A New Hazards Summary Report for the Swimming Pool Reactor, Tennessee as a PRYC document and containing substantial new and revised old information was completed and delivered to the Atomic Energy Commission. The operators and supervisor for the second shift, to begin July, 1955, have been trained and the crew for a third shift is being recruited for training. On acceptance of the Hazards Summary Report, amendments to cover two megawatt operation will be filed, initial studies for five megawatt operation, foreseen for FY-1968, have been initiated,

Use of the reactor for research has begun to impose steady-state load which leads to frequent conflict with the needs for nuclear contracting service and student experiments. Wherever possible, the reactor is used for these purposes. It is noted that for this work and its use has been quite satisfactory. The reactor is not always an adequately flexible unit for the steady-state and criticality experiments. We would like to see the reactor power pool type core in the second pool to take the load. Meeting Load, a significant first step in this direction can be taken. The reactor is being used for the production of the complete vacuum-tube

The reactor is being used for their pool reactor. They have one £0 a year budget for the system, Further planning and preparation, smelting

farada studies will go on in 196.

The major uses for the pool reactor have been in the neutron diffraction programs, which uses two spectrometers occupying six inch beam tubes, the study of radiation effect on the reactivity of graphite, which uses an 8 inch beam tube, the activation programs which use the pool as the irradiation stations for open pool irradiations, and many special irradiations in support of research programs and thesis studies, such as fast-neutron induced mutations in sugarcane. A borated-water shutter is being installed in a six inch beam tube, and a temporary block-type shielded room for irradiation of small animals erected around the tube exit.

The 1-77 reactor has had a heavy schedule as the major training unit for the Nuclear Engineering Division. This unit was improved with new safety circuits installed with ORO safeguard committee approval.

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Division training activity for 1965 included two supervisors for the Columbia, S.A, reactor and six operators for the BONUS project. Division personnel are also directing thesis problems, primarily on heat transfer, for three students in the Nuclear Engineering program.

?The increase in reactor based activity indicates a growing need for Personnel space and laboratory type facilities within the reactor building. The necessary building volume and area is available for such development.

Nuclear Science and Technology: This division is responsible for teaching and research in nuclear energy related areas of the physical sciences.

?Through the division, support of the Master's degree? programs in physics and chemistry of the University is provided, Tale support takes the

form of the teaching of specialized graduate-level courses and provision of facilities and problems in nuclear energy areas for the required ?masters degree theses. In addition, facilities and research support for ?thesis work are provided to degree Candidates at the masters and at the doctorate level who have been drawn from the United States and from Latin America. Studies in residence under these programs receive support from the U.S.-ABC Graduate Fellowship program, the International Atomic Energy Agency, their governments or other agencies of their home countries, The student continues his affiliation with his home university, and the degree is awarded by that university.

Post-graduate training and experience, for new Ph.D's and for mature scientists seeking advanced information and techniques are also provided for U.S. citizens and for qualified men from foreign countries,

In addition to the training-oriented teaching and research, the division Provides the administrative framework and scientific environment for Physical and chemical research at the professional level and of direct interest to the program divisions of the Atomic Energy Commission, This work is supported by the appropriate AEC division and the work done is pertinent to the program of the division, but its presence has a very marked influence in setting the standards of quality of the work expected from students in theses and in post-graduate work.

The major scientific areas of activity in the Division are solid state physics, hot-atom chemistry, neutron diffraction (reported separately), low energy neutron physics, radiation chemistry and instrumentation, The Solid state physics research lies in two major areas. The nature of the electric properties of crystals and the effect of neutron, gamma and x-rays upon them, and the effect of selected energy photons on alkali-halide crystals, Three papers from the first group on the magnetic structure of  $\text{FeB}_2\text{O}_4$ , and on dielectric properties of radiation-damaged triglycine sulfate and of rochelle salt were presented before the American Physical Society during the past year. The work on the alkali halide crystals is in part a doctoral thesis problem for a student of Harvard University. Through irradiation of the crystal with monochromatic radiation, it has

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been possible to control the initial site of radiation interaction and observe the relationship between the radiation absorption and the formation of lattice vacancies. A significant relationship between them has been demonstrated. Further experimental work and theoretical analysis is in progress. This problem represents a joint effort of the Physics Department in Mayaguez, which is supplying space and the radiation source, and PRNC.

The hot-atom chemistry program has been devoted to a study of the valence state of compounds as formed using various isotopes of an element. Tin and antimony compounds were subjected to neutron irradiation and the change in valence state measured as a result of the irradiation and following thermal and gamma annealing. A paper on this subject was presented before the American Nuclear Society, with a graduate student as joint author. A similar program on organic phosphorous compounds has been initiated.

In instrumentation, emphasis is on radiation detection systems. The work on photomultiplier fatigue has produced a comprehensive paper in Nuclear Science and Engineering on a new semi-empirical theory of this effect and the experimental results confirming the theory. In addition,

graduate student thesis study of the statistical model used in analysis

Was completed, Another group, in the Physics Department laboratory, 18

Developing and calibrating a high sensitivity calorimeter for absolute

measurements of x-rays. During 1965, this work will be taken over by 8

ev dosimetry group in the Health Physics Division although much of it

Will be used for the M.S. thesis 4m physics and in nuclear engineering,

Radiation chemistry research has yielded papers on such diverse topics

as radiation-induced bromination of 2,3-Dimethylbutane and the effects

of radiation on estrone in solution, The results are in press in

Radiation Research. In addition, a new effort based on radiolysis of

hydrogen halides has been started. The radiolytic mechanism will be

studied with a view to enhancing or at least maximizing the G value

The products represent direct sources of chemical energy produced from

nuclear energy, and they will be studied further as possible fuel cell

feed materials.

Nuclear Engineering: In its first full year of operation, this program

underwent rapid expansion. Starting with 15 students, and about 9 full

student-years of enrollment, it jumped to 25 students? and over 20 student

years with the addition of 10 engineers for the Puerto Rico Water Resources

Authority, Additional teaching personnel were recruited from the Health

Physics Division and from the PRWKA to help absorb the load increase.

Since each student must complete a thesis before the College will grant the degree of Master of Science in Nuclear Engineering, PRIC is being

hard pressed to develop about 15 suitable thesis problems. However, this has been done and the laboratory will benefit from work on many problems

in instrumentation, heat transfer, reactor dynamics, dosimetry and radiation effects.

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Upon graduation of the current Large group, enrollment will stabilize at about 20 students and 12 student years of teaching, unless the Water Resources Authority makes another late decision to train more students. A full time state member from U.C.L.A., has been added for 1966 to improve the handling of the base program, and the Water Resources Authority has pledged help again if they add more students.

The Nuclear Engineering Division of PRNG is, at this time, engaged primarily in maintaining the degree program of the College with advanced training and research support. However, in addition, research projects

are being developed by the faculty in areas of direct interest to PRIC.

These include studies on radiation effects on the thermal emissivity of graphite, development of a neutron energy selector based on absolute reflection techniques and the generation of random numbers based on short time fluctuations in decay rate of a long lived isotope. The last is in response to the need for a random number generator for shielding calculations using Monte Carlo methods.

The recent Latin American Conference of Nuclear Energy demonstrated the great interest in Latin America in nuclear power. Continued development of the FRNC program proper and cooperative work with BOMMS and other atomic energy installations are needed to keep pace. Within the ASC Nuclear Science and Engineering Fellowship program, four recipients have selected the U.P.R.-P.R.N.C. program for their training,

Health Physics: the primary responsibility remains surveillance of conditions to insure health and safety of all PRC personnel. Specific activities include personnel monitoring, area monitoring, environmental surveys, waste disposal, and decontamination as needed. In addition,

g) aspects of industrial safety and fire prevention are now centered in the division so that it is truly concerned with all aspects of guaranteeing a safe working environment.

The division personnel discharge their responsibilities through inspection, education and, where necessary, citation. The operating and research divisions are responsible for carrying through their activities in a manner without the immediate presence of health physics personnel, except in unusual cases.

In addition to the operational safety responsibility, the division operates an infirmary for orderly and proper attention to injuries, and also provides the "Occupational Health Program" developed in keeping with Manual Chapter 0528. This program has been started in Mayses and, as soon as the difficulties unique to the local environment are worked out, it will be extended to cover Rio Piedras. Experience with the

Program up to now, based on about, 150 employees, has been excellent,

To help the research groups, particularly in the life sciences, with the

many-faceted difficulties of accurate radiation dose measurement, &

Dosimetry group has been formed within the Health Physics Division. The

group will help develop techniques and set standards for dosimetry with

all types of ionizing radiation

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The educational program in Health Physics has been de-emphasized while

UAFort was concentrated on improving the health physics service provided

in the laboratory. While the improvement process is still in full swing,

completion of staff and existing progress makes possible the focusing of

attention on health physics education again.

Participation is continuing in the National Health Physics Fellowship

Program and four fellows, two from Puerto Rico and two from the United

States have elected to take their program at U.S.-F.R.N.C.

Agricultural Biosciences Division: The training and education function

Agriculture continues in teaching nuclear techniques used in several  
Central science (plant physiology, genetics and agricultural biochemistry)  
Work is done at both the undergraduate and the graduate levels by formal  
teaching offerings and by thesis research leading to the M.S. degree. At  
present four students are at various stages in graduate studies carried  
out within the Division. In addition the staff is involved in the  
advanced training of an ORINS and an TAEA fellow in GRINS summer  
participants.

ry)

Research activities of the Division fall within three major programs:  
1. Effects of ionizing radiation on plants, application of radioisotopes to  
crop studies, and food preservation through radiation?

The first of these programs is concerned with plants which are impor-  
tantly in the tropics, emphasis has been placed on neutron  
irradiation effects as the Puerto Rico Nuclear Center is unique in having  
the only research reactor in the tropics available for biological studies.

Selection effects are being evaluated in terms of the genetics, physiology  
and biochemistry of the plant system. Specific projects include production  
of a high sucrose mutant of sugarcane through neutron irradiation of Fe<sup>3</sup>  
Gheerik. Biochemical mass screening of plants grown from this seed  
carried out at the first and second generation through use of non-  
destructive tissue sampling and subsequent chemical assay for microgram  
quantities of sucrose and reducing sugars. Another project is investigation  
of the biochemical pathways of sucrose formation and degradation in sugar  
cane. Here, rates of protein formation in cell-free extracts of sugarcane  
are measured by determining incorporation of C-14 labeled amino  
acids. Other studies are directed toward identification of nucleotides  
found in sugarcane,

Radioisotope techniques have not yet been applied extensively to the  
agriculture of the humid tropics. To establish fundamental principles

relationships which may be applied to agronomic practice is the aim

Of this program within the Agricultural Bio-Sciences Division, ?At the  
Sresunt Pine projects here deal with uptakes of strontium and calcium by  
Bitite grown in soils containing different Levels of these elements. Under  
Rovelopment are projects studying the micronutrients nutrition of sugarcane  
Ge tute may be Jafluencea By agronomic and environmental factors, and the

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cycling of micronutrients in tropical crops. In all of this work emphasis  
is placed on application of radioisotope tracer techniques.

The third area of division research is that of the preservation of tropical  
fruits and vegetables by ionizing radiation, with the aim of making  
feasible the shipment of this exotic food to commercial markets. Study of  
?the radiation pasteurization of mangoes is being carried out, using the  
PRIC 2,000 curi= cobalt 60 gamma source. Extension of storage life for  
up to thirty days at 50°F was found after 250 kilorad doses. Now being  
investigated are the best conditions of pre- and post-irradiation

treatment and of varietal differences. Soon to be studied are the changes induced by radiation pasteurization in levels of vitamins, sugars, and Pectins found in mangoes and the radiation survival of the microbial factors responsible for spoilage. Extension of these studies to bananas is likely, through Division of Radioisotopes Development's support.

The state is engaged not only in the research indicated above, but also participates in the 06 program research of PREC, particularly in the Terrestrial Ecology Program, the Parasitology Program, and the Resonance in Radiation Program. Cooperative research with various agricultural institutions in Puerto Rico and in Central America (via the U.S.-ABC Atoms in Action Exhibit) continues,

International Atomic Energy Agency Exhibit: PRNC is participating with ORINS of the Central American Commission for Co-operation and Research for operation of the gamma source and neutron source and for developing

the research program in physics, chemistry and biology in which these sources are used,

oe Exhibit was inaugurated in San Salvador, El Salvador on February 23, 1965. Research work undertaken under the PRNC program included the uses

Of gamma radiation in entomology, genetics, food preservation and dosimetry.

A total of 964 samples were irradiated using the Cobalt-60 gamma irradiation

Facility of the Exhibit; this was the largest number of samples irradiated

using an AEC International Exchange,

The research program undertaken in El Salvador has a close relationship

With PRIC research programs at Puerto Rico and is also related to the

Agriculture and the economy of El Salvador. Five PRN staff members and

two technicians travelled to San Salvador during the Exhibit. Detailed

follow up programs in entomology and genetics have been planned. Similar

programs will be continued for the next three years that the Exhibit will

be in Central America,

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

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five times @ 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 established. The research program,

all of which is built around the graduate activity, is being developed

under the sections:

## 1, Organic Chemistry

a. Synthesis of compounds of interest to the nuclear field,

especially medicine and radio-biology.

b. quantitative study of organic reactions utilizing

radioisotopes.

## 2, Solid State Physics of Organic Crystals (Sponsored by ABC Division of Physical Research).

This section studies the effect of neutron and of gamma and X-ray

radiation on the photoconductivity of organic crystals. Measurements

have been limited to anthracene crystals; plans are being made to extend

the work to other organic crystals.

The indications are that the program of this Division will attract all  
Of the graduate students for whom laboratory space can be provided.

A temporary structure has been erected outside the Bio-Medical Building  
which can house eight graduate students.

Clinical Radioisotope Applications: The Clinical Applications Division

offers three types of courses for education and training

of physicians; maintains diagnostic services at the Puerto Rico Nuclear  
Center to support its teaching program; operates the Radioisotope Laboratory  
at the University Hospital for the Medical Staff of this Hospital; col-  
laborates 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.

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:

4, Formal instruction to physicians who want to become qualified radiation

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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, Inservice training for nurses, technicians, and radiological physicists

Medical Sciences and 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 previously existed in the Division of Radiobiology is being continued,

#### 1, Midgee Culture Program

The first phase in the program was 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.

Beginning in February-1964 and extending through February-1965 several radiobiological studies were instituted with tissue culture cell lines. Concerning these are the studies of the intracellular capture of neutrons by organic compounds containing B-10. The organic chemistry section of the Radioisotope Applications Division has been preparing a series of new boron compounds which are described in the associated Form 289.

IZ, Indigenous Viruses and their Radiation Induced Genetic Variability

TIT, The use of gamma radiation to modify *Schistosoma Manson cercariae*

?0 that they induce immunity to attack instead of causing disease,

?Toe procedures outlined in the proposal are, st this stage, directed towards:

(1) defining useful parancers for assessing the effects produced and

(2) comparing the effectiveness of different approaches to the provlen.

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?This program is scheduled over a tuo year perio?, by which time it will

bbe possible to decide along wha: lines any furtker research might best

be pursued, the hoped for enc y.. dt being a contribution to knowledge

which may eventually help i: conbating the dlecase.

echnical Services (Rfo Piedras): ?This section has charge of building

BeSpeseeh irate Siocrest tne operetion of e anal eletrrente shop

fang general instroental repair. Shop services in general and engineering

supervision are supplies by the Mayaguer branch.

Technical Services (Mayaguez): The Division is responsible for maintenance of all buildings and general service facilities and for operation of the machine shop, carpenter shop, electronic shop and glass blowing shop.

For maintenance, a detailed schedule based on punched cards has been established and has proven to be very effective. It is being constantly revised to cover equipment not previously included, particularly new acquisitions.

The shops provide services on a cost basis for non-maintenance tasks.

The largest operation this year was construction and installation of special partitions and equipment for the Latin American Nuclear Energy Conference. Addition of an electronics engineer has improved services available in the electronics shop. The glass shop is now being operated by personnel trained by our former scientific glassblower, who has returned to the United States. Glass shop service now provided is quite

Sefactory, anda trainee from the Atomic snerey Commission Laboratory  
in Colombia is expected soon.

Mo immediate changes are contemplated as a rev shop building is schedule!  
for construction in 1966, We expect to provide the recssury personnel  
for precision and vacuum quality work which the new facilities will make  
possivie,

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PROGRAM 05

Resonance in Raiiation Fivects: The studios on radietion effects produced  
?ea function of vavel- jth have been extended to cover genetic damage,

in addition to the continuation of studies on inactivation of enzymes,

A three-fold increase in chromosome breaks has been demonstrated in onion root tips labeled with BUdR, when irradiated first below and then above the K absorption edge of bromine. Work on carboxypeptidase with various ethyl labels is continuing, and studies on *B. coli* have been initiated.

It appears that the total radiation effect depends on the site of initial absorption of the photon, for systems in which selected heavy atoms are incorporated into an otherwise light atom structure.

In support of the biological studies, development of new high-intensity low-photon-energy sources, using field emission techniques were initiated. Also, we have started study of photon focusing systems in the low energy range using total reflection techniques. To improve dosimetry, development of a high sensitivity calorimeter has also begun, in collaboration with the Health Physics Division.

This program operates in close collaboration with similar studies on radiation effects in alkali halide crystals, a part of a physics program within the geology division of the U.P.R., Mayaguez

Physics

**Marine Biology:** This program, started in 1962, is designed to provide information on the distribution and movement of trace elements in selected but coupled ecological and biogeochemical systems. It includes detailed studies of the marine biosphere and hydrosphere as well as limited studies of the Lithosphere. Studies are made on land, on the sea, and in the sea. The geographic area under investigation centers on the west coast of Puerto Rico, with particular emphasis on the area surrounding the site of the BOMUS project, but extending for marine observations along the north and south coasts and to the eastern extremity of the island.

Three rivers drain into the Culebrinas Passage, marking the west coast of Puerto Rico: the Culebrinas north of Rincén, the Afasco, south of Rincén, and the Guanajibo south of Mayaguez. Each drains a watershed with a different type of soil system, permitting comparison, in small geographic areas

of significantly different trace element distributions on and off

shore. Greatest effort up to now has been in the Affagco River valley

fant outflow area, with the others developing rapidly.

A complete spectrum of physical techniques has been brought to bear on  
?these problems including tracing of natural and fall-out. radioactive  
elements, and stable elements studies using neutron activation analysis,  
stoichiometric absorption and flame spectrophotometry, calorimetric and fluorimetric  
analysis, x-ray emission analysis and structural analysis using x-ray and

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neutron techniques. Recent acquisitions of mass spectrometers will  
open this area, particularly for isotope ratio studies.

?Analyses are applied to inorganic materials on land and from the  
bottom of the sea and to samples taken at all points in the food  
web.

This program has particular significance in the present period of developing use of nuclear energy. It is vital to our knowledge of the fate of radioactive materials from tests, nuclear plant outflow, accidental discharge, waste disposal and the proposed large scale use of nuclear explosives for earth moving.

Paramutation: Genetics regulatory systems which control gene mutation have been investigated with emphasis given to the paramutation system as it occurs in maize. Radiation treatments of the components of the system have indicated that the type of change which occurs is an inactivation process rather than a true mutational event. Radio-sensitivity curves of the regulator responsible for paramutation change have been obtained. Additional sources of paramutation induction from South American sources have been evaluated and found to be generally associated with variegated aleurone types. A final report for this project, which will terminate in June 1965, is being prepared.

Induced Sterility for Population Control of the Sugarcane Borer in Puerto Rico: Gamma-induced sterility effects, artificial: cultural methods, and behavior have been studied to determine the suitability of the

method of sterile male population over-flooding for controlling or eradicating *Distra saccharalis* (Fab.) (Crambidae, Lepidoptera).

Dosage-effect. Studies have shown that adult males can be effectively sterilized at 18 kilorads, and at 14 kilorads in virgin adult females.

?Adult longevity and oviposition is not affected by radiation below

70 kilorads. Mortality dose for larvae is between 2 and 11 kilorads,

and development is abnormal at dosages needed to produce sterility.

Pupal development is adversely affected by dosages of 8 to 12 kilorads without induction of sterility. The artificial culturing methods

developed are adequate for present needs and mass-rearing methods are

under investigation.

Terrestrial Biota, van I: Radioecology of a Tropical Rain Forest:

The rain forest irradiation project was started in the Spring, 1963,

with the objectives of determining effects of gamma irradiation on the

over montane rain forest near El Yunque and the movement of chemical elements of fall-out in the normal biogeochemical cycles. An area in the Luguillo Forest Reserve provided by the U.S. Forestry Service has been developed with trails, towers, instrumentation, electric power, and work facilities, A group of 12 participating investigators from

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other universities began a year of measurements preceding irradiation.

The project now involves 65 phases with 15 resident scientists and

student assistants. The effect of irradiation will be assayed by measurement of animal noises, vegetation density to light, plant and animal

Populations, changes in microclimate, localized effects, cytogenetic

effects, and changes in chemistry and fallout. A 10,000 curie Cesium 137

source was installed on January 19, 1965 and the irradiation was completed April 27, 1965, study of the effects produced by the irradiation

began on this date. Fall-out elements are extractable with existing

levels of activity and with tracer experiments. The level of fallout held in the vegetation is relatively high indicating the effect nutrient holding

ability of the vegetation.

## Terrestrial Zoology Program IT: Radiation Induced Variability

work on the regular

study area was continued with successful mosquito and rat trapping and bleeding taking place at regular intervals. It is hoped to have a clear picture of the arboviruses present in El Verde before the radiation source is added. No viruses have as yet been encountered in the El Verde material.

The Mechanisms of anti-radiation immunity in the inoculation of

Mice with Irradiated and Normal *Schistosoma mansoni* Cercariae: Approval

This program was received in December, 1963, and the first preliminary experiment designed to determine the number of sexually paired cercariae necessary to induce a standard infection is underway. A modest mouse colony is available and cultivation of host snails for the program has also been started. Previous work indicated an acquired resistance to challenge with virulent *Schistosoma mansoni* cercariae after infection by cercariae which had been damaged by exposure to gamma irradiation. When the optimal experimental procedures have been established, it is intended to make a detailed study of all detectable reactions occurring between

the challenging parasite and the "immune" host.

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?PROGRAM 03

Neutron Diffraction Program: The Neutron Diffraction Program has undertaken work on magnetic ordering and on the determination of light atoms in the presence of heavy atoms} the two fields in which the neutron technique has provided unique contributions to solid state physics and chemistry.

Magnetic work has been undertaken with the cooperation of Brookhaven National Laboratory personnel, The structure of Fe<sub>3</sub>SiO<sub>8</sub>, has been solved and Fe<sub>3</sub>O<sub>4</sub> and CuCrO<sub>2</sub> are under investigation.

?the structure of Ca<sub>2</sub>SiO<sub>4</sub>, (a laser matrix) has been determined as part of the program of determining the positions of light atoms in the presence of heavy atoms. Under investigation are d-tartaric acid and its hydrogen

bonding and Cu Formate  $\cdot$  H<sub>2</sub>O which becomes antiferromagnetic at 17°. Preliminary diffraction results indicate disordered hydrogens, and dielectric constant measurements indicate a hitherto undiscovered phase transition at GBC which may be associated with the disorder. Work will continue on Geuterated material and other hydrates with interesting physical properties.

In addition to the PRNC personnel and Brookhaven employees that initiated the project and have continued to cooperate with it, Dr. K. Okada, a

solia state physicist from Nagoya Institute of Technology, Japan, is completing a two-year stay; Dr. i. Bielen, a German government scientist, spent two years here; and Dr. D.7. Croner of Lot Alanos Scientific Laboratory is spending a year at PRIC to work on alum structures.

sts  $\phi$  in Organic Crystals using Electrical Conductivity:

Effects of neutron, gamma, and x-ray irradiation on the electrical conductivity of anthracene crystals are under study. Initial phases of the study have been limited to changes in dark and photoconductivity produced by neutron, gamma, and x-ray irradiation which apparently knocks out hydrogen atoms from the crystal, Electrical conductivity was selected because evidence indicates this parameter is most sensitive to the presence of impurities or defects, Another phase of this investigation will include

a more precise and direct technique for determining trap densities and

Geptns by measuring mobility and conductivity se a function of temperature,

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Non U.S. Students at PRNC

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Oriel Alva

Ernesto N. V. Anadey

+ Incas C, Di Rienzo

Héctor Miguel Forcher

Aldo Ernesto Lanazo

Jorge R. Uper Verde

+ Marcelino Angel Riepoli

Dolores A. Virques Retomazo

= Manuel J. Caused

Miguel Mazzet Marino

Marcelo Bertholds

BOLIVIA

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José Forno Arce

Mario Vaksanoviec

. Pedro Vargas Fernández

Zoilo Cordero Video

. Enrique Benavides Velasco

+ René Balderas Idpez

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6, Tealo Yanai CSrdova

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1, Jorge anaye Paigerta

2. César Arango Jaramillo

3. Alvaro Ariza Tondotio

Cecilie Arredondo Alba

5. Antonio Barragia

6. nts Guerrero Anonacia

7, Mansel Gummén Jurado

8, Alberto Jiménez Sécnez

9. Arecio Pefolaza

20, Santiago Pinto Vege

31. Guitleme Podrfguer Figueroa

12, Alvaro Roses

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5. Carlos Victor Wheeler

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4, Leonor B. Oroase Tépex

5, Fausto Mutiloz Ribedenoira

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1, Vicente Alejanro Rodriquez

2, Marina M, Salazar Barehone,

3. Oscar Nave Rebolis

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2, Willie Bhagan

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1. Rodolfo Aguilera Cuenca

2, Antonio Bosch

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4. Alfonse 1, de Garay y Castro

5. Peter L, Foerstadt Sicnel

6. Senén 2. Gonzéies Corona

7. Victoria Goneflex de) Agaila

8. Juan Tartigue Gordtlio

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22, Oractela Maytorena Serna

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## PARAGUE

2. Victor M. Duarte Yolinas

3. Margarita Lipex Borjas

4, Mario Agiayo Zayas

5. José M, Galiano Gonadlex

6. Bernardo Troche Bos

Antonio Bilin

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7: Jorge K, Ronn caldersn

8, Jorge Brnesto Diaz Gerefa

9 Roberto Lépez Tharra

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BL, René J, Pinelo Molina

12, Angol C. Rey Sdachex Gignoux

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1, Francisco Lantagora

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1, Rafael Gonsdles Magsenet

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Author

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Cancer Morbidity in

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The Importance of Cobalt

Teletherapy in a Radio-

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Cancer

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Hematology

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?Symposium on Health  
Physics in Biology and  
Medicine- May, 1958

Ban Juan, Puerto Rico

International Cancer  
Congress, 1958  
Tendon, England

Meeting of the Puerto  
Rico Medical Society-  
Sotomayor, 1958

Ban Juan, Puerto Rico

Interamerican Congress  
of Radiology- Yaguajay, 1958  
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Sen Juan, Puerto? Rico

56th. Annual Meeting of

?the Medical Association

Of PLR. Nov.) 1959

San Juan, Puerto Rico

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Dr. AM. Andino

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?The Absorption of Gamma

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Cancer Control in Puerto

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The Demonstration of

Chemical Principles by

the Use of Radioisotopes

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Rico Nuclear Center

1960

The Thorium Isotopes

Method for Dating Marine

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An Experimental Study

of Fatigue in Photo-

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A Practical Method for

?the Compensation of  
Fatigue Effects

Radioactive Iodine  
Treatment in Hyper-  
?thyroidism

Place Presented

Teh., Latin American  
Chemical Congress  
April, 1959  
Mexico City, Mexico

Ast., Latin American  
?cancer Congress  
October, 1959  
Buenos Aires, Argentina

56th. Annual Meeting of  
?the Medical Association  
of P.R., Nov.» 1959

San Juan, Puerto Rico

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April, 1959

Mexico City, Mexico

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Mexico City, Mexico

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Chemical Society-  
September, 1960

New York,

80th. Annual Meeting of  
the P.R. Chapter of the  
American College of  
Physicians Oct. 1960  
San Juan, Puerto Rico

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Suspensions in Different  
Hematologic States

1961

The Puerto Rico Nuclear  
Center Research Reactor:  
Characteristics and  
Program Plans

Place Presented

Sectional Meeting P.R.,  
Chapter of the American  
College of Surgeons-  
August, 1960

San Juan, Puerto Rico

Conferences on Society  
Culture and Health in  
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New York

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20th, Annual Meeting of  
the P.R. Chapter of the  
American College of  
Physicians- Oct., 1960  
San Juan, Puerto Rico

PLR, Medical Association  
Meeting- November, 1930  
San Juan, Puerto Rico

Symposium on the Program  
Planning and Utilization of  
Research Reactors  
October, 1961

Viena, Austria

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Dr. Henry J, Gomberg

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Cytology in Cancer of the  
Gervix-Uteri

Radiotherapy for Advanced  
Cancer: Cancer Control  
Progran in Puerto Rico

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Carcinoma of the

Esophagus

Place Presented

Meeting of the American

Nuclear Society-

June, 1961

Pittsburgh, Pennsylvania

2nd. General Session of

the American Public Health

Association, 89th. Annual

Meeting, Nov. 1961

Detroit, Michigan

IAEA, Regional Symposium

on Biocuration and Nuclear

Energy- November, 1961

Bariloche, Argentina

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of Lectures on Nuclear

Energy- October, 1961

Chicago, Illinois

?Annual Meeting P.R.

Chapter of the American

College of Surgeons-

February, 1962

San Juan, Puerto Rico

Let. National Cancer

Congress- 7th Radio

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Society Meeting- Sept., 1961

Miami, Florida

?Teh, Interamerican

Congress of Radiology-

September, 1962

Sao Paulo, Brazil

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Annual Meeting of the  
Radiological Society of  
North America- Nov., 1961  
Chicago, Illinois

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Conference April, 1961  
University College of  
the West Indies  
Kingston, Jamaica

2nd. Annual Meeting of

the University of T.S.,

Journal of Medicine

Volume, 296

San Juan, Puerto Rico

Caribbean Chemistry

Conference. April, 1962

University College of

the West Indies

Kingston, Jamaica

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Dr, Antonio Bosch

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Dr. Juan Pacetti

Chemistry ix Zetin America

Application of Atonie

Snery in Agriculture

Carcinoma of the Anterior

?Two-Thirds of the Tongue

Carcinoma of the Skin

Overlying Cartilage

1962

Comparison of Rod Worth

?vy Period and Analog

Computer Methods

Elimination of Control

Hod Vibration Caused by

ater Flow

Effects of L-Triiodo-

?thyronine in Altering

the Response of Kidneys

to Cobalt-60 Irradiation

Photochemistry of Thynine

Solutions

Distribution of Radio-  
active Antimony Formed by  
Nuclear Transformation  
of Antimony Oxides

Lev. Intersmerican Congress  
of Chemical Engineers  
October, 1961

Ban Juan, Puerto Rico

In response to joint  
invitation of ABC and  
the Governor of Nebraska-  
October, 1962

Lincoln, Nebraska

Annual Meeting of the  
P.R. Medical Association  
November, 1961

San Juan, Puerto Rico

Annual Meeting of the  
Radiological Society of  
WeA.- November, 1961  
Chicago, Illinois

Conference on Light  
Water Moderated Research  
Reactors- June, 1962  
Oak Ridge, Tennessee

Conference on Light  
Water Moderated Research.  
Reactors. June, 1962  
(Oak Ridge, Tennessee)

6th. Annual Meeting of  
the Radiological Society

of N.A.- Soverber, 1362

Chicago, Illinois

Colloquium on Photo-

chemical Transformation

of Natural Products, 2nd.

Int. Symposium- Sep.» 1962

Prague, Czechoslovakia.

Eastern Regional Meeting

American Chemical Society

November, 1962

Gatlinburg, Tennessee

---Page Break---

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De.

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veitization of Nuclear

Energy for Civilian

Purposes

Case Report of Patient  
with Carcinoma of Thyroid  
Treated with I-131.

The Use of Radioisotopes in  
The Clinical Evaluation of  
Carcinoma of the Cervix  
Uteri

Polygenic Variability  
Induced by Thermal  
Neutron Irradiation

Effects of Ionizing  
Radiation on Parathyroid  
Gland

Accumulation of Radio-  
nuclides in Marine  
Plankton and their Pas-  
sage through Food Chains

Prognostic Factors in  
Cancer of the Esophagus

Cancer Mortality dn

Puerto Rico

Aspects of Ascorbic Acta

Metabolism in Acerola

Ascorbic Acid Synthesis

Place Presented

?Teh. Convention of the

PAU of Engineering

Socleties- August, 1962

San Juan, Puerto Rico

59th, Meeting of the P.R,

Medical Association

Tovenber, 1962

San Juan, Puerto Rico

tn. Interamerican

Symposium on the Peace-

ful Applic. of Iuclear

Bnergy- April, 1962

Mexico City, Mexico

Annual Meeting of the  
Radiation Research  
Society- May, 1962  
Colorado Springs, Colorado

American Society of  
Agricultural Sciences  
October, 1962

Mayaguez, Puerto Rico

3rd. International  
Symposium on Water  
Pollution- Aug. 1962  
Cincinnati, Ohio

Annual Meeting of the  
Radiological Soc. of P.R.  
at the American College  
of Radiology~ Feb., 1962  
San Juan, Puerto Rico

59th. Annual Meeting P.R.,  
Medical Assoc.- Nov., 1962  
San Juan, Puerto Rico

American Society of  
?Agricultural Sciences

October, 1962

Mayaguez, Puerto Rico

59th, Annual Meeting

Puerto Rico Medical As-  
sociation Wov., 1962

San Juan, Puerto Rico

---Page Break---

Dr. VJ. Medina

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he Influence of Copper,  
Tron, and Form of Nitrogen  
fon Mo99 Uptake in Cajanus

Anaieus

Inelastic Scattering of  
Iron Using @ Neutron  
Source

?Te Thallous-Thallic  
Exchange at Various  
Acidities in Perchlorate  
Media

Sofentific Documentation  
in the Field of Chemis-  
ey

?The Structure of Beta-  
Hydroxysulfides Obtained  
by the Oxidative Addition  
of Thicls to Glefine

The Syzthesis of Intra

molecularly Coordinated

Boron compounds

Scientific and Techno-

logical Resources of

Latin America,

?The Scientific and Tech-

nological Resources of

L.A. and the Alliance for

Progress

?An Investigation of the

Carotenoid Pigments of

?Achiote

American Society of

Agricultural Sciences

Postover, 1962

Mayaguez, Puerto Rico

Meeting of the American

Physical Society

January, 1962

Yew York

Sth, Latin American

Congress of Chemistry

September, 1962

Seminar on Setentific

Documentation in L.A.

sponsored by UNESCO

Septenber, 1962

Line, Perd

8th, Latin American

Congress of Chemistry

Septenter, 1962

Buenos Aifes, Argentina

Gen, Latin American

Congress of Chonistry

September, 1962

Buenos Aires, Argentine

Seminar on Chemical  
Industry of L.A, and the  
Common Market, Oth. L.A.  
Congress of Chemistry

September, 1962

Buenos Aires, Argentina

?The Johns Hopkins Uni-  
versity- April, 1962

Baltimore, Maryland

American Society of  
Agricultural Sciences  
October, 1962

Mayaguez, Puerto Rico

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Dr. Howard J. Teas

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Keto Acids in Some

Tropical Plants

Inhibition of Banana

Fruit Ripening by Geama

Radistion

Hodgkin's Disease: Our

Experience at the Dr. I.

Gonzilez Martinez

Oncologic Hospital

Carcinoma of the Tonsil

Immune Responses to

Trasisted Cercariae of

Schistosoma Mansoni

Dosimetry from Photon

Spectra and Pulse-Height

Distributions

1963

A Neutron Diffraction

Refinement of the CaWO<sub>4</sub>,

Structure

Method for the Isolation

of Thorium from Siliceous

Material

New Results in the Search

for Alpha Particles from

the Thermal Neutron-

Induced <sup>238</sup>U (α, n) <sup>239</sup>U

Reaction

Place Presented

?Annual Meeting of the  
Society for Economic  
Botany- June, 1962  
Washington, D.C.

2nd. International  
Congress of Karyology  
Research- Aug. , 1962  
Harrogate, England

59th. Annual Meeting  
Puerto Rico Medical As-  
sociation Nov. , 1962  
San Juan, Puerto Rico

?Annual Meeting of the  
Radiological Society of  
America, and the American  
College of Radiology  
February, 1962

San Juan, Puerto Rico

American Society of  
Parasitologists and  
the Helminthological  
Society- June, 1962  
Washington, D:c,

2nd. International  
Congress of Radiation  
Research Aug. , 1962  
Harrogate, England

International. Union of  
Crystallography-  
September, 1963,

Healy

2nd. Caribbean Chemical  
Symposium- August, 1963  
Rfo Piedras and Mayaguez,  
Puerto Rico

Physics Department of  
the University of Bonn

September, 1903

Bonn, Germany

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Search for Alpha Particles

from Thermal Neutron-

Induced  $^{238}\text{U}(n, \alpha)$

$^{235}\text{U}$  Reaction

Determination of Dis-

sociation Vapour Pressure

and Structure of Some

Heavy Metal Sulfides

Nuclear Centers in Latin

America: their part in

Scientific Development

?reneient Radiation

Effects on Electron

Eniseion of Kigh-

Recistivity Layers

?Time-Dependent. Schottky

Bnission in Photomiti~

plier Tubes

Photochemistry of

ymine

Magnetic Ordering in Some

Relaved Orthornoubic Cncm

ana Pom Structures

Fat Absorption Study with

131 Labelled Oleic Acid

in Patients with Cancer

of the Uterine Cervix

Receiving Cobalt Radiation

to the Abdonen

Neutron Diffraction

Studies at the Puerto

Rico Nuclear Center

Have Presented

2nd. Caribbean Chemical

Symposium August, 1963

Rio Piedras and Mayaguez,

Puerto Rico

2nd. Caribbean Chemical

Symposium- August, 1963

at Piedras and Mayaguez,

Puerto Rico

Study Group Meeting on

Research Reactor

Utilization

American Nuclear Society

November, 1963

New York,

American Nuclear Society

November, 1963

New York?

2nd Caribbean Chemical

symposium August, 1963

Rio Piedras and Mayaguez,

Puerto Rico

Symposium on Ferro-

Magnetism and Ferro-

electricity, June, 1963

Leningrad, Russia

Thirty Second Annual,

Meeting of the P.

Dietetic Association

San Juan, 1963

San Juan, Puerto Rico

International Colloquium

of Neutron Diffusion and

Diffraction- Sept., 1963

Grenoble, France

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De. Robert A. use

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Actions of 5-Bromourao).)

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Chromosomes

Effects of Radiation on

Paranutation

Radiation Induced Moai-

Pieation of Paranutation

Expression

Use of the PRIC Gamma

Irragistion Facility in

Agricultural Research

Activation Analysts

Method for Scandium,

?Antimony, and Phosphorus

Resonance Radiation Ef-

fects of Lov-Bnerey

Monochronatic X-rays on

catalase

Resonance Radiation Ef-

fects of Lov-Bnerey

Monochromatic X-reys on

?the Mettal enzyme

Catalase

Basic Mechanisms in the  
Radiation Chemistry of  
Proteins and Nucleic

Acids in Aqueous Media

First Presented

at the International

Congress of Genetics

September, 1963

Scheveningen, The

Netherlands

Lith, Annual Meeting

of the Radiation Re-

search Society

May, 1963

Milwaukee, Wisconsin

Lith, International

Congress of Genetics

September, 1963

Bchoveningen, The

Netherlands

Fall Meeting of the

Anerican Society of

Agricultural Selences

Ostover, 1963

Mayaguez, Puerto Rico

2nd. Caribbean Chemical

Symposiun- Aug. 1963

fo Piedras and Mayaguez,

Puerto Rico

Lith, Annual Meeting

of the Radiation Re=

search Society

May, 1963

Milwaukee, Wisconsin

?2nd. Caribbean Chemical

sium Aug., 1963,

Blo Piedras and Nayaguec,

Puerto Rico

Conference on Basic

Mechanisms in the

Radiation Chemistry of

Aqueous Media

May, 1963

Gatlinburg, Tennessee

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Radiotherapy in Carcinoma

of Cervix tert

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High Buergy Gama Paotons-

Neutron Conversion Device  
for Half-Life Measurements

Base-catalyzed Formation  
of Indater

Association Constants  
for Sulfide-Paenol  
Complexes

Longevity of Adult Diet  
saccharalis (Fab.)  
Graminiae, Pyralidae,  
Lepidoptera

Mating Behavior and  
Fecundity  
echaralis

Mating Behavior of the  
Sugar-Cane Borer,

*Diatren saccharalis* (Fab.)  
Grain-borer, Pyralidae,  
Lepidoptera

Place Presented

gt. Congress of the  
Pan Pacific Surgical  
Association  
November, 1963  
Honolulu, Hawaii

Annual Meeting of the  
Weeters Branch of the

Panama Association  
April, 1963

Mayaguez, Puerto Rico

2nd. Caribbean Chenscal

sium August, 1963

Rio Piedras and Mayaguer,

Puerto Rico

?American Physical Soc.

Sanuary, 1963,

New York

and. Caribbean Chemical

Symposiin- August, 1963

Rio Pledras and Mayaguez,

Puerto Rico

2nd, Cariebean Chentoal

Symposiue- Angst, 1963

sfo Piedras and Mayaguez,

Puerto Rico

Felt Meeting of the  
American Society of  
Agricultural Sciences  
October, 1963  
Mayaguez, Puerto Rico

Entomological Society of  
?America Meeting  
December, 1953,

St. Lould, Missourd

Fall Meeting of the  
American Society of  
Agricultural Scences  
October, 1963  
Mayague, Puerto Rico

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oviposition by *Diatrea*

*saccharalis* (Fab.)

Cranbinae, Pyralidae,

Lepidoptera

Rift Valley Fever and

Wairoa Sheep Disease

?Acid-catalyzed Solvolysis

of Some Substituted  $\gamma$

Butyrolactones and  $\gamma$

Valerolactones

Oxidation of Primary

Aromatic Amines with

Manganese Dioxide

1964

Experimental Demonstration

of Neutron Albedo in Water

?A. General Time Effect of  
the Senottry Type

Exeitons and Color Centers  
in Mgo

Weutron Radiation Effects  
fon Solid State Detectors

Place Presentea

Fall Meeting of the  
American Society of  
?Agricultural Sciences  
Octover, 1963  
Mayaguez, Puerto Rico

?ea, International  
Cong. of Tropical  
Medicine and Nalaria  
September, 1963

Bio de Janeizo, brags

end. Caribbean Chemical  
Symposium- August, 1963  
Rio Piedras and Yayaguer,  
Puerto Rico

2nd. Caribbean Chemical  
Symposium August, 1963  
Rlo Piedras and Mayaguez,  
Puerto Rico

YOKIIT Annwal Meeting  
Of the American Assos,  
of Prysice Teachers  
January 20-25, 1964  
liew York City?

Latin American Conference  
on Nuclear Spectroscopy  
fang Solid Stave Physics  
February 24-27, 1964  
Lima, Ferd

Latin Anerican Conference  
fon Nuclear Spectroscopy  
and Golia Stave Physice  
February 24-27, 1964

Lima, Peru

Latin American Conference

on Nuclear Spectroscopy

and Solid state Physics

February 24-27, 1964

Lima, Peru

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De. Robert Stevenson

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Mes Jusn J. Rigas

the

Variation of the Internal

Field Produce by Gama

Irradistion in Tryglycine

Sulfate Crystals by an

Av, Field

Distribution of svl25

Formed in Tin Compounds

by Neutron Capture

Properties, Mechanism and

Experinental Reduction of

Effects of the Time

Dependent, Field Emission

of Photomultiplier Tubes

(ave-32)

Reduction of Fatigue

Effects in Photomultiplier

Nb

?Trace Analysis in Water

from Lake Ypacarai

Investigations in Trace

Element. Distribution in

Marine Water and Sediments

Stable Element Analysis

of Some Marine Organisms

?The Structure of Four

Isomeric 2-Phenyl-

?sulfinylindenes

Place

Latin American Cont.

on Nuclear Spectroscopy

and Solid State Physics

February 21-27, 1964

Lima, Peru

Latin American Cont.

on Nuclear Spectroscopy

and Solid State Physics

February 21-27, 1964

Lima, Peru

Ninth Scintillation and

Semiconductor Counter

Symposium

February 26-28, 1964

Washington, D.C.

Ninth Scintillation and

Semiconductor Counter

Symposium

February 26-28, 1964

Washington, D.o.

Inter-American Symposium

for the Peaceful Application

of Nuclear Energy

March 9-13, 1964

Valparaiso, Chile

Inter-American Symposium

for the Peaceful Application

of Nuclear Energy

March 9-13, 1964

Valparaiso, Chile

Inter-American Symposium

for the Peaceful Application

of Nuclear Energy

March 9-13, 1964

Valparaiso, Chile

Symposium dealing with  
"Organic Sulphur Compounds", Meeting of  
the American Chemical Society,  
April 6-10, 1964  
Philadelphia, Pa.

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Dr. R. Goodman

Mortiner Kay

eA. Young

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Prof. R.B. Knight

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Virus Studies Conducted in  
the Isborstories of the  
PRIC by a Combined Teun  
fron PRNC, the Puerto Rico

Dept. of Health, and the  
U.S. Public Health Service,  
Communicable Disease  
Center, Atlanta, Georgia

Informe sobre 1a Situación  
?Actual de las Revistas  
Chent{rices y Técnicas  
Latinosmoricanas: Química

Polara Anisotropy Centers  
in Ganna-Trradiation  
?Tryglycine Sulfate

Photoreactions of Some  
D.NA. Bases

?A Neutron Diffraction  
?Study of CaN and CaN

Goniostate for Siemens  
and Philips Diffracto-  
meter

X-Ray and Neutron

Refinement of Hydroxi-  
apatite

PREC Engineering and  
Related Activities

Face Presented

British Ninth Scientific  
Meeting- April 13, 1964  
Kingston, Jamaica

UNESCO Meeting - Centro  
de Cooperación Científica  
de la América Latina  
University of Puerto Rico  
April 28 - May 2, 1964

San Juan, Puerto Rico

American Physical Soc,  
Meeting- April 30, 1964  
Washington, D.c.

International Photo-

biology Congress

July 25-30, 1964

Oxford, Engiaza

?Amer. Crystallographic

Association Mecting

July 26-32, 1964

Bozenan, Montana

Amer. Crystallographic

?Association Meeting

July 26-31, 1964

Bozeman, Montana

?fner. Crystallographic

?Association Meeting

Tuly 26-32, 1964

Bozeman, Montana

Bighth Convention of

?the Pan American Union

of Engineering Assoc.

(uraDr)

August 17-21, 1964

Caracas, Venezuela

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De. Manuel Pantagua

Migs Zonaida Prius

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Dr. Vfctor Marcial

De. vfetor Marcial

Dr. victor Marcial

Dr. José M. ?Toms

Dr. Jeanne Ubifias

mate

Evaluation of the Renal

Condition in Diabetics

Using Radioactive Isotopes

Cancer of the Anterior

2/3 of the Tongue

Management of Cancer of the

Uterine Cervix Associated

with Pregnancy

Pre-radiación Pre-operatoria

Radioterapia Convencional

y Supervoltaje

Significance of the Pres-

ence of Fxfoliated Tumor

Cells in Cases with

Carcinoma of the Uterine

Cervix after Radiation

Therapy

?The Radiologist & Cancer

Contre Activities in a

Community

Cancer of the Nasopharynx

Cancer of the Tonsil

of Mucosal Biology and

Medicine- Sept. 21-25,

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Bao Paxio,

earl

Sta, Inter-American

Congress of Radiology

October 2-9, 1961

Caracas, Venezuela

South, Inter-American

Congress of Radiology

October 2-9, 1964

Caracas, Venezuela

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Congress of Radiology

October 2-9, 1964

Caracas, Venezuela

Beh, Inter-American

Congress of Radiology

October 2-9, 1964

Caracas, Venezuela

North, Inter-American

Congress of Radiology

October 2-9, 1954

Caracas, Venezuela

8th, Inter-American

Congress of Radiology

2-9, 1964

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8th, Inter-American

Congress of Radiology

October 2-9, 1964

Caracas, Venezuela

8th, Inter-American

Congress of Radiology

October 2-9, 1964

Caracas, Venezuela

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Mr, Miguel Figueroa

Dr. Juan Pacetts

Mise Blofee Trabal

Mr. Sigfredo Torres

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Tile Place Presented

Prognosis in Adenocarcinona Sth, Inter-American

of the Uterine Cervix Congress of Radiology

October 2.9, 1964

Caracas, Venezuela

Agricultural Applications Caribbean Food Crops

of the PRIC Cobalt-60 Gamma Society Meeting

Irradiation Practice October 18-24, 1964

Bridgetown, Barbados

Extending Shelf Life of Caribbean Food Crops

Mangoes with Irradiation Society Meeting

October 18-24) 1964

Bridgetown, Barbados

Significance of the Presence Sixty-Second Annus)

of Exfoliated Tumor Cells Meeting of the Puerto

in the Vaginal Smear in Rico Medical Assoc.

Patients Treated with November 12, 1964

Radiation for Carcinoma of San Juan, Puerto Rico

of the Uterine Cervix

Significance of Scinti- 1st. Argentinian

graphic, Clinical, and Symposium of Nuclear

Pathologic Studies of Medicine

Mayroid Nodules February 19-21, 1964

Mendoza, Argentina

Induced Sterility of Entomological Soc. of

*Dintrea succcharalis* (Fab.) American Meetings

by Gamma Radiation Nov. 30 - Dec. 3, 1964

Philadelphia, Pa.

Thermal Annealing of Annual Winter Meeting

Neutron Irradiated of the Amer. Nuclear

Antimony Compound Society

Nov. 30 = Dec. 1964

San Francisco, Cal.

Cancer of the Mouth and 2nd. State Odontological

Pharynx, Diagnostic and Can. Division of Oral

Treatment Problems Health of the Commonwealth

of P.R. Dept. of Health

December 9, 1964

San Juan, Puerto Rico

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PRNC Weekly Seminars

Bivisson®

Dr. José A, FerrerMonge

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Dept. of Biology, U.P.R.

Dr. Herminio M. Braz

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Mr. Julidn Roiadn

?Agricaltaral Experiment

Station, Rfo Piedras

and

capt. Charles R. Angel

U. S. Army Tropical Research

Medical Laboratory

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UPAR.

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TUTE of TECTURE

Radioactive Iron 39 in Tropical  
crops

Biological Dosimetry

?umor-host relationship studied

4p vivo and in vitro

Kinetics of the T (1)- (112)

Exchange in Perchlorate Media

Exfoliative Cytology in the

Evaluation of Radiation Response

of Cancer of the Cervix Uteri

Recent Investigations on the

maturity of sugar cane in

Puerto Rico

?Te Concept Temperature

me Physics of Radiation

Detection and Mearurements

Serological Diagnosis of

Bilbarsioeie

Irradiation Injuries to Elastic

Arteries

the Van de Grasff Generator  
and its Applications

Coronary Artery Disease

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Radiotherapy and cancer

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De. J. L, danela de guew.

Acsoziate Darestcee

Dr. Gustave ?andeine

sof Biology, UFLFe

nto

Biology Department, U.P.E.

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Radioisotopes appli.

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Radioisotopes Appli

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World-wide Fallout in Marine

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Change in Crystallinity of

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