PRNC70

PRNC 70

PUERTO RICO NUCLEAR CENTER

RESEARCH AND TRAINING

OCTOBER 2, 1957 ? DECEMBER 91, 1963)

(OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT

NO. AT (40-1)-1833 FOR U, S. ATOMIC ENERGY COMMISSION

---Page Break---

1

J TABLE OF CONTENTS

---Page Break---

PUERTO RICO NUCLEAR CENTER

Following the rapid evolution of miclear weapons, it becase pot
sible to devote incressing resources to the non-nilitary applicatios
of atonic energy. In 1993, Presiaent Dwight by Eisenhower Proposed 10
Bho United tations General Aeseably that the nuclear powers, sho
sociate in this effort under the aegis of the United Nations. ?The
United states forthwith began a ceries of moves in compliance with the
International comitaent. ?Bilateral agreenenta with over 30 nations
wore made to form the basis for effective international cooperation in
Feactor development with special reference to mclear power. ?The first

Geneva Conference in 1955 involved the massive deciaseification of Feactor technology and mich fundanental information concerning miclear reactions and thelr physical constants. ?The value of international cooperation being evident fron this conference, the next step was the establishment of the International Atonie Energy Agency as a special agency of the United Nations.

Mach of the early program involved the Buropean nations, Rissia, United Kingdom, Canada and the United States; countries that had had?a ?rch and development interest in the field since the substantial resi beginning. Nuclear power development was pushed vigorously in the United Kingdom while in other countries the greater availability of fossil fuels permitted a broader exploration of reactor concepts before

the selection of the types most profitable to exploit.

Although the prospective need for nuclear power in latin America

seened rather renote at the time, it was the general opinion that the

countries comprising Spanish and Portuguese speaking America would

eventually find thenselves confronted with the necessity of moving to

In the meantime, substantial inmediate advantages should

muclear power.

accrue from a vigorous atomic energy program in general scientific de-

velopment, and especially in medicine and agriculture.

At the 1956 Panama meeting of the Organization of American States

President Eisenhower urged action by the Organization of Anerican States

to hasten the beneficial uses of nuclear energy. As part of its effort

to this end, a study of the needs and potentials of Latin American

countries was made by Admiral Paul Foster, then Deputy General Manager

This indicated the great

of the United States Atomic Energy Commission.

need for technical training in a latin American framework to make avail~

As a result of

able the latest knowledge and technology in the field.

the study and his conferences with the officials of the University of Puerto Rico, Admiral Foster reconmended to the United States Atomic Energy Commission the creation of a Niclear Center in Puerto Rico to be managed by the University of Puerto Rico. The recommendation was approved by the Commission and by the Department of State.

Joint planning studies were initiated by the University of Puerto Rico and the United States Atomic Energy Commission (USAEC) for the

---Page Break---

proposed Muclear Center. Tue responsibility for implementing and Administering the contract for the new Center was assigned to the Oak ~ Ridge Operations Office whose Operations Manager, Mr. Sam Sapirie, negotiated vith the University the contract which gave eubstance and direction to the original concept.

As part of the forvard planning, the Tenth Oak Ridge Regional Symposium was held at the University of Puerto Rico in Jamary, 1957. In an address to the Symposiun, Chairman Lewis L. Strauss of the Atonic Energy Commission said: "The broadened progran will provide the University of Puerto Rico with unique training and research factliti And because these facilities will be truly outstanding---the most up-to-date in concept and design---and because the instruction vill be in

Spanish, the University of Puerto Rico may well become a training center to many countries of the hemisphere. I can tell you that we will co-operate enthusiastically in the expansion".

By January 23, 1957, Chancellor Jaime Benftez had appointed an ?Aa Hoc Comittee of the University faculty to explore the developnent Of graduate work in the natural sciences at the University of Puerto Rico, with particular reference to possible developnents in the field of nuclear energy. Menbers of the Committee were:

Dr. Marston Bates, Chairman, Director of Research

Dr. Conrado Asenjo, Departuent of Biochenistry, School of Medicine

Dr. Anador Cobss, Department of Physics, Rlo Piedras

Dr. Mariano Garcfa Rodr{guez, Department of Mathematics, College of Agriculture and Mechanic Arts

Dr. Victor Rodr{guez-Ben{tez, Rim Pilot Plant

Mrs. Marie Barton, Executive Secretary

?me Ad Hoe Coumittee recomended to Chancellor Benftez the
establishment of graduate studies and research at the University as
gptsblinment of S time graduate studies and research are necessarily
fhe Committee font, that Qirther recomended that the proposed mcleat
seeteeP eel located in Nayeguer.

ntscipating te forse conclusion of 8 contract the USABC
awarded a grant of $216,950 to the University of Puerto Rico to purchase

f i Genter in Ro Petras

equipment for the Radioisotope Techniques Training
E23) to establish @ program in Nuclear Science and Technology at Mayaguez.

en
t AT-(40-1)-1833 to operate the Nuclear Center on
Scie opt Unicel wae, Se et ?rae
fee pronto eo rable et Ee, Roa
Sie em re ieee ay ete
fre Doge ge fe er aaa otce in hee,

Representatives of t

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feenntner to sou snrste ting vlog i he Cran

?The goal of the Puerto Rico Nuclear Center (PRNC) is to de

oe vig Roe Rhus crt (5) it vee

copes States Ptre re ee cis ma eet

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riculture, industry. ?These programs employ the Spanish ?ane

SASL PT eee

?he University of Puerto Rico is itself a charter member of the Union of latin fneflenn Universities and at the tine of te estabhish= font of the Buereo Rico Miclear Genter there were 313 staente from 19 herican Repuviice in ite stuant body. ihe total enrolinent of the University of Puerto Rico during the academic year 1956-57 we approxi- ately 16,000 with AML tine Faculty of 1,c8%

Dr. Charles F. Bonilla, from Colunbia University, agreed to serve ae Director of the Puerto Rico Muclear Center for two years beginning October 16, 1957; Dr. José L. Garcfa de Qievedo was appointed Head of Research and Head of the Reactor Division; Dr. Anador Cobas was 94 pointed Head of the Radioisotopes Division; and Dr. Fred Soltero was named Head of the luclear Science and Technology Division.

The first meeting of the complete PHIC staff vas held on
Jamery 17, 1958, and an organization plan was discussed. Professor
Warren Miller, Director of the Nuclear Technology Progran at
Pennsylvania State University, gave a seninar and acted es consultant
to the staff.

on July %, 1958, groundbreaking ceremonies for the Reactor Pail
ing of PRNC were held in Mayaguez with Dr. Milton Bisenhower acting as
official representative of the U.S. Government.

?An 8000 curie Cobalt-60 Therapy Unit was installed in April, 1959,
at the Cancer Hospital where it remained until transfer to the Bio-

Medical Building in early 1963.
Dr. Charles Bonilla returned to Columbia University at the expira-
tion of his leave of absence in September, 1959 and Dr. José L. Garcia
de Quevedo served as Acting Director until July 1, 1960 when Dr. John
Bugher is a menber of the Rockefeller

C. Bugher was appointed. Dr.
Foundation and is on loan to PRNC at the request of Chancellor Benitez.
Deputy Director in

Dr. Henry Gomberg joined the Nuclear Center as

October, 19651.

?On August 23, 1960 the PRNC Research Reactor was dedicated with

Chancellor Jaine Benftez acting as Master of Cerewonies. Anong the

distinguished quests at the dedication were Senator Hickenlooper of the

Joint Committee on Atonic Energy, Mr. Robert B. Wilson, Comnissioner of

the Atonic Energy Commission, and Mr. Sol Luis Descartes, Vice-Presiicnt

of the Banco Crédtto y Ahorro Poncefio.

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new Puerto

1961. In

?spital was

?me first section of the Bio-Medics

?ane Of PRC to

Rico Medical Center at Rfo Piedras was gccupsee

Fascarg, 1963, the Dr. I. Gonzhlez Martines Oncologie Ho:

Ynaugurated and it became possible for the ?medical progr?

be more effectively consolidated

?the Marine Biology and Oceanography Progran "2, greatly benefited
by the acquisition from the U.S. Amy of 2 200 Son ?Diesel propelled
vessel. It was renamed the ff the distinguished
harine biologist, Bell Masayu
rach in Mexico in 1958. This vesse
Elapted to the requirements of the ocean-s0:

me ecological studies of the Luguillé
made possible by the U.S. Forestry Service
Teast for the Terrestrial Ecology Program.

me years covered by this condensed report were Ct°%,
tion of facilities at several locations, of Secruituent and training of
otro and of the continual expansion of he. ?Shucational activities into
states the disciplines to which nuclear reactions Oot relevant. As the
Jear ended, PRNC was a vigorous and volt eeGnded institution, operating
year eee tine campuses of the University of Pucrto ?Rico and active in
on al) One science departaents of the Univers fy. Froa the small nucleus
sit Greonnel who had had the courage to invitee the new project, the
of perpen grown to a total of 226 persons BY HRC end of 1963. ?The
Siysical plant was completely operstive "Ot, ?the program had expanded £0
physicet rapidly than the available space net SAN jaboratories had to
much tained in University buildings end temporary structures had to be

ing activities.

erected to house the growil

PROGRAMS

the Puerto Rico Nuclear

In the first year of the operation of

center, it vas necessary to conduct @ considershie portion of the train-

{eg program at the undergraduate level. With the growth of the Univer-

re 7oeraduate program, it was feasible to incorporets Tat, ?of these

etry courses in the regular undergraduate curricvtay and to replace

{hon with work at the graduate level in the Nuclear Center

iki Shimada, who lost

a has proved to be excellently

ving operations of PRNC.

o Experimental Forest were

?which provided an extensive

of construc-

?as a further expression of policy, it became generally accepted

that the Puerto Rico Nuclear Center should function as 6 extension of

iret arious scientific departments having graduate progrens # that

graduate students would approach the Nuclear Center ?through the normal

sreuaion procedures of the University. Each graduate student conse

Giontly has his proper acadenic hone under the general guidonce of the

eee y is department, with members of the Puerto Rico Nuclear Center

staff participating on the appropriate committees.

---Page Break---

?The creation o:

stton of the new Department of Nuclear Engineering in the

Gellege of Engineering completed a structure in vhich there is a

aepar University corresponding to every phase of graduate

ediication and training in the Nuclear Centers

At the date of this report, the

. 1s report, the graduate prograne are opera

gt the Master of Science invei aithoughn sone of the Departaente wiht

be prepared to\ operate at the doctorate level in the not too Suevant

fistrer"?Gince a?thesie ie pert of the reqaisenente,for'a matter cf

ee degree, every graduate etudent taking work in the Tuclear Center

4s expected to? complete « reasonable research problem as part of the

quired vork. ?The protien is selected in consultation vith the student

and hie advicor:

to problens of

ielding @ reasonable solution in the tine available,

sociated vith the degree prograns tends to be nore restricted in

scope and requires more innediate supervision than does that conducted

at the post-doctoral ana long term project level

?Thesis research

In accordance vith the policy of considering graduate education as

high-level training, a large part of the research capacity of the Puerto Rico Nuclear Center fas been Increasingly aveorbea in thesis research conducted by candidates for M.S. degrees. Generally the research problems selected are those of direct concern to the United States and especially to Puerto Rico. The graduate student or visiting scientist who cones to the Puerto Rico Nuclear Center, works on problens whose nature and dimensions he can study at first hand and where the results of his research may be put into perspective together with all of the other factors that compose the problem. Thus, for example, he learns about reactors, their design and operation, and the economic and

engineering problems that must be solved if practical pover production He conducts his studies in an environment where he

is to be achieved.

can observe a power system vhich, at a high level of efficiency, exploits hydroelectric, fossil fuel and nuclear power plants, all subject to the same bases of economic analysis and all feeding into the same pover grid. He can observe, if he wishes, the interrelations of rural electrification, small industries and agriculture, all with unsolved problens and, in some instances, essentially with the sane dilemmas ?that he finds in his own country.

The Nuclear Center thus does not attempt to tell the student or visitor what the solutions to his country's development problems are; rather he participates in a Puerto Rican effort to solve what are fundamentally U.S. problems: In special cases and where the circun-

scientific problen of

stances are favorable, the student may work on &
primary importance to his own country but this is the exception rather

?than the rule.
The concept of "training" has been extended to a much higher level

of performance than is usually meant by the term. Graduate education

and its associated research become in themselves training at a mature

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level. In the process, the studer

iefional probiens and to project possible Pros

national Precientific output of his work becowed,

theme Tae Sone of this work may have en SPErect

with time, fotood example of values obtained tn

Yon of spoilage of tropical frui

studies of retardati

Shues of radiation. The arrest of ripen!

Gan permit a marked reduction of losses

can Peret refrigeration. ALL of this york has bees

mene tgrand can continue for a considerable period o

future

under the Education and Training Program there 48 % oubstantial

vorun ae tests research which 46 oriented to the needs of Fe graduate

volume of ney of the major problens of modern science are noe ?well

{"projects vhich can be effectively

Gdapted to sub-division into sual

adapted to sup dclate students. Inevitably the Muclear Center Nee ?moved conducts wea Sresearch programs which are primarily directed, to the seeeetine of new knowledge and only secondarily usefs) Yo ?the program Of gratuate education. These research projects ore supported by the Ggoeopriate divisions of US-AEC. Here the objective £8 ?the research approprinther than training; but these activities have had & profound, Ufect?on the vigor and content of the training programs:

fable economic impact in

?thie wey is in the

?its through moderate

?mangoes, etc

?ena of the require-

done by graduate

xf time into the

slightly more than one half of the totel progran of the Fuerte, nico Mucear Center i devoted to training and education vith he other wittion being concerned with advanced research, All of 3e ?advanced Portion eee airected to matters of concern to the United States and to

yeeeMTmadiate Caribbean region. Anong these activities are those ?ing the long-term effects of

devoted to developing knowledge concern!

life and similar questions

radiation and fission products on marine

ioactive elements in tropical forests,

pertaining to the cycling of ra?

Juestions vhich are intimately linked with the feasibility of construct-

Gig a new canal through Central America or the Isthms of Panana using

nuclear explosives for the earth removal.

of the scientific program has involved many sharp

h the Puerto Rico Nuclear Center

11 institution of a multidisci:

?The development

decisions concerning the areas in whic

should exert itself. A relatively sua!

plinary nature cannot expect to be effective in all scientific fields-

A careful choice has been made, therefore, of those fields of endeavor

vherein an institution on an island in the tropics can operate to

advantage.

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RADIOISOTOPE APPLICATIONS DIVISION

BASIC COURSE IN RADIOISOTOPE TECHNIQUES

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jorough and intense introdiction to the use of radi

on to the use of radlots

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ology, and Health piysice- Medical applications are also

sidered. Training in laboratory work is eaphaeized.

RADIOCHEMISTRY

Designed specifically for chenistry students, thi

one-cenester course with three hours of lecture and one laboratory

period a veck. ?The student 1s introduced to the fundanentals of radio~

Teotope techniques in scientific research. ?The course covers the

chenical aspects of nuclear processes and stresses the application of

radiotectopes to chemical research.

te to 8

NUCLEAR TECHNIQUES IN BIOLOGICAL RESEARCH

this is a one-senester

?ally for biology students,

for lecture and one laboratory period a week.

fundamentals of radioisotope techniques in scien-

of nuclear processes, and

?to biological research

Designed specific

course with three hour:

The course covers the

tific research, and the biological aspects

stresses the application of radioisotopes

RADIOLOGICAL PHYSICS AND RADIOBIOLOGY

?month course given once a year, from August to

?es are given three times a week, plus one-hour

oe teboratory twice a week. It is offered to Doctors tn Medicine who

of Aabotaents in Radiology in local hospitals. The course Coucte the

SrSammental concepts of radiological physics, the physics of diagnostic

roentgenology, radiation measuring instruments, dosimetry, Tadiobiolosy

yadiation protection and history of radiology-

?This is a three

October. One-hour lectur

THESIS RESEARCH FOR M.S. DEGREE IN CHEMISTRY

eh may be done at the Puerto Rico

gutual interest to the graduate student

research programs in

the required thesis reses

Nuclear Center on @ subject of

?and his PRNC advisor. This division has active

---Page Break---

Organte Chemistry, Solution Chenist

') Solution Chemistry, Photochenistry, Radiation

Chemistry and Physical Chemistry which provide excellent opportunities

for graduate students.

?The research progran in Chenistry 18 divided into th

?Organic Chentstry, Tadiation Chentstry and Photochentstry, end

parts:

Jn addition there is @ nev program in Solid dtate

Paysical Chemistry.

Prysies.

The Organic Chemistry Progra under the direction of Dr. H. Ha

Szmant includes the following projects: amend

NUCLEOPHILIC SUBSTITUTION REACTIONS OF IMIDATES

with E.P. Olavarria (supported by National Institute of Health grant)

?The purpose of the research is to develop a method of replacing

?an alcoholic hydroxyl group by a mucleophtle via the imidate derived

from the alcohol and a negatively substituted nitrile. In the first

phase of this research there ie being investigated the mechanisn of the

base-catalyzed imidate formation by kinetic means. Interesting and

unexpected differences are being encountered in the reactivity of the

isoneric cyanopyridines and different alcohols and glycols.

BETA-HYDROXY SULFOXIDES with J. J. Rigau

?As part of @ program dealing with radiation protective agents,
there has been synthetized a series of beta-hydroxy sulfoxides ty the
oxidative addition of thiols to styrene and indene. The compound
2-(p-aminophenyl thionyl)-1-phenylethanol is now being tested at the
Oak Ridge National Laboratories. Since the reaction produces four
?stereoisomers, these are being separated by chromatographic means end
ft is hoped that infrared and nuclear magnetic resonance spectra will
permit the assignment of the configurations to each isomer. Of special
Tnterest will be the relation between intramolecular hydrogen bond
formation as a function of the substituents in the aryl sulfoxide

portion of the molecule.

NUCLEOPHILIC SUBSTITUTION REACTIONS OF AROMATIC SYSTEMS

with A. Carrasquillo, Dept. of Chemistry, U-P-R-

tn connection vith another problen, it is of interest to prepare
pefodobenzoic acid, p-iodobenzophenone and ?p,pl-diiodobenzophenone
pertaining radioactive iodine, and this is being attexpted using
cotleophilte substitution of iodine by fodide-131. The mcLeophilic
metstitution reactions of aromatic systens in which the activating
Geitp ie not a nitro substituent have been 1ittle investigated, ent
groUP she Kineties of these reactions should be of fundanental interests

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NEW REACTIONS OF suLF

" oxt0e:

4th O- Cox, Depts of Chearetrys U-P-Re

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expe rneyetFe Being explored renctions of astfoxtdes in which the

COS aee ie transferred to either (a) another gulforide molecule, or

(ike tattle coop Siner than sett ?SF oped atetie

Heel Sr meee epctton oF tones

eter s*peile" ot cunruine vi trither a

fen condone ano eae atmeereteed by te, triton of

SPEYER eceetcconra ng arnoeranes

Be cistntion ot previous wr

eal vine vr thre are ng, rege

ae caries to caus direct replacement of a hydroxy? ? of

Also, there are being carried out achydrchalogenst

410d out det jenation reactions

with alpha-and-beta-chlorsloses in an attempt to relate the structures

fof both compounds through the expected coon product, nanely the

Lj2edichloroketene acetal derivative of Deglucofurancse

ORGANIC DERIVATIVES OF DIBORON - with L.F. Pazos (supported by the Petroleum Research Fund, American Chemical Society)

?There have been prepared several members of a new class of

?The rates of

derivatives of diboron and polyfunctional alcohols.

formation of the new compounds, and the infrared spectra of the latter are also being investigated in order to relate the position of the

3-0 bands with ring size and the nature of substituents.

?The Radiation Chemistry and Photochemistry Program under the supervision of Dr. Malcolm Daniels consists of the following projects:

RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF NUCLEIC ACIDS AND RELATED COMPOUNDS (supported by National Institute

of Health grant)

?The work to date has been devoted to aspects of the photochemistry

of thymine, Using radiations fron low pressure lig lamps and eppropriate filters it bas been shown that thymine is rapidly photolyzed at 18\9 A pdt not at 2537 A. This repid photolysis seems to be dependent on the presence of oxygen, and it has been found that a major product is a thymine hydroperoxide, together with hydrogen peroxide. Work in progress is devoted to identifying the other major products chronatographically and investigating in detail the kinetics of the reactions involved.

---Page Break---

?Mis work promises to be of considerable importance if reactions of higher excited states are involved in radiation chemical processes, and should also clarify the mechanisn of dimerisation of thymine which seems to be of major importance in photobiology.

Quite recently a rotating cylinder (Couette-type) viscometer has been acquired and work complementary to the above is being started on D.W.As

RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF OXYANIONS

(supported by USAEC Division of Biology and Medicine)

Work started Decenber, 1962. Spectral investigations preliminary to photolytic work have beén carried out. In addition, studies on the photolysis of nitrate ion at 313 m have been performed. Preliminary

experiments indicated a strong and interesting pli dependence of nitrate formation in the alkaline region. There are three regions of obvious interest:

fa) rate independent of pHi from pH 2 - pl 6

b) the small plateau centering on pt 10

¢) the strong increase fron pli 11.5 to pH 1b.

?The mechanism and kinetics of photolysis have been investigated for the first tvo of the above regions.

?Te Physical Chemistry Research Program under the direction of Dr. Bdwin Roig consists of the following projects:

COMPLEXING OF THALLIUM (IIT) WITH AZIDE

with R. Figueroa

Spectrophotometric evidence shows that thallium (III) complexes with azide. Data are not as yet conclusive but it seeus the complexing is ina 1 to 1 molar ratio with a rather small association constant. Experiments are now being conducted to confim results.

DETERMINATION OF THE HYDROLYSIS CONSTANTS OF THE THALLIC

SPECIES with J. Anziani

There is sone doubt as to the hydrolysis constants found in the literature. ?The constants will be determined by potentiometric acid titrations of thallium (I)-thallium (III) solutions with constant ionic strength. After a long and tedious procedure of purifying reagents, all stock solutions required for the study have been prepared. At present the work is being delayed because of difficulties in eliminating leakage of very small currents through the mull detector in the potentioneter

arrangement.

---Page Break---

F RADIATION DAMAGE ¢ STALS USING

AL CONDUCTIVITY f

Infrared Spectrophotometer used in confirming molecular structures

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Photoscanning equipment for tumor localization

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B

CLINICAL APPLICATIONS DIVISION

SHORT COURSE IN CLINICAL APPLICATIONS OF PADIOISOTOPES

Training 1s given over @ two-aonth period in the clinical uses of radioisotopes in Gingnosis and thorayy. nie ceuzes consists of foreah Isctares, denonstrations, seninray roindeatie discassionay review of iiteratare and Inboratory work. Tyo techniques are introticed each week, preceded by an explanation of the theory and nedicel aapeste of the tests. Fartleipaste perform approciantely 60 tests, during the sightcweck period. Procebares included are thyroid function stadies, blood volume and cardiac flow, erythrocyte survival, location of cancerous aetactascr, gstrctatetinalwboorpiony fetal an hepatic

LGNC COURSE IN CLINICAL APPLICATICNS OF RACIOISOTOPES

?Tis fe a six-onth to one-year course which stresses the research spects of radioisotopes in clinical medicine. The trainee concentrates on a special basic technique and pursues a research project within the scope of the Miclear Center's research prograa which is of particular

interest to him. A preperatory period is allowed during which the trainee meets regularly with meubers of the staff to discuss problens related to such matters as experimental procedures, techniques, and biological supplies.

ORIENTATIGN IN RADIOISOTOPE TECHNIQUES

This is a one-semester course designed to orient the prospective physician to the uses and medical aspects of radioisotopes in clinical practice. Subject matter covers the general application of radio-isotopes for diagnosis and treatment in medicel practice.

Under the direction of Dr. Sergio Irizarry a varied program of medical research utilizing radioisotopes and biochenistry, has been developed. A summary of the research project follows:

THYROID PROJECT (in collsboration with Dr. Lillian Haddock, Head Endocrinology Section, University Hospital)

?A total of 310 cases from University Hospital records were abstracted to date. From these records we selected 11 hyperthyroid

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uw

cases, 10 euthyroid cases, and 12 hyperthyroid cases that were typical of these functional conditions of the thyroid gland utilizing rigor Clinical laboratory criteria. From these patients the following dai see etaineds (a) lyperthyroia ranged from 61.1% to 976. Average vas Wristh, standard deviation was 10.1%, Average minus three standard certions was 7.27%. Total number of measurenents taken from this (t) Bithyroid ranged. fron 19.2% to 39%. Average vas

group was 22.

SE°0E "standard deviation was 5.66. Average minus three standard de-

aoa aan B36. Average plus three standard deviations was 42.63}.

S12. (ce) Hypothyroid ranged fron 1.1%

Average

Total mumber of measurements va:

to 12.lg. Average was 5.7K, Standard deviation was 3

plus three standard deviations was 16.64%.

our values have an overlapping between the hypothyroid and the euthyroid groups. This overlapping is theoretically of the order of 13.2 on the basis of isotope studies alone in the group of hypothyroid and euthyroid patients having an uptake between 8% and 16-1/2%. Me

applied values between 16-1/26 an W7f for nomal and from © to 8% for hypothyroid and on this basis the group found to be unclassified occurred in 17% of the measurenents.

?Additional work will continue in defining the Limits between hypo-thyroids and normals by collecting more cases, ?The differentiation between normals and hyperthyroids appears to be good.

INTESTINAL FAT ABSORPTION PROJECT (in collaboration with Dr. A. A. Cintrén Rivera, Head, Clinical Research Laboratory,

University Hospital)

tis is a study of intestinal absorption in patients undergoing radiotherapy. Seventeen patients have been examined to date and it vas noted that a depression in oleic acid levels occurred in five of then while undergoing radiotherapy to the abdomen.

TRIPLE ABSORPTION TESTS

?This study is designed to determine the feasibility of doing vitamin A, I-131 tagged oleic acid, and xylose determinations in the

same patient simltaneously. Fifteen patients were exemined to date and in 6 of them the three tests correlated well. Vitamin A and oleic acid correlated more closely than xylose in the group tested. Results yere: 11 normal and } abnormal results with Vitamin A, 13 normal and 2 abnormal results with Radio-oleic acid, and 7 normal and 8 abnormal

results with xylose.

---Page Break---

6

SLO0D Levets oF

BLOOD LEVELS OF RADIO-OLEIC ACID IN HYPERTHYROID

This project 4 4

2 deatened to &

oria project 0 test the capacity of the un

MEsraerT ad Cae to citect the toa evel anantecrests oP ite seta rand sapereny ihe gastrointestinal tract. ?The unblocke inyroid gland supposedly will remove. inorganic nadiocatiny Sekine ee

radioactivity. We hi

wave measured 10 hypert?

found the expected caveat hypertiyroid patients and have

found the exp fepression in the blood radioactivity level in all

TUMOF LOCALIZATION

?The scanning equipment for tumor localization has been moi

sees henner loetctin thn att

sere Dprtn arb oh Pw et a ek

Sst iets rez fo ars eft 8 pling eee

eines et cet eee eat a eaela

ois ste an eects on, uel conning ee

Senet Tages aon etaesmine eet eto

eral tees ee eal eer oleae

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study other organs and tumors.

RENOGRAM STUDIES IN RABBITS RENOGRAPHIC CHANGES IN PARTIALLY RADIATED KIDNEYS IN RABBITS (in collaboration with Captain William L. Caldwell, Army Tropical Research Laboratory)

Thirty-two rabbits were subjected to partial renal damage by radiation. Renal function is being followed up by sequential exami-

nations employing the hippuric acid radioisotope renogram.

DETECTION OF EARLY RENAL DYSFUNCTION BY MEANS OF TUBULAR LOADING DURING RENOGRAMS Dr. Marcelo Bertholds

Nine patients in whom equal danage vas suspected but not proved by routine laboratory methods were subjected to a double isotope study: (a) The standard renographic procedure. (b) Renography under the load of & grams of sodium-para-aminohippurate P.A.H.) given by slow intra= Senous injection. In eight of the nine patients in whon a routine

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6

Automated Biochemical Analysis

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RADIOTHERAPY AND CANCER DIVISION

RADIOTHERAPY RESICENCY PROGRAM

This 1s an approved progran for radiotherapists that fulfi11s the

requirements of the American Board of Radiology. Plysiciane with a year of internship or equivalent clinical experience are accepted. ?The ?raining period lasts three years, but trainees are required to take an ?additional year of supervised practice (preceptorship) vefore adnission to the specialty examinations. Trainees learn to Aagnose cancer, to determine the extent and radiosensitivity of a tumor, to choose the appropriate treatment, and to plan and conduct radiological ?therapy. Background in clinical? oncology is imparted to residents ?through work with nev, follow-up, and hospitalized cancer patients. Radiation therapy experience is acquired by vorking with roentgen. ?therapy machines of various voltages, cobalt teletherapy units, and the application of radioactive miterials such as radium, strontiun cobalt, and iridiun. Trainees becone familiar with cancer control. activities in Puerto Rico which include a centri cancer registry, tumor clinte work, cancer detection, and public and professional education in cancer. Regular teaching activities include: bi-veekly treatment planning conferences, weekly clinical cancer conferences, weekly Oncologic Hospital Tunor Board conferences, weekly University Hospital tunor conferences, weekly Nuclear Center seminars, weekly hospital grandrounds, bimonthly and monthly cancer seminars. ?The following special courses are included: Radiological Physics, Medical Statistics, Bio-Chemistry of Cancer, Radioisotope Techniques, Radiobiology, and Tumor and Tissue Culture,

SHORT TERM RADIOTHERAPY TRAINING PROGRAM

Special programs are prepared according to the needs of the

applicant. Participants may engage in a research project and may participate in all teaching activities of the Radiotherapy and Cancer

Division, but are not given patient responsibility.

Under the direction of Dr. Victor A. Marcial en active program of cancer research has been developed:

CARCINOMA OF THE PENIS (in collaboration with Dr. J. Colén, Oncologic Hospital, and Drs. J. Figueroa Colén and Rail A. Marcial Rojas, School of Nedicine)

Data obtained indicated that cancer of the penis is three tines as frequent in Puerto Rico as in the continental United States. Regarding treatment it vas found that enall lesions can be treated vith radiation therapy sparing amputation of the organ with a satisfactory

five year survival (65%). The results were published in Radiology

August, 1962+

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CANCER OF THE ESOPHAGUS (1n coliaboration with Dr. Pablo

5, Auxilio Mato Hospital, and Dre Rail Ae Marcial Rojas,

School of Medicine) * ?

?The first phase of the project concems epidemiological investign-

tion of the probes of cancer of the esopiagus in Puerto Ricos Tt has

been found that the mortality from cancer of the esophagus in Puerta

Rico in both sexes ie the highest in the world. The eecond Phase. of

the project concerns investigation of the clinical features of 400

cases of cancer of the esophagus from the Dr. I. Gonzdlez Martinez

?The task of abstracting information fron the

Oncologic Hospital.

Patients? records, the preparation of coding sheets and perforation of

IBM cards was completed. We are avaiting the radiodiagnostic and

histopathological evaluation of the cases before proceeding with the

final report.

HODGKIN'S DISEASE (in collaboration with Dr. Eduardo de LeSn,

School of Medicine)

In this project 83 cases with Hodgkin's aisea:
z4lez Martinez Oncologic Hospital records were investigated.
found that the highest survival ves achieved in the last seven years
when the modalities of treatment included radiation therapy for the
involved areas and the adjoining potentially involved regions. The
data on these cases will be placed on TM cards for final analysis and

from Dr. I. Gon-
Tt vas

publication.

CARCINOMA OF THE ANTERIOR TWO THIRDS OF THE TONGUE
(this is a clinical project by Dr. José M. Toné, and Dr. Victor
Marcial)

?An evaluation of the clinical aspects of 197 cases of cancer of

the anterior two thirds of the tongue seen at the Dr. I. Gonzdlez Martinez Oncologic Hospital is in progress. Etiological factors and evolution of the disease are considered. An appraisal of the benefits of various treatment methods is also included.

EVALUATION OF RADIATION RESPONSE IN CASES WITH CANCER OF THE CERVIX UTERI TREATED WITH RADIOTHERAPY BY MEANS OF EXFOLIATIVE CYTOLOGY (in collaboration with personnel of the Cytology Laboratory of the Puerto Rico Department of Health)

The aim of the project is to determine the validity of exfoliative cytology as a prognostic tool in cases with cancer of the cervix uteri treated With radiation. So far, 356 cases have been studied. This is

a long term project that will require a minimum of two years of
Only 152 cases qualify for the minimal two

observation in each case.
year follow-up. As an initial step in the analysis of the data collected, a study of the significance of persistent tumor cells in the vaginal smear at the end of external radiation therapy is being

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wv

conducted. The purpose of this inttial analysis 1s to deteraine 1f the

Presnce or peratacen, sor cle at the gad of external reaiat ion £8

- cor prognosis. ?cases with at least two year foLlov-upe

will be used for this study. your foliovust

IRRADIATION OF THE KIDNEY (in collaboration with Dr, WiLlten

Caldwell of the Rodr{guez Amy Hopital)

The objective of the study is to devise treatment techniques for cancer in or around the kidney area that would prevent damage to this organ. One aspect of the study concerns investigation of shielding portions of the kidney during irradiation. For this, a group of 32 rabbits vere divided at random into four groups of 8 animals each. The animals were given localizing excretory urograms and were subsequently {radiated with 2000 rads in a single dose with cobalt 60. The follov-ing portals were used:

Group I - The lover half of both kidneys was irradiated

?The medial half of both kidneys was irradiated

Group IT -

Group III - Both kidneys were irradiated

Group IV - (control) - the left kidney was irradiated

?At present, three months after irradiation, 19 rabbits are still

alive; 6 in group I, 5 in group IZ, 2 in group III, end 6 in group IV.

?As expected, animale in group TII did the poorest. Twenty-six weeks after the conclusion of renal irradiation the animals remaining vill be Killed and necropsies with histologic examinations of the renal tissues

VA1L be done.

Renograne using Hippuran 1°31 pefore irradiation, 2-1/2 weeks, 4e1/2 weeks and 8-1/2 weeks after irradiation have been informed. The data vill be analyzed after the study is completed.

?A prelininay study was performed in which young adult New Zealand vabpite had the left kidney irradiated with a dose of 3,900 rats in 3 eeks. One group received 25 mg. of InTriiodothyronine daily and the Sther group was the control. Triiodothyronine dia not protect the Kidney against radiation, but made it worse. The average kidney weight In aninals irradiated and receiving I~Triiodothyronine vas 1.8 ga.) and the average Kidney weight in aninals of the control group was 3.l gu. The right kidney that vas not irradisted had a sinilar weight in both

groups, 11.7 and 11.9 ga.

IRRADIATION OF THE EYE

?The objective is to develop treatment techniques for tumors in and around the eye vith preservation of vision. The initial part of the

project concerns the investigation of the role of oxygen in the radio

sensitivity of the lens.

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le qualitative

8, 000 Curie Cobalt-60 Teletherapy Unit being adjusted prior to irradiation

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MEDICAL SCIENCES AND RADIOBIOLOGY DIVISION

Training activities of tnt

tt of this nev division have beon dtrecte

snprovig the, competence of PANG Eleaedicadtetiniclae fn'tiome.

fing 196, it snouid be possible to accept? a mall maser of state

from other countries. oF OF students

Under the asrection of Dr. M. Pa

o y M, Paul Wetnbren the following researc!

activities have been initiated: * ae *

STUDY OF CHROMOSOMES IN CULTURED HUMAN LEUCOCYTES

(in collaboration with Col. M. Dacquisto, Director, U.S. Army

Tropical Research Medical Laboratory)

Specimens have been prepared from ?than 100

repares more than 100 persons with

the majority taken fron norwal healthy individuals. The abnormals

currently under study are drawn from patients receiving radiation

therapy for malignant disease and fron those suffering from ?sprue?.

OBSCURE ACUTE NEUROLOGICAL SYNDROMES IN CHILDREN

(in collaboration with Dr. Dolores Méndez Cashion, Pediatrics

Dept., University Hospital--support from National Institutes of

Health)

jonsists of a systematic search for the

Part of this program c

?tal swabs from the children

presence of enteroviruses in serial rect

Rider study. The tissue culture unit of this division undertook the

?ereening of 100 pairs of svabs in August, 1963 and fron 22 of the 200 acts of eulture tubes inoculated we recovered agents which caused & Gytopathogenic effect both in the prinary tubes and on passage. | NAte-, yeraenoGeon saved for transnission to NIH for final identification of These agents. In 6 cases ?agents? cane fron paired svabs and in the restinieg 10, only from one of the pair in spite of repeated isolation

attempts fron the "sterile partner".

RADIATION INDUCED VARIABILITY IN INDIGENOUS ARTHROPOD BORNE ANIMAL VIRUSES OF PUERTO RICO--TERRESTRIAL ECOLOGY PROGRAM, PART II (support fron USAEC Division of Biology end

Medicine)

Support for this progran vas received in April, 1963, but the initial few months were spent in recruiting personnel and training them, Now we have established a mouse colony holding space and

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has been activated. Tt is antici

Zfaehitey ant Inboratory vill be

pated that the permaneot re the end of 1964, oF at the latest, in the endy for occupation before cperations to-date have een oriented Firat quarter of 1905; solents,? Feraanent trap Lines have been towards mosquitoes and rlevouente which are narked and released. At and are sot weokly to trop nee are bled for antibody studies and aleo selected {nerves eolation, Hosgiitoes are caught in Light, traps for attempted vitut.ing on munan bait, Arter Sdentification the are ain see toed in borine pissna albumin and the renulting mosquitoes ae trlsted into aice to attenpt vinua isolation, To date ausponsion, tnotans have been nade fron uaterial collected at the

El Verde Field Station.

Inboratory quarters and the program
pated that the permanent small anima:

DENGUE VIRUS ISOLATION

In August, 1963 a "Dengue-Like" illness occurred in an epidemic scale in the town of Manat{, Puerto Rico. Manat{ is situated 3.5 miles inland at the mid point of the northern coast % miles west of San Juan. Tt is probable that cases of the disease occurred elsewhere on the island before the epidenic at Manat{. Shortly after Manat{ was declared an epidenic area, cases occurred in the San Juan area and notably in Bayamén. From here it "noved" to the eastern end of the island and then dow the coast with what would appear to be the last

cases in the neighborhood of Ponce which is situated to the west of

center on the southern coast.

me Puerto Rico Tuclear Center becane involved in the measures taken to study the disease when the Arbovirus unit of the Medical Sciences Division was invited to join Dr. Costa Mandry's tean from the Department of Hoalth and a tean fron the Conmunicable Disease Center, Atianta, Goorgin. (On Augist 23 St vas arranged that specinens could be collected from acutely ill patients in Manat{ and 2 patients were bled by the tean of the Puerto Rico Nuclear Center to vhich Dr. Agustin Cajigas of the Department of Health had been assigned for duty during

the investigation.

On August 29, 1963, Dr. Telford Work, Chief, Virology Section at C.D.c, visited Manat{ with Dr. Cajigas and they obtained specimens fron 6 individuals previously bled and 5 who clained to have been afflicted in the past 3-4 weeks. On receipt of these specimens, at about 9:00 P.M., they were immediately processed and set up in an haenagglutination-inhibition test against Dengue type I antigen provided by C.D.C., Atlanta. ?The erythrocytes were added to the test at 5:00 A.M. and the test read at 6:00 A.M. on August 30. The results are set out below; the results identified by letters pertain to the sera from the individuals with a "history" of disease.

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Aeute onvaleacen

Spectnen serum titer eae

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Fron these results it was clear that the disease was associated with an agent which is related to Dengue I type virus. (Until such ?time as an agent is adapted to regularly kill a laboratory animal, it is not possible to establish its exact identity). The agent which caused the illness in Puerto Rico was in all probability the same as that which caused the epidenic in Jamaica a few weeks earlier. It has proved unusually hard to adapt to either laboratory mice or tissue

culture, Several different groupe have been working with it but none has had any success in fully adapting an agent fron many samples of material.

?The contribution of the Puerto Rico Tuclear Center to the overall effort lay largely in the -initial preparation and screening of specimens collected in the field. In all 1,237 uman blood specimens were centrifiged, the serum separated and anpouled. One ml of each serum was prepared for testing by the haemagglutination inhibition test. Aliquots bf all specimens were sent to C.D.C., Atlanta, both for attempted virus isolation and serological study.

of the 1,237 sera 88 were taken in the first 12 houre of illness and in the PRIC laboratory were innoculated into infant mice and tissue cultures to attempt virus isolation. Mosquitoes were processed in 208 pools. ?The distribution by species is shown below:

A. aegypti 6,849

C. quing:ifesciatus 10,983

C1 nigripalpus %

Catex species 85

Total ? 17,943

From the acute blood specimens and from some pools of mosquitoes, agents have been obtained which cause transient illness in infant mice

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eee Oo erSare affect in Afriean green monkey (Cercopithecus 8) kidney tissue cultures. The presence of virus may be in etl feted gussaauiens ymcentes aii ete escent antibody technique. In the hopes of increasing their pathogenicity, two strains of virus are in continuous passage in Anta mice and two tiore are in serial passage in infant mice which have teen, rradiated with 250 rep of X Ray (from a 350 KVP machine) prior to Anoculation in order to decrease their*natural resistance to the agent, An haemagglutinin has been made from 2 strains of virus but its potency is so low that it is of little value for practical purposes. a

SCHISTOSOMIASIS (supported by USAEC Division of Biology and Medicine)

fathorization for this program was received on Decenber 3nd, 1963, and although at this tine no results are available, the progran is based upon work by Dr. John Villella and Dr. Henry J. Gonberg while at the University of Michigan, and on basically similar information published by Sadun et al. Both these groups reported an acquired Tesistance to challenge with virulent 8. mansoni cercariae after infection by cercariae which had been damaged by exposure to gama irradiation. ?The differences in the results of these groups appear to be

related to the enployment of different routes of infection; wile Villetla uses intraperitoneal infection, Sadun et al. prefer the percutaneous route. It is the object of the present progran to perfect more delicate means of assessing the degree of protection obtained and then to establish the conditions required to produce the greatest possible degree of protection. Experiments have also been designed to test the duration of the protection conferred and the stages at viich various serological tests yield positive results. When the optinal Guperimental procedures have been established it is intended to make © Getailed stady of all detectable reactions which occur between the challenging parasite and the "immune" host.

The problens attendant upon reasonably accurate quantitation of the "immune response" or degree of protection conferred upon @ mouse which has been exposed to irradiated cercariae are virtually insupersti® using techniques in current use by parasitologists. It is proposed ?0 Gxplore the possibility of defining an "infective dose" based on mimbeT?

of live cercariae.

---Page Break---

Mosquito identification

---Page Break---

Greenhouse

Bias iun

AREA

Gamma Pool Facility.

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AGRIC

ULTURAL B 10-SCIENCES DIVISION

Tre Agricutturat

airec ng ABPSeUItArAL BioSciences Division tua

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U-S. Departaent of Agriculture operates an Expericent

Station in Mayaguez, Educa?

through this disteisn WUsatsonal opportinities available to scidents

THESIS RESEARCH FOR M.S. DEGREE iN BIOLOGY

Courses for the H.8, Degree in Biology 4

Health Physics, Introduction to Blo-Physien, clear Techaigiee oy

Biological Research, Marine Applications in Nuclear Science, Atomic and

Maclear Physics, and General Cytology. ?he required thesis may be done

at the Miclear Genter on a probles of mtual interest to the graniate

student and his PRIC advisor. Research in Biology, Radiobtolegy,

Marine Biology and Entomology are described in this report. ,

MECHANISM FOR RADIATION-INDUCED BACK MUTATION

Dr. F. K, 8. Koo

Back mitation can be attributed either to a true reverse mutation
at the mutated locus or to a suppressor gene that arises through mta~
tion at a locus other than the mtated one. With the present knowledge
of the fine structure of genes, the structure of the DNA molecule, and
?the amino acid sequence in some proteins, one may envisage another
mechanism of back mutation; i.e., @ process by which an impaired func-
tional unit is restored to normal function by replacing a damaged unit
with an identical or similar non-damaged one. ?The restoration through
?this mechanism can be achieved only by interchanges between the sane
amas of homologous chromosomes or sister chromatids where breaks have
been induced by irradiation treatment. ?The replacement may occur 8°

ft: (1) a single nucleotide pair; (2) @ group of nucleotide
the levels of: (1) a single muctest(s) a cistron. ?his eechanisn 18

fre specifying an amino acid; ry
raise cacuane of the existence of repeats of the sane meleottte
WorkaDe eecmasGuences, for a group of nucleotide and cletrons Unt
aa ete cee an blosyntheaie, The Probability for two te
control a single rePalation at sultable positions for 8 varia?

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interchange is small but by no means zero. A mis-replacenent of the damaged genetic material might lead to a restoration of function as well. It is known that, in some cases, a modified protein enzyme with ?@ changed amino acid sequence performs a function not recognizably different from that of a normal enzyme.

On the assumption that repeats exist at different levels in the genetic material, a mutation may be induced by impairment or loss of one of the menbers in the repeat and a back mitation by adding an identical member back through interchanges between homologous chrono-somes or sister chromatids, Thic working hypothesis is to be tested by using yellow-green mtants of Oryza sativa in which normal green stripes representing back mutation events are expected to be detected in leaves following seed irradiation. Since back mtation in this test systen presumably involves interchanges between sister chromatids, chromosomes mst first be induced into a bipartite condition before being irradiated, The first phase of the program, i.e., induction of mutations, is being carried out with the aid of gamma and neutron irradiation. ?This study may also shed light on the nature of gene structure in higher plants.

STUDY OF THE RADIATION EFFECTS ON STIMULUS TRANSMISSION AND PULVINUS SENSITIVITY IN MIMOSA PUDICA Dr. F. K. 8, Koo

?Tis species appears to be relatively resistant to permanent damage by gamma radiation. The initial damage to stimilus transmission was more severe at all dosage levels than the damage to pulvinus sensitivity. At 50 Kr some reversible damage occurred. ?The speed and degree of recovery of stimulus transmission and pulvims sensitivity appeared to be negatively correlated with radiation dosage.

ACTIONS OF 5-BROMOURACIL DEOXYRIBOSIDE CBUDR) ON PLANT CHROMOSOMES Dr. F. K. S. Koo

BUDR is a well known radiosensitizer in cell killing. In the present study with chromosomes in Zebrina pendula, Rhoeo discolor, and ?Allium cepa, several additional aspects of BUDR action have been revealed: (1) It induces breakages more readily at centromeres than at other chromosome regions. (2) It often prevents the contraction of the secondary constrictions while the other chromosome regions usually contract under the influence of p-dichlorobenzene. (3) It produces preakages directly (without incorporation) in the chromatids in addition to its chromosome-breaking action through incorporation.

(4) In combined treatment with ganma rays, it interacts with radiation to increase chromosomal aberrations, resulting in synergistic effect.

These forenentioned actions appear to involve different mechanisms.

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INHIBITION OF R

a 1

Bry RONOrS J. Teas! with Weve EANANAS, BY GAMMA, RADIAT ION

Campos °

: Cuebas Quintana and Joaquin Oliver

Unripe bananas of

gamma, radteryennnes Of Johnson and Monte Cristo variety

Fipens dn ein ton nen stored At room temperature, ?Ordingelig seek fae

of both varieties was retarded tetany, spproxinately 05 Kr the nipuni

srrect on Fisrare ?ag_reterded by tan daye,or sone with Unite af bey

She ripentse vers gRigher doses caused euriy blackening of the seine?

either 2 minutes aie cglid be Feactivated in the irradiated fruit ty

acid or exposing ton pa stenegne PEM 2Hnaichl phony

See Gpeimoring to 1 pea ethylene gas. the use of radiation talon

the fruit at any time by the apeee ee eee tne BosetbiLity of Stpenen

of possibie eccnonie mgotneg@p sation of stavlen offee s trentaet

ACEROLA METABOLISM - Dr. Andrew Maretzkt

Injection of acerola fru

sent with unifomay grola fruit during the earliest stages of develop-
jetectable uptake of ralioactivity by ascorbic acid, Sinilar Tes
were observed with uptate of these radioisotopes invo acerola. through
ete eater teendeaee leer
Jeaves. Conversion to ascorbic acid was not detectable in fruit sli
incubated with the above mentioned precirsore for periods of 5 wines
to 3 hours, or with acetate labeled in either the carboxyl or the methyl
group carbon, These negative results suggest the possibility that
pathway of biosynthesis ic operative, different from that observed in
ross seedings, ming beans and stravberries. Extension of these inves-
figations to fruit slices incubated with Czl-bicarbonate resulted in
interesting labeling patterns. A very suall anount of radioactive
ascorbic acid was formed under these conditions. Considerable conver-
Sion into earbohyarates and organic acids took place. These conversions
appeared to be triggered only partially by photosynthetic mechanisns,
iether studies showed a remarkably higher rate of formation of one of
the taveled substances than that calculated for the other major compo-
sete. this substance behaved chronatographically very similer to
seers tie acid. Experiments to complete the identification of the un-
Seeceeece still in progress. The information available at this tise
crown ere i polycarboxylic acid with a neutralization equivalent of 90
an coparently aifferent from any of the organic acids vbich ?commonly
occur in plants.

During the ations were continued on the isolation and
saenti fication of ?piological antagonists fron marine algae. A dino~

Plagellate from which ve hed previous'y isolated acrylic acid, inhibit~
Thevgram positive bacteria, and a Bich molecular weight substance,
tee eeine yeast growth, vas found to concern ?also a neurotoxin. This

ted to the shellfish poisons.. Further york is

toxin appears to be relat

ear investigs

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in progress on the purification of the toxin and on the deolation of
larger quantities of the yeast inhibstor for degradation studies,

AUTOMATIC ANALYSIS OF THE SUCROSE CONTENT OF
SUGARCANE ~ Dr. R. A. Luse

?As. background for proposed studies on sugarcane mitants, expert.

ments have been done to test the feasibility of analyzing for sucrose Content hundreds or thousands of plant tissue samples. Application of the Technicon Auto-Analyzer for this mass screening has been shown ty be reasonable, since nearly 500 samples may be analyzed: per day, with minimal operator attention. Over 1500 samples of sugarcane extracts have been analyzed during preliminary experiments designed to show variability of sucrose levels within a single plant and between several Plants. Current studies are being carried out on sugarcane seedling and jeaf tissue, to find whether or not there is correlation between early sucrose levels and sugar yield in the mature plant.

NEUTRON INDUCED HIGH-SUCROSE MUTANT

Dr. R. A. Luse

The above studies will be combined in a more general research program to be carried out on a co-operative basis by investigators from PRNC and the Agricultural Experiment Station. In this program, the biochemistry of those sugarcane mutants produced by neutron seed irra-diation waich show high sucrose content will be investigated. Levels of enzyme which play a part in the biosynthesis of sucrose will be determined on those sugarcane plants with high sucrose (as shown ty the mass screening). Such a progran is expected to shed considerable light on the enzymology of sugar formation in sugarcane.

PARAMUTATION - Dr. Duane B. Linden

Genetics regulatory systens which control gene mtation are being investigated with major emphasis being given to the paramitation syste as it occurs in maize. The nature of the regulator and its product as well as the type of alteration that is produced are the problens to te solved. Radiation treatments of the components of the systen have indicated that the type of change which occurs in this systen is an inactivation process rather than a true mtational event.

Experinents were designed to determine vhether the paramtation inducing process has @ radiosensitivity similar to gene mutational events. The source inducing the paramitation change (Ret and Fe) ant the site of action (RT) were each tested. -

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wore cut one day naa Procedure wis sinilar for ali groups. Tassels

Fey evolved ot ion efit poionatpinl th fins.

felling day.? he tastls bene ued sete nate

fe Soatipitie taser (ie Be ee eat eset crue te

to x8 r® stock, using the ré r8 as fenaie. meee

When the site for paramtats

crone te", thet tation change was irradiated before

crossing to BOF or EA approxinately. 10h of the tine (10 out of 170

sags) th 0 apparent paramitation, (i.e. the testeross ears were

204 dark purple). In addition there 1s?evidence that there is sone

St the cara?y preyugual paramtation interaction in 15-204 of the reat

of the cars. ?appear to have either a reduced paramitational

change or are segregating for paramitation altercation on the eat

ch ear traces back to a single irradiated pollen grain.

When the R5t stock was irradiated prior to crossi: O anc

testerossed GU of the tine there vas nb apparent effect. there were

no ears that vere 5Of dark purple (Lee. no paramitation), Hovever 236

of the ears had Light spotted and dark spotted seed predeainate with

very few yellow and sone dark purple Kernels, Tuere wae a definite

effect. on the paramitation interaction bit probably no instance of

conplete inactivation. the renainder of the eare are in e suspect

category with Light spotted predoninate and cone dark mottled of full

purple seed, very fev yellow. ?The ears appear to be significantly different from the majority class which had light spotted and full yellow seeds predominate,

The final group involved irradiation of the HY with subsequent testcrossing identical to R5t. Here there was 5% apparent coaplete inactivation of the paramitation interaction (1.e. ears were 50% dark purple). A reduced paramutation effect is more difficult to detect in the marbled induced change as the variability is greater. There was no effect on the paramutation interaction or perhaps sone with reduced effect in BY of the ears. The other 9h of the ears have what appears to be an increased paramitation expression. The seeds are predominately yellow and light spotted with no very dark mottled and no full purple Seed on the ears. ?The altered RT seed appear very similar to the R° from R8t induced paramitation change. This would indicate that the Hib source has some mechanisn which inhibits full induction of the

paramtation alteration.

RADIOECOLOGY OF A TROPICAL RAIN FOREST, TERRESTRIAL ECOLOGY PROGRAM, PART I (supported by USAEC Division of

Biology and Medidine) santa

this progran was starte

the direction of Dr. Howard 2. du as ta

bees eee Tgs5 with, the objectives of determining effects of

fn the spring of 19:2, rain forest and the movenent of f01l-0

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elements in the nomai chemical cycles occurring ina rain forest. An grea in the Iuguillo Forest Reserve was provided by the U.S, Forestry Service and studies were initiated on the normal pattern before irra Giation. The area vas developed with trails, instrumentation, electric Power, and vork facilities. A new staff has begun measurenents, Some specialists were brought in from universities in the mainland for short periods. A ten thousani curie Cesium source will be brought into the area around January, 1965 for irradiation of about three months. Studies of effects produced will follow to match those made prior to irradiation.

MARINE BIOLOGY PROGRAM (supported by USAEC Division of Biology and Nedicine)

Tais program is under the direction of Dr. Frank Loman. ?The acquisition of equipment began in February, 1962 and on July 3, 1962, @ 100 ton ship, belonging to the U.S. Army, was delivered to San Juan, Puerto Rico by the U.S. Coast Guard. The vessel was naned the "Shinada",

Five basic areas of research have been proposer

MEASUREMENT OF MARINE PRODUCTIVITY BY MEANS OF c!? AND OXYGEN METHODS

This phase has been delayed until our research vessel is completely equipped, since water samples mst be taken at sea and the analysis mst be done at sea to measure productivity.

DETERMINATION OF SELECTED STABLE ELEMENTS IN MARINE ORGANISMS, WATER, AND BOTTOM SEDIMENTS

In the analytical techniques used until now, the majority of investigations have been done using the technique of activation analysis. Samples of marine origin are difficult to analyze for trace elenents by any technique due to the large amounts of NaCl present. Activation analysis nethods have Depp developed for analyzing the following, frace elegents: Scandium?, Silver!0, Vanadium, Manganese, Cobalt©0, Seleniun?3, and Iodinel28? ?All olenents selected for activation analysis with the exception of iodine may be coincidence counted. The coincidence counting results in the exclusion of counts other than those of the desired isotope, so that less rigorous chemical separations my be used than if ordinary ganna spectronetry

were used.

---Page Break---

The Shimada

Communications and Loran Equipment

---Page Break---

Carbon nitrogen oxygen analysis of marine specimens

---Page Break---

DETERMINATION OF co

CENTRATION FA

ORGANISMS WITH SELECTED RADIoeLEMENsS) /? ARINE

The uptake of radioactive scandium and ruthensun by mar

pd tunteutes has been investignted Organtoar wore nelnveined ina,

closed aysten in'vhtch water had teen frradlated and venperacare was

controlled by punping fron a large reservoir, ?Contrary to the

experiment in which these ofganiens vere held in onall volumes of

contaminated vater, the uptake of both radioactive elenents, was not

hah and proceeded? ata very slow rate. At the end of two weeks, the cayantons' had not reached an equilibrium state, ?Results obtained Uy other investigators using small volines of water showed that equilivriun is renched in as Little as four to eight hours, The explanation may lie in the fact that with a small volune of meter the oreanion takes up all te radiouctive elenents present ani then reaches eqillibrium.

MEASUREMENT OF RADIOISOTOPES NOW PRESENT IN MARINE ORGANISMS, WATER AND BOTTOM SEDIMENTS

?This work is well under vay and rainwater samples were collected and analyzed, The {plowing Seotapes aye been found in, raimater samples: Cei4#, pritl Rul, 2195, nv99, Csl37, and Bal37, sr90-y90 separations were made using a conbitiation of nithe acid precipitation and ion exchange separations.

Biological specimens of the following types have also been analyzed: terrestrial plants, marine algae, marine angiosperms, and, marine invertebrates. Recults to date: in terrestrial plants no Cs137

was detected vhicn 13 contrary to expectations.

In marine algae only Z795, Nb95, Rul06, Rp106 and K4O were found. It was expected to find Cell, ?pri, co57, Co60 and ZnO5 on the basis of findings in the Pacific Proving Ground.

COLLECTION OF BACKGROUND OBSERVATIONS IN PHYSICAL AND CHEMICAL OCEANOGRAPHY TO BE USED IN INTERPRETING DATA COLLECTED IN THE FIRST FOUR PROGRAMS

As of the end of the period covered by this report this part of ?the program was being activated.

In addition to the prograns mentioned above, the Marine Biology group was asked to study the off-shore area at the BONUS reactor site

for background data to be used in case of an accidental release of yadioactivity through the salt water cooling systen of the reactor.

---Page Break---

This was accomplished using a Rhodamin-B fluorescent dye that is magenta in color and has a peak fluorescence at approximately 66700 millimicrons when excited with ultraviolet Light. ?The dye dees? roy complex with beach or organic surfaces and is easy to see and photse graph at dilutions of at least one part in ten billion parts of sen water.

RESONANCE IN RADIATION EFFECTS PROGRAM

Drs. H. J+ Gonberg, R.A. Luse, and F. Vazquez Martinez

Experiments using monochronatic x-radiation in the energy range 6.4 ~ 8.3 Kev have shown increased inactivation of the metalloenayne catalase at or near the K-absorption edge of iron (7.11 Kev). ?This ds taken to confim the resonance radiation hypothesis of Gouberg and previous experimental work of Ennons and Paraskevoudakis.

X-radiation intensities have been measured in the sample holder with a Fricke ferrous anmonium sulfate dosimeter. A more sensitive method for detection of the ferric ion produced has been developed using the ferrithiocyanate complex.

The x-ray emission systen utilized for the present resonance radiation studies has been characterized quantitatively as to intensity and photon energy distribution and second harmonic contamination. ?The monochromatic x-ray beam resulting from crystal diffraction and collimation was analyzed horizontally across its front for (a) intensity distribution, utilizing a special moving slit device; and (b) photon energy distribution, using double diffraction by a second analyzer crystal.

Estimation of the extent of second hamonic energies was made fron (a) absorption measurements relying on the different mass absorption Coefficients at the first and second harmonic wave lengths and (b) double diffraction measurenents in which photons with second

hamonic energies were analyzed separately. Correction for percentage of reflection by second harmonic energies also was determined by the double diffractoneter method. Contamination by higher harmonies was shown to be considerable at higher operation voltages; monochromatic beams can be obtained only by proper selection of tube potential.

?The effects on the beam by varying the position of the various components in the x-ray system (tube, diffraction erystal, two soller slits) were determined and the systen was selected which provides hich unifornity of photon energy distribution. As a result, a diffraction system was developed which permits irradiation with photons of uniform energy distribution (only 50ev in 6-9 Kev),

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NUCLEAR SCIENCE AND TECHNOLOGY DIVISION

This division

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sud Rivets interested in specialicing tr the micieey nepestee ne nes

THESIS RESEARCH Fi

serence RRS RCH GORA THE M.S. DEGREE IN NUCLEAR

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Feinsology; mudiologsch grctchne esto usice; Meier Fagor

fescar Mjnte ieee re Setmaey of Hers Stee

electives: Reactor Instrumentation and Control, Reactor Metallurey Chenieal Processing of Tiiclear Fuels, Thiclear Measurenent and Instra-eoaeeal 1» Quantum Theory, Radiochemistry, and Servo Mechanisms. The tates case alles le

THESIS RESEARCH FOR THE M.S. DEGREE IN CHEMISTRY

The following topics are included in the required curriculum for the course: Advanced Inorganic Chemistry, Advanced Organic Chemistry, Nuclear Chemistry, Advanced Radiochenical Techniques, and Nuclear Measurements and Instrumentations. . Anong the electives available are the following: Mathematics of Modern Science, Advanced Inorganic Chemistry, Radiochenistry, and Health Physics. The required thesis research may be done at.the Nuclear Center and is based ona scientific problem of mutual interest to the graduate student and his eivisor fron

the Nuclear Center staff.

THESIS RESEARCH FOR THE M.S. DEGREE IN PHYSICS

the following courses are available to the graduate student in Physics: Maclear Physics, Introduction to Theoretical Physics, Tuclear

ant Reactor Physics, Mathematical Physics, Introduction to Physical Statistics, Atenic and Nuclear Physics, Introduction to X-Ray Diffraction, Introduction to Quantum Theory, Introduction to Neutron Physics, Methods of Theoretical Physics, Interaction of Radietio® with Matter, wet Introduction to Celestial Mechanics. The required thesis research may be done at the Nuclea based on a problen of mutual

r Center and is \

Gnterest to the graduate student and his advisor from PRNC.

---Page Break---

Under the direction of Dr. Oven H. Wheeler the research in organic chemistry is as follows:

SYNTHESIS OF SUBSTITUTED STILBENES with H. Battle

Synthetic methods for preparing cis-end trans-sttlbenes are being conpared. ?The ultraviolet and infrared spectra and polarographic reduction potentials will be measured in relation to the effects of substituents. The spin-spin hydrogen coupling in the cis-stilbenes 1s being measured in conjunction with the Instituto de Quimica of the

Universidad Nacional Auténoma de México.

RADIATION CHEMISTRY OF STEROIDS with R. Montalvo

?The effect of gamma radiation on estrone and its derivatives is being studied in relation to the mechanism of hydroxylation of these compounds. Comparison will be made with the effect of x-rays and of chemical radical hydroxylation.

STEROID DERIVATIVES OF RADIOLOGICAL INTEREST

with C. Reyes

Derivatives of corticosteroids incorporating boric acid in the side chain are being prepared as neutron absorbers. Other derivatives incorporating sulphur compounds in ring D or the side-chain will be prepared as possible radiation-protecting drugs.

MECHANISM OF THERMAL REARRANGEMENTS with I. Casanova

?The postulated intramolecular nature of the Chapman rearrangenent of phenyl benziminio ethers is being checked using Carbon-14 labelled compounds. ?The allied rearrangement of the corresponding allyl ether will be studied using tritium labelling.

DEUTERIUM ISOTOPE EFFECT IN THE ETARD REACTION

The nature of the rate-determining step in the etara oxidation

of toluene with chromyl chloride is being investigated using methyl-

deuterated toluene.

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»

NEUTRON DIFFRACTION PR

Research). Dr Tensei almoiover, pr wEOEt by Usaze

National Iaboratory), Dr. Helmet? Berd

Okada (Japan) SESE

Division of

ners Frazer (Brocsaeny cf

Germany), and Dr. Kenkiens,

With the present shielding, it is esti ?ted me the teat operation

e by estima? that the facil: m

operated safely at reactor power levels up tena ea oe

eons Be Beat aa

sxe i Teeltt Sect nts C2 hen tae he fee eta

sasple to be" Lnvestignteds the aeotiennig ne Seem crztah Le the

crit ttn appopeuen tthe tea ae

solid state physics. aaa

Preliminary diffraction data are now being collected from a natural mineral sample of fayalite (FeoSi0},) in preparation for later low temperature magnetic structure studies. ?he first problen expected to be completed on the spectrometer is a single crystal structure analysis of calcium tungstate (the mineral scheelite). This structure was examined many years ago using X-rays, but reliable oxygen coordinates could not be obtained because of the intense tungsten scattering. Work on the structure will commence upon the arrival of Dr. Mortimer Kay. Dr. Key, of the Georgia Institute of Technology, collaborated with Dr. Almodévar and Dr. Frazer on this problem. Subsequent research will fall into two general areas: the structural role of hydrogen in hydrogen-bonded crystals, and the magnetic spin structures of transition metal compounds. Some sample preparation work is now in progress for these later studies.

MODIFICATION OF THE THERMAL COLUMN IN THE PUERTO RICO NUCLEAR CENTER REACTOR -Dr. John A, Wethington (University of Florida) with Orlando Angleré

i rua] column 48

Me cylindrical access position of the graphite theraal column 48 a conventent place for wet exponential experinents if a suitable source condition can be achieved. The exponential decrease of neutron

across the bottoa of this access, when the coluan is los

graphite, vitdates its use for such experiments.

eral column assenbly in

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5 renoved from thé

Sone graphite wa avity or neut

order to create a graphite Lined ¢: tron Det

configurations of reflectors were tried in onder fo Sores)

syimetrical flux distribution at the bo

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deen shown that the void pattern selscted does give a suitable source

condition. The flux deta are being fitted with both cosine and Besse. |

fcnctions in order to establish the best equations for neutron flux as |

fa function of space coordinates. |

In adéition to the improvenent in flux shape, use of the cavity

Pa eeeae tthe cbsolute neutron flux ty one decade in the vertica. |

decess position and by three decades in the horizontal access position.

RADIATION EFFECTS IN FLUOROCARBONS - Dr. John A. |
Wethington with P. Rosa Gonzélez

The effect of reactor radiation on flucrocarbons is an unexplored field. Samples of CyPy35 (CyPg)3N, and C-C3Py60, supplied by

?the Minnesota Mining end Manufacturing Co-, are being distilled in order to obtain known fractions for the determination of physical properties. Physical properties will be studied as a function of radiation dose.

CERIC DOSIMETRY - Dr. Fausto Mufioz Ribadeneira with
Milagros Miré Villerini

Ceric sulfate has been yidely used as an efficient chemical dosimeter for doses up to 10? Rad, but difficulties related to chemical purity and water quality make its use problematic due to the erratic "g" value changes from one determination to another.

?The "G" values found by the ceric-cupric system are reported as

follows:

NG" VALUES CERIC-CUPRIC SYSTEM

cut

Concentration Barnstead ?Tri-Distilled

Normality water Water £

0.0 2.78 0.21 2.51 0-03 1-000

0-001, 2.57 0430 2.50 0.03 1.002

0.01 2.54 0.09 2.47 0.01 1.0006

on 2.22 0.02 2.22 0.01 «21.0531

f = correction Factor

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Inspecting the values obtatne

suy that the Increase in copper-concentration reascen she Meee eet

and at the seme time produces good st Stee ?c" values

Suter solutions, the 'o" correeponaine aoe eeiuti nna saga cistttted

concentrations in @ range of 0 to 1 x 10°, are int a ?copper

several reports, also being very stable. for copper comentrentt

{°C forly both solutions prevent a "0" unich a5 ERe acon enerettons of

magnituie and limit of error. aed

trae explanation of the physical chentstry of the copper &

sin enc beng tied ond tore copmnrated eleiog oo

Ge (is0u)3 are being used. Results are being tested nev

PRNG 2000 curie cobalt source. te a Ti

RADIATION EFFECTS IN THE THERMAL EMISSIVITY OF GRAPHITE

Professor Richard B. Knight (North Carolina State College) and

Professor K. Soderstron vith Mr. Guillermo Rodriguez Figueroa

?An apparatus consieting of a cylinder of graphite in an evacuated aluninun housing has been constructed and mounted in one of the bean tubes. The changes in the thermal emissivity of the graphite due to neutron bombardment are being studied by measuring the heat-loss of the graphite to a flow of cooling vater in the outer-Jacket, on heating the inner surface of the graphite.

FERROELECTRIC PROPERTIES OF TRIGLYCINE SULFATE

CRYSTALS - Dr- Julio Gonzalo Gonz4lez with Juan Lépez Alonso

the ferroelectric hysteresis behavior of crystals of triglycine
sulfate is being studied over a range of frequencies and at ambient
end tow temperatures. ?The effects of x-rey and gamma radiation vill
be studied.

HE MINIMUM CRITICAL

DETERMINING T! 1
A GRAPHICAL METHOD FOR DET! fe MINION CRT eh

MASS OF A BARE HOMOGENEOUS REACTOR ?
Anneliese Kraft de Pérez
.s reactor can be

?The minimun critical mass of a bare homogeneous reactor Cor
caleunved fron the eritical mass equation. The tedious sPon ac
point by point plotting to find the minimum nar from the eye ot
votained for each fuel-moderator system denonetra'
finding a more simple method.
?iman into the critical
woults in a transcen-
The eolution 18
ted by a strat

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Introduction of the requirenent for ¢ mone

ass equation and a convenient transform tic) C41)

dental equation which has only @ graphe*r

given FA ght

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ven bythe intersection of two functions;

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4

Line whose direction depends only on the nuclear parameters of the

moderator and an exponential function which depends only on the muci

Paraneters of the moderator and an exponental function which depenie

only on the average mmber of fast fission neutrons emitted as a

result of the capture of one thermal neutron in the fuel. |

The graphical nethot tn genersl tome leeds immediately 29 the |

tinimin critical mass for spherical, cubical, or,gylindrical shapes o¢

Feactore for any moderator in combination with U2.

HIGH ENERGY GAMMA PHOTON-NEUTRON CONVERSION DEVICE

FOR HALF LIFE MEASUREMENTS - Dr. Eddie Ortiz with

J. Facetti and S. Pinto Vega

?The basic principle involved is the disintegration of deuterium by high energy gamma photons to produce fast neutrons which are moderated by an optimum thickness of paraffin to get the best balance between moderation and capture and then the neutrons are detected by ?8 BF3 counter.

?The half-lives of cal9, as%, ne2!, 537, un, ana of fission products from U235 fuel elements have been measured. Fission product @ecay has been measured using the fuel elenents from the PRIC Svinning Pool Reactor and by separate irradiation of uranyl nitrate.

The arsenic sample shoved a 3.66 min. activity in addition to the expected 26.8 hr As activity. Experiments are now in progress to identify this presumed nev activity.

THEORETICAL AND EXPERIMENTAL STUDY OF FATIGUE IN PHOTOMULTIPLIER TUBES - Rev. Ignacio Cantarell

In spite of the wide-spread use of photomultiplier tubes for precise measurenents, there exists a difficulty which has not been overcone and vhich continues to distort the measurements made with

then. This difficulty is fatigue vhich is reflected in the abnormal,

variation in the gain with tim

?The more explicit brochures from phototube suppliers attribute the fatigue to cesium migration and coment that this phenomenon is not fully understood. Before 1958, only a few qualitative and semi-quantitive studies had been made and the causes of fatigue remained unexplained.

It was decided to carry out a systematic quantitative and qualitative study of fatigue in multiplier phototubes. The

variables vhich affect the phenomenon of fatigue vere first determined: These were found to be: (a) vorking time, (b) rest time, (c) history

---Page Break---

co previous use of tube, (4) intenetty

, (@) intensity and nature of

1 Pigplied voltage to aysonee Cay tee eppliea source,

(oereture. (2) nature of aynodes and (g) tube

The principal variable was time, since it fun

tne fatigue, anu 4o\an effect which cannot? be eraesemeneally affects

Muaies were later performed on the dependence of tevieve sectional

to the other variables.

ANNEALING EXPERIMENTS IN NEUTRON IRRADIATED

COMPOUNDS - Dr. J.F. Facetti with E. Trabal and 8. Torres

Antimony-III and -V compounds were submitted to thermel annealing

after neutron irradiation. The samples were analyzed by extraction

vith Isopropyl ether and measured with NaI (TI) crystal coupled to a

multi-channel pulse height analyzer.

The products of this type of Szilard-Chalmers process show

annealing response similar to other oxyanions and oxides studied.

DISTRIBUTION OF RADIOACTIVE ANTIMONY FORMED BY NUCLEAR

TRANSFORMATION IN ANTIMONY OXIDES - Dr. J. F. Facetti with

B. Trabal and S. Torres

Antimony oxides were irradiated with neutrons in the PRNC mpclear

reactor, to study the distribution of radioactive Sbl2@ and sbi!

between the tri and pentavalent oxidation states.

Antimony (V) vas extracted with isopropyl ether. ?The radioactive samples were counted in a NaI (?TI) well crystal coupled to « mlti-

channel analyzer.

The results show a linear relation between the composition of oxide and the percentage of radioactive Sb?, similar to that obtained by other workers with arsenic oxides.

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Adjusting a specimen on the Neutron Spectrometer

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HEALTH PHYSICS DIVvIs ION

?Te primary function of this divisi
sion is to establish and
and carry out,

a program guaranteeing the safety of Te

Rico Nuclear Center. 'y of all personnel working at the Rierto

PRO RGm tae menc oma

ae

onal operation ot the on meemect pol ype rexereh reer,

laboratory in ares was conducted under the direction of Dr. Jo: gente

Ferrer Monge. e project is kept current by continuous s: fag ten

gathering of data, ¥ Seas

A gratuate program lending to the M.S. Degree in Health Piysice ts

approved ty the Us-ABD" Special Feliovship Fropran administered by O&185.

Giicational cpportunitses offered by this divielon include:

THESIS RESEARCH FOR M.S. DEGREE IN HEALTH

PHYSICS

?Te graduate program in Health Physics includes the following courses:

Radiological Safety, Radiobiology, Radiological Electronics, Atomic Prysics,

Tiuclear Measurements and Instrumentation, Radiochemistry, Nuclear Techni-

ques in Biological Research, Mathematics of Modern Science, Advanced Radio-

chemical Techniques, Nuclear Chemistry, Health Physics and Biological

Oceanography. The required thesis research may be done at the Nuclear

Center on a problem of mutual interest to the graduate student and his

FRNC advisor.

SURVEY OF BONUS REACTOR SITE

?An ecological and environnental survey of the BOWS Reactor site in Rineén, Puerto Rico, is continuing. The general purposes of this project are to provide: dava on radioisotopes nov present in the area, snd useful data for the Marine Biology and Oceanography Program of PRNC under the direction ot De. Frank Loman. ?The project is divided into five parts: (1) survey of dicta, (2) determination of present ?radioactivity levels and composition of soil, rocks, water, sir and biota, (3) determination of . Stabte clonent composition of biota, (i) ecllection of background dasa ©

eaition of plokes (and topographic factore related to

eteorological, Hyirolosicel,, ca2ts hue coLiected to wake en evalustion

ecology, (5) integration of the da

related to a possible reactor accident.

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FUNDAMENTALS

Bonus Power Reactor

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we

REACTOR DIVISION

The division operates and mainte

Mayeguer: an 1277 Homogeneous Reactor anf en Mid pool tree geen retctor designed for operation at a'5 negiuatt power levels ?ie pslreneasnis fr ?the operation of the hot cells, gama irradiation facilities and shops. In addition t-te responsible for the aainte= nce and operation of the physical plant and the meteorological

station. It provides reactor and associated facilities for research

?Tne PRNC Research Reactor is operated at its authorized power level of 1 megawatt. Modifications have been made to correct defects and improve operation. Control rods have been calibrated, new core configurations have been studied in which the control rod worth has been improved considerably and in which all control rod interaction has been eliminated; neutron flux mapping of the cores has been done and in generals complete detemination of reactor parameters has been

?An expanding research program utilizing the reactors is develop~ ing. Two of the beam tubes of the reactor are now being utilized fulltime. A neutron spectrometer has been installed in one and the

?Thermal Bnissivity of Graphite Research Apparatus has been installed in another. A second larger neutron spectrometer was installed in a third beam tube.

?the Reactor Division has trained reactor operators for the new pows pover reactor being constructed in Rincén, Puerto Rico which Mil ae Mecrated by the Puerto Rico Water Resources Authority for the

U.S. Atomic Bnergy Comission.

REACTOR SUPERVISOR TRAINING

?This course is based on individual needs and interests. The trainee becomes acquainted with the electrical, electronic, and mechanical equipment associated vith the PRIC research reactor. He learns the roles and regulations governing operating procedures and pecones acquainted with and perfomns the duties of a reactor operator, Techniques and procedures for the irradiation of samples are denon-strated and reviewed as well as the techniques for the preparation of sere tetux mappings, neutron distribution and fuel burn-up calculations The routine aeintenance problens of reactor equipment and components ae retlined as well as the basic problens of safe reactor operation,

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ainder of the

Control room for research reactor currently operating at one megawatt power level

---Page Break---

NUCLEAR ENGINEERING DIVISION

ARCH FOR M.S. DEGREE IN NUCLEAR

| and bridge from which the reactor core is suspended.

« Research reactor Po rol room is visible inthe background,

??

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APPENDIX

---Page Break---

SCIENTIFIC

John C. Bugher, Director

M.D., University of Michigan

Pathology.

Henry J. Gonberg, Deputy Director

Pa.D., University of Michigan

Physics

Amador Cobas, Associate Director

Pa.D., Columbia University

Physics

Ismael Almodévar, Head

Neutron Diffraction Program

Ph.D., Carnegie Inst. of Technology

Chemistry

Héctor M. Barcel, Head

Reactor Division

M.S., University of Puerto Rico

Nuclear Technology

José A. Ferrer Monge, Head

Health Physics Division

Ph.D., Louisiana State University

Biology

José Luis Garcia de Quevedo, Head

Nuclear Engineering Division

Fh.D., Duke University

Prysics

53

STAFF

Sergio Irizarry, Head

Clinical Applications Division

M.D., University of Buffalo

Internal Medicine

Frank Lowman, Head

Marine Biology Program

Ph.D., University of Washington

Marine Biology

Victor Marcial, Head

Radiotherapy & Cancer Division

M.D., Harvard University

Radiology

Howard 7. Odum, Head

Terrestrial Ecology Program I

Ph.D., Yale University

Zoology

Eawin Roig, Head

Radioisotope Applications Div.

Ph.D., Pennsylvania University

Chemistry

Paul Weinbren, Head

Medical Sc. & Radiobiology Div.

M.D., LRCP, Witwatersrand Univ.

Pathology,

Owen H. Wheeler, Head

Wuclear Sc. & Technology Div.

Ph.D., University of London

Chemistry

---Page Break---

oh

Oriel Alva, M.D.

University of Bienos Aires

Radiotherapy

Enrique Avile, M.8,

University of Wiseonein

Oceanography

Hetmit J, Blelen, Ph.D.

University of Cologne

Inorganic Chemistry

Antonio Bosch, M.D.

Universidad Axténona de Méjico

Radiotherapy

Richard Brovn Campos, M.S.

University of Puerto Rico

Nuclear Technology

Ignacio Cantareli, Lic.

University of Madrid

Nuclear Physics

Pedro Cruz Gonzélez, M.S.

University of Puerto Rico

Paysies

Baltazar Cruz Vidal, M.A.

Harvard University

Physics

Maloolm Daniels, Ph.D.

University of Durham

Chendetry

George Drevry, M.A.

University of Texas

Zoology

Juan F. Facetti, Pa.D.

University of Asuncién

Radiochenistry

Zenaida Fries, M.P.H.

University of Michigan

Bio-Statistics

Joaquin Garcfa de 1 Noceda, B.S.

University of Puerto Rico

Physics

Jean Garcfa Rivera, Ph.D.

University of Wisconsin

Chenietry

Norma I. Gonzéiez, M.S.

Fordhan University

Biology

Julio A, Gonzalo Gonedlez, Ph.D

University of Madrid

Physics

Richard B. Knight, M.S.

University of Iiiinoie

Blectrical Engineering

Francis K. 8. Koo, Ph.D.

University of Minnesota,

Radiation Genetics

Aldo B. Lanaro, M.D.

University of Buenos Aires

Muclear Medicine & Endocrinology

Duane B. Linden, Pa.D.

University of Minnesota

Flant Genetics

Robert A. Luse, Ph.D.

University of California

Biochemistry

Andrew Maretaki, Pa.D.

Pennsylvania State University

Blochenistry

Raf MeClin, M.8.

University of Puerto Rico

Physics

Milagros Miré Vilarint, M.S.

University of Rierto Rico

Chemistry

Fausto Mufioz Ribadeneira 3.Ch.

Escuela Politécnica Nacional

Chemical Engineering

Margaret Nickle, M.S.

University of Minnesota

Bacteriology

---Page Break---

Kenkichi Okada, Ph.D.

Kyoto University

Physics

Eadie Ortiz, Ph.D,

Agricultural & Mechanical

College of Texas

Physics

Heidi Pabén Pérez, M.A.

University of Rochester

Radiation Biclogy

Maria M. Palacios de Lozano, M.S.

University of Rochester

Radiation Biology

Kenneth Soderstrom, M.S.E.

University of Floriaa

Mechanical Engineering

Juan J, Soltero, B.S.

University of Puerto Rico

Mechanical Engineering

Robert A. Stevenson, Ph.D.

University of Hawaii

Marine Ecology

H. Harry Semant, Ph.D.

Purdue University

Organic Chemistry

55

José M, Tong, M.D.

University of Zaragoza

?Therapeutic Radiology

Jeanne Ubifias, M.D.

Universidad Nacional Auténoma

de Majico

Radiotherapy

Florencio Vazquez Martinez, D.Ae.E.

University of Madrid

Physics

John B. Villella, Ph.D.

University of Michigan

Zoology

David Walker, Ph.D.

Washington State University

Entomology

Barbara Weinbren, M.A.B.M.B.Cb.

University of Oxford

Biochemistry

Carlos Wheeler, B.S.M.E.

Case Institute of Technology

Mechanical Engineering

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57

Staff Publications

1958 - 1963

Aimodévar, I., and Truman Kohman, ?um

Marine Sediments, ly, mortum Isotopes Method for Dating

Marine based on Ph.D, thesis egie Insti

Fe D. thesis at Carnegie Institute

wro=-) and R.D, Macfarlane, Study of the Sml49 (n, OL) wal46 React:

With thermal eutron, published in-Phyeiee feview 121, ES

?(ise2), Physics Review Letter, July 1962. me

1 B.C, Frazer, HJ. Bielen, and M.J. Kay, Neutron Diffraction

froiren (Progress Sumary heport fo. 1), published as FRIC-5,

Bielen, H.J., et. al., Logarithmische Rechntafeln, published in the

93rd. issue of the German Handbock for Chemists, Paarnacists,

Physicians, and Paysicists (1962).

, Ta. Hahn, W. Bysel, F, Weber, Structur Polymorphic Mischkristal-

?Toilaing, Von Verbindungen des Phena Kittyps, Chemie der Erde 22,

TP se

Blanco de del Campo, M., Symposium on Endecervical Adenocarcinona,

published in Acta Gitologica, Vol. IV, No. 1, 2, 3 (1960). ?

Symposium: Training of the Gytotechnologists published in Acta

Gitologica, Vol. IV, No. 1, SS

--, Symposiun on Effects of Progestational Agents, published in

?Acta Citologice, Vol. VI, pages FTES OEE)

Bonilla, F. (Former Director of PRNC), Fluid Flow in Reactor Systems

(chapter 9-2), Heat Renoval from Nuclear Reactors (Chapt Chapter 5-3)>

published in ficlear Engineering Handbook, McGraw-Hill Book Co.

New York (1958).

Bosch, A. and Maj. Wil. Caldveli (Medical Gorps, U.S. Amy) Effects

?oe Prilodothyronine in Altering the Response of Kidneys £9

eT ee paaictogs Volr G1, To. %,

Oetover 1963.

|, W.L. Caldwell, and Dr. R.W, Thomassen, Unfavorable Response of

Radiation Nephritis to Administration of Lafritodothyronine,

jublished in Nature, No, 4863, January 12, 1563.

Bugher, J.Ce, Book Review of Bently Glass? Science and Liberal Eaueation,

?published in Eugenics Quarterly, September 1961.

---Page Break---

58

Bugher, J.C.» The Puerto Rico Huclear Center Research Reactor: | Char-

acteristics and Propram Plans, published in Symposium on the

Progranning and Utilization of Research Reactors, Vol. 2, Vienna

(1961).

'=-, Yellow Fever, published in Encyclopedia Britannica, 1961

edition, pp. 683-084,

, Health Perspectives of Our Radioactive World, The First Annual

Bronfman Lecture, published in American Journal of Public Health

?and the Nation's Health, Vol. 52, No. 5, Nay 1962.

) et. al., Proceedings of Weapons Effects Seminar for Civil

jefense, jointly sponsored by PRIC, ABC, and the Commonwealth

Of Puerto Rico, published in Novenber 1962.

Canterell, I. and I. Alnodévar, Fatigue in Photomultiplier Dub

Its Relationsnip to the Malter Effect, published in Trans,

American Wuclear Society, Vol. §, io. 1, 25 (1961).

and

» 8, Cusdrado, and I, Alnodéver, A Simple Device for the Auto-
matic Elimination of Fatigue Bffects in Photomultiplier Tubes
published as PRNC-26, October 1963.

-, and I, Almodévar, Fatique in Photomultiplier Tubes- An Effect
?of the Malter Type, published in Nuclear Instruments and Methods
?2 No. by 353, October 1963.

-, and A, Macias, Time-Dependent Schottky Emission in Photo~
multiplier Tubes, Trans, Anerican Nuclear Society, Vol. 6, No. 2,
18 (1963).

=, and J.A, Gonzalo, Transient Radiation Effects on Electron
Bnission of High Resistivity Layers, Trans, Anerican Nuclear
Boctetys Vals 6, or 2, 305 (1903)-

Cobas, Anador and HH. Szmant, Solid State Physics - Radiation Damage

in Ongante Grystals (Progress Summary Report Wo. 1), published
PRNC-21 (July 1963).

Daniels, M., Fhotochentcally Induced Oxidation of Arsenite: Bvidence
for the Existence of As IV, published in Journal of Physical

Chemistry, August 1962.

., Radiation Chemistry of Arsenite, Part II: Reactions in Oxygen-

Free Solutions, published in Journal of Physical Chemistry,

?ugust 1962,

, and A. Grimison, Photochemistry of Thymine, published in

Nature 197, 484 (1963).

---Page Break---

59

Facetti, J.) Be treba, R,

» Re Moctin,

published in Physical Review Letters, Suig 4, yey WsteRe P20,

» Distribution

on of Radioactive Antimony Formed by Neutron Capture

33 Retimony Ggepounds, published as PRIC-29. Also published in

ee reed ?ganic and Nuclear Chenistry, Vol. 25, pp. 759°

Ferrer-Monge, J., Inheritance of Yield Component: spe

ot nts in an Interspecific

Bibrid of Cotton, (Fn.D. Dissertation) Louisiane State University,

=» Ecological Study of the West Coast of Puerto Rico (Progres:

Suimery Report No, 1), published as FANG-27, Novenber 1953.

Garcla Benitez, C. and 8. Wolff (of ORL), On the Increase of Sites for

Chromosome Exchange Information After Cisonasone Duplication

published in Science, March 196, (Work done at ORNL.

Garcla de Quevedo, J., The Puerto Rico Nuclear Center, published in

?Revista del Colegio de Ingenieros, Arquitectos ¥ Agrimensores de

Puerto Rico" 9, No. 1, 4a (1959).

Goaberg, H.J., J. Villella, and S.8, Gould, Corcariae Vaccine to Pro-

Tete Gaindly to Sobistosoniasis, pubisshed in Pioenix, Vol. 2,

Guce mee Goi. (work done at the University of Michigan.)

, and eA, Tase, Resonance Eadtation Effects of Lov Energy Hono

= Sere eablished a FRNC-2 Wanuary 1963)

sic X-rays on

shrouate Topas 98 eeyraléo published in Radiation Research,

Vol. 19, May 1963.

Gonzalo, J.A. Research in Ferroelectrics, Thermal Wysteresis in Barius

Tigenate, published as PRNC-25 (October 1963).

vcortum Teotope Effect in the Hydrogen Bonding of

Grintgon, Oxy She Deuterlam Lesh Bop pubtiated in douse oF Papeica.

Chemistry, Vol. 7, 2 (1963)-

for Radiation-Induced Back Mutation, published

Kooy F.K,S.» A MOGRAIEET SF Gongress of Radiation Herenreh, Abstract

in Bee 234 (August 1962).

of Papers, page

by X-Rays and Thermal, Neutrons in

cauced ?Terma

=, Biological Effect, FTES! OF Avena, published in Radiation

5 xaple

Gilet oes tae es

---Page Break---

Koo, F.K.8., Polygenic Variability Induced by Thermal Neutron Irra-

@iation, published in Radiation Research, Vol. 16, p. 50L

bstract) 1962.

) Action of S-Bremquractt Deoxyrtboside on Plant Chromosones, pubs

Llshed in Genetics Today, Vol. I~ Proceedings of the XT Inter

national Congress of Genetics, (he Hague, Netherlands) September

1963.

-, Synergistic Effect of 5-Bronodeoxyuridine and Gamma Rays on

Ghonosones, published in Selence, July 19, 1963. ~

Linden, D.B., Experiments Utilizing Radiation in a Paramutation Progran,

published in Maize Genetics Cooperation Weweletter, Vol. 36, Taso"

=, Additional Sources in Paramutation Induction Ability, published in Genetics, Vol, W8, July 1963.

n=, Effects of Radiation on Paramutation, published in Radiation Research, Vol. 19, May 1963.

=, Radiation Induced Modification of Paramutation Bxpression, published in Maize Genetics Cooperation News Letter, Vol. 37, pp. 133-134 (1963); also published in Genetics Today Vol. I- Proceedings of the XI International Congress of Genetics, September 1963 (?The Hague, Netherlands.)

» Survey of Some South Anerican Races with Variegated Alurones for Paramitation Induction Ability, published in Maize Genetics Cooperation News letter, Vol. 37, pp. 134~135 (1963).

Iowan, F. (a joint author), Disposal of low-level Radioactive Waste
into Pacific Coastal Waters, publication 985 of the National
Readeay of Sciences and the National Research Council (1962).

yy Hes Bate ranean (Progress Sumacy Report Bo, x), piste
as PRIC-15 (1963).

Jaws, B.A and A.D. MoLaven, Yechanisn of Inactivation of Bnayms Proveint
?by Ultraviolet Light, published in Science, Vol. 13%, No. 3Ne2,
pp. 036-037, September 22, 1961.

» Growth of Sterile Plant Roots in Sand or Soil in an Inexpensive
Growth Chamber, published in Soil Sclence Society of Anerica
?Proceedings, Vol. 26, No. 4, pp. 406-408, Jwly-august

aac-ney and A.D, Mclaren, Mechanisn of Enzyme Tnactivation by ULt

violet Light and the Fhotochenistiy of nino Actas Cat 537 Aly

Fublished in the Journal of Fhotochenistry end Photeblolowy,

Beptenber 1962. (Work done at University of California, Berkeley,

California.)

---Page Break---

a

Iuse, R.A., Review of Recent ey in

» Review of Recent Literature in Phe

wotobiology I, published

the Journal of Fhotochenistry and Fiotobiology, Watch 1962. Also

, Review of Recent Literature 4 m sy

Review of ature in Photobiology and Photoshente

published in Joumal of Fhotochentstey ant Photabisloaee

Decenber 1962. oer

) A.D. Mebaren and J.J. Skujins, Sterilizati

J. Skujins, Sterilization of Goth by Terad

?snd fone Further Observations x Sell Eaeye setivity, Bite

fence Society of America Proceedings, Vol.

pp. 371-377, July-August 1962, ca lead

) and A.D. Mebaren, Mechanion of Enzyme Inactivation by Uitraviolet

Light and the Photochenistig oF Hive setae, published in Fhoto- ?

chemistry and Photobiology, Vol. 2, pp. 343-360, August 1963.

, scent Literature in Motobiology ang Potechentetey IIL, published

in the Journal of Photochemistry and Photobiology, Vol. 2, pp.

73-19, 1963.

Marcial, V.A., Panel Discussion on Mediastinal Tumors with Presentation

?Of Cases, published in "Soletin de 1a Asociación Médica de Puerto

Fico", Vol. 50, No. 10, October 1958.

| ReA. Marcial Rojas, B, Mirabal, R, Diaz Bonet, L.A. Dfaz Bonet,

?Atieainal Tunore in? Children (Symposium with Presentation of Cases),

Eipiiahed In "Boletin de Ia Asociación Médica de Puerto Rico",

Vol. 51, No. 11, November 1959.

, Carcinoma of the Base of the Tongue, published in Anerican Journel

ee Fe Roe synenl29 (1999).

a=, RA, Marcie) Rojas, P. Dfaz Bonet, J, Davila Lope,

Santiago, Byriposiiim on ?Tumors of Bone, published in

Santiee?, ide iedics de Puerto Rico,? Vol. 51, lo. 2, February

1959.

) Cancer Morbidity in Puerto Rico, published in Acta Unto

taternationales Contra Cancrum, July 1960.

uasnse, Socioneconomie Aspects of the Incidence of Cancer in Puerto, EXGOs

Setisied in Annals of the New York Academy Of Sciences, Decesber

1960.

cen-osy ets ele Gareinona of the Penis, published in Radiology, August

1962.

Our Cancer Problem, published in ?poletin de 1a Asociacién MSdica

de Puerto Rico,? october 1962.

---Page Break---

Marcial, V.A., 0. Garcfa Ranfrez, and 8.A. Forster, Ivo Years Experien:
in etéatative Cytolosy in Puerto Rico, published in "woletin as
Ip AicclaciGn Média de Puerto Rico,? Vol. 5k, No. 9, pp. 203.05,
September 1962.

=, J. Figueroa Colén, R, Marcial Rojas, and J.B. Colén, Carcinona
nis, published in the Medical Association Bulleting
3+

of the Pe
?Fanuary 1963.
Maretzki, A. and MT, Mallette, Nutritional Factors Stimulating the

Formation of Lysine Decarbosylase in Escherichia Coli, publishea
Jn Journal of Bacteriology, Vol. 83, lio. 4, pp. 720-726, Apri

1962.

Medina, J.V. and H.J. Teas, Fluorescent Compounds in Bf-1, published in
Maize Genetics Cooperation Newsletter, 136e.

, Fluorescent Metabolites Accumulated by a Mutant of Maize

?published in Naize Genetics Cooperation liews Letter, Vol. 37,

PP. 135-136 (1963).

Odum, H.T., R.J. Beyers, and N.E. Armstrong, Consequences of Small

Storage Capacity in Nannoplankton Pertinent to Measurement of

Primary Production in Tropical Waters, published in the Sears

Foundation: Journal of Marine Research, Vol. 21, No. 3,

September 15, 1963.

» M.J. Copeland, and R.Z, Brown, Direct and Optical Assay of Leaf

Mass of the Lower Montane Rain Forest of Puerto Rico, published

In the Proceedings of the National Acadeny of Sciences, Vol. 49,

To. 4, 00, 429-434, April 1963.

-» Rod. Beyers, J. Lariner, R.B. Parker, NE. Armstrong, Directions

?for the Determination of Changes in Carbon Dioxide Concentration fron Changes in pH, published in Publications of the Institute of Warine Science, Vol. IX, pp. ¥54-N89, December 1963.

+) ReP. Cuzon du Rest, RJ. Beyers, and C, Allbaugh, Diurnal Metabolism, Total Phosphorus, Onle Anomaly, and Zooplankton Diversity of Abnormal Marine Ecosystems of Texas, published in Publications of the Institute of Marine Science, Vol. IX, PP» Nok=53, December 1963.

seen, Wb, Siler, RJ, Beyers, and N.B. Armstrong, Experiments with Engineering of Marine Eoosystens, published in Publications of the Institute of Marine Science, Vol. IX, pp. 373-403, December 1963.

-» Limits of Remote Beosystems Containing Man, published in The

American Biology Teacher, Vol. 25, lo. 6, October 1963,

---Page Break---

63

cain, HeP., Productivity Hoasure

, 2008 surements in Teras Turtle Grass

Etfacks of Dredetag? en Tatiacsustat eae Tee Cease a

Publications of the Institute o

13058, Decosnes Gaggstttate Of Marine Science, Vol. IX, pps

Okada, K., Fhoto-Micrographic Observations on X-Irradiated Rochelle Salt

Geistale,? publishes in the Tussnoas Sue a eS

2, No. 10, 613, October 1963, * ar of Renin Payeiss,

ortiz, B., Student Method for Determining the Binding

Deuteron, published in American Journal of Pigstce oy, oS

Biers rican Journal of Paysics 2, Noe 20,

, An Inelastic Neutron Scatterss

An Neutron Scattering Experiment, published in Anerican

Journal of Piysies, Vol, 30; Toe Snape ?31-630. (September 1962)

» Simple Experiments that can be done with a Neutron Soure

published as PRNO-DN (igegpe oe Sa & Here *

Palacios, Motley Radioactive Waste Dispose, (aoter's Thesis

University of Cincinnati, June 1960. : »

Roig, E., I, Rieckehoff, C, Russo, and J.D. Curet, Radioisotope Denon:

tration of Common Ton Effect on Solubility, published by Journ

?Of Chemical Education, Vol. 38, page 350, July 1961.

) and R.W, Dodson, The Thallous~Thallic Exchange at Varlous

?Acidities in Perchlorate Media, published in Journal in Fhysical

Chemistry 65, 2175 (1961).

Smant, HeH., G.W. Miller, J. Mekhlouf, and K.C. Schreiber, Preparation

?and Properties of frialkylfluorosilanes, published in Journal of

Seeanis aenistay 21 2 OE

Villella, J.B., H.J» Gonberg, and S.E, Gould, Inmnization to Schistosoma

ond in Mice Inoculated with Radiated Cercariae, published in

Mans

Seience; October 13, 1961. (Work done at the University of Michigan.)

Wethington, J.A., Activation Analysis (anéiisis por Activactén), published

?in ?soletin Informative, Comisién Nacional de Energfa Atémica,

Buenos Aires, Argentina, August 1962.

Wheeler, 0.H., The Girard Reagents, published in Chemical Reviews 62,

205 (1962).

=, The Polarographic Reduction of Ortho-alkyl Nitrobenzencs,

published in Canadian Journal of Chenistey, Vol. Ti (1903) pace

92, (UPR), Decenber 1962,

a---u-, Solvolysis of Sone Substituted Glutarie Anhydrides, published in

DSS Spants:Chenlstey, 24, WMD,ANG (lez) (UE).

---Page Break---

6h

Wheeler, 0.H., and C.B. Covarrubias, Ultraviolet Spectra of Some Sub-

?blished in Canadian Journal of Chemistry,

stitutea Styrenee, put

), 122! gee york for this paper was done at the "Instituto

de? Guinica? of the Universidad Auténoma de Mexico.)

Electronic Spectral Data - Volume IV (to which Dr.

weccoe, Organic

?imeler contributed), published by Interscience Publishers,

New York, 1963.

Oxidation of Substituted Anilines with

wscsesy and Ds Gonzélez,

Published in the Journal of Organic Chemistry,

Manganese Dioxide,

-, Solvolysis of Some Substituted Gluteric Anhydrades, published

in The American Chemical Society (1963).

and C.B. Covarrubias, Ultraviolet Spectra and Polarographic

?Reduction Potentials of Some Cinnanic Acids, published in the

Journal of Organic Chemistry, Vol. 28, 2015 (1963).

.-, Peter H. Grove, M. Santiago, and R, Béez Galib, Ultraviolet

?Absorption of Substituted Phenyl and Polycyclic Aryl Chalcones,

published in Canadian Journal of Organic Chemistry.

n-a-, Research Activities at Puerto Rico Nuclear Genter, published as

PRNG-23 (September 1963).

---Page Break---

5

Participation in Scientific Meetings

Author

Dr, Amador Cobas

Dr. Victor Marcial

Dr. Angel A.

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21958

Title

Plans for a Health

Physics Training Progran

at the Puerto Rico

Nuclear Center

Cancer Morbidity in

Puerto Rico

Cancer in the Puerto

Rican Woman

The Importance of Cobalt

Teletherapy in a Radio~

therapy Department

Cobalt Teletherapy in

Cancer

1952

Hematology

Vitamin B-12 Absorption

in Tropical Sprue

Serium Electrosphoretic

Patterns in 1,100 cases

of Schistosome mansoni

Place Presented

Symposium on Health

Physics in Biology and

Nedicine- May, 1958

San Juan, Puerto Rico

International Cancer

Congress- July, 1958

London, England

Meeting of the Puerto

Rico Medical Society-

September 1958

San Juan, Puerto Rico

Interamerican Congress

of Radiology Nov., 1958

Lima, Perd

?Symposium on Health

Physics in Biclogy and

Medicine- May, 1958

San Juan, Puerto Rico

2nd. Interanerican Atoms-

for-Peace Symposiun-

May, 1959

Buenos Aires, Argentina

Regional Meeting of the

?American College of

Physicians- Oct., 1959

San Juan, Puerto Rico

56th Annual Meeting of

the Nedical Association

of P.Re- Nov, 1959

San Juan, Puerto Rico

---Page Break---

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Dr. Victor Marcial,

Inna Rieckehoff

Consuelo Russo

Dr, Juan D, Curet

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Dr, Ismael Alnodévar

Me. .P. Kohman *

Dr. I, Alnodéver

Rev. I, Cantarell

Dr. AM. Andino

Dr. Arb. Rodriguez

Title

The Absorption of Gamma

and Beta Rays by Weakly

Paremagnetic Substances

cancer of the Tongue

Cancer Control in Puerto Rico- Ten Years Experience

The Demonstration of Chemical Principles by the Use of Radioisotopes

?Training in Radiochemistry in the Puerto Rico Nuclear Center

1960

?Te Thorium Isotopes Method for Dating Marine Sedineters

?An Experimental Study of Fatigue in Photomultipliers

A Practical Method for ?the Compensation of

Fatigue Effects

Radioactive Iodine

?Treatment in Hyper-

?thyroidism

Flace Presented

?7th. Latin American

Chemical Congres

April, 1959

Mexico City, Mexico

lst. Latin American

Cancer Congres

October, 1959

Buenos Aires, Argentina

56th. Annual Meeting of

?the Medical Association

of P.R., Hov., 1959

San Juan, Puerto Rico

Tth, Latin American

Chemical Congre:

April, 1959

Mexico City, Mexico

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Chemical Congres

?April, 1959

Mexico City, Mexico

Meeting of the Anerican

Chemical Society-

September, 1960

New York

Meeting of the Anerican

Chemical Society-

September, 1960

New York

Meeting of the Anerican

Chemical Society-

September, 1960

New York

loth, Annual Meeting of

the P.R. Chapter of the

American College of

Physicians Oct., 1960

San Juan, Puerto? Rico

---Page Break---

Author

Dr. Victor Marcial

Dr. Warren Miller

Dr, Eddie Ortiz

Dr. A.L, Rodriguez

Title

Treatment of Cancer of

?the Tongue er of

Socio-economic Aspects

of the Cancer Incidence

in Puerto Rico

Beta Spectra with a

Plastic Scintillator

Instructional Laboratory

Experiments with a

Neutron Source

Compton Spectra

Experience with and

Dr. Ernesto Marchand Integration of the

Dr, A.L, Rodrfguez

John C, Bugher

Diodrast Renogram (a
summary of the experi-
ence of 70 renograms)

Serial In-Vitro Uptake
of Fe-59 by Bone Marrow
Suspensions in Different
Hematologic States

362

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

6r

Elace Presented

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

Sen Juan, Puerto Rico

Conference on Society

Culture and Health in

?the N.Y. Acadeny of

Sciences- June, 1960

New York

29th. Conference of the

American Society of

Physics Teachers-

January, 1960

New York

29th, Conference of the

?American Society of

Physics Teachers-

January, 1960

New York

29th. Conference of the

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New York

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?the P.R. Chapter of the

American College of

Physicians- Oct., 1960

San Juan, Puerto Rico

P.R, Medical Association

Meeting- November, 1960

San Juan, Puerto Rico

Symposium on the Program-

ming. and Utilization of

Research Reactors-

October, 1961

Vienna, Austria

---Page Break---

68

Author

Rev, I. Cantarell

mite

Fatigue in Fhoto-

Dr. Ienael Almodéver multiplier Tubes and

Dr. John C. Bugher

Dr. Job. Garcfa de

Quevedo

Dr. Henry J.

Gonberg,

Dr. Victor Marcial

its Relationship to

?the Matter Effect

Health Perspectives of

our Radioactive World

(ie First Annual

Bronfman Lecture)

Education and Research

Centers

Fission, Fusion and

Radiation Energy in a

Tew Dimension

Cancer of the Esophagus

The Prognostic Value of

Cytology in Cancer of the

Cervix-Uteri

Radiotherapy for Advanced

Cancer: Cancer Control

Program in Puerto Rico

Cancer of the Tongue

Carcinoma of the

Esophagus

Place Presented

Meeting of the Anerican

Muclear Society-

Sune, 1961

Pittsburg, Pennsylvania

2nd. General Session of

?the American Public Health

Association, 89th. Annual

Meeting, Hov. , 1961

Detroit, Michigan

ABA, Regional Symposiun

on Bducation and Nuclear

Energy- November, 1961

Bariloche, Argentina

Samuel Sackett Series

of Lectures on Nuclear

Energy- October, 1961

Chicago, TlLinois

?Annual Meeting P.R.

Chapter of the Anerican

College of Surgeons~

February, 1961

San Juan, Puerto Rico

Ast, National Cancer

Congress- 7th Radio-

Logical Workshop~

August, 1961

Bogoté, Colombia

Let. National Cancer

Congress 7th Radio-

Logical Workshop-

?august, 1961

Bogota, Colombia

?American Roentgen Rey

Society Meeting- Sept. 1961

Mion, Florida,

7th. Interanerican

Congress of Radiology~

September, 1961

Sao Paulo, Brazil

---Page Break---

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Dr. Edwin Roig

Title

Teletherapy Isotope

Cancer Control in Pu

\erto

Rico, Twelve Years

Experience

Treatment of Cancer of
the Tongue

Cancer of the Esophagus

Carcinoma of the Penis,
Therapeutic Problens

Common Ion Effect on
Solubility- A Denons-
tration with Radioisotopes

The Role of Calcium on
the Intestinal Absorption
of Vitamin B-12 in
?Tropical Sprue

The Thallous~Thallic
Exchange at Various
?Acidities in Perchlorate
Media

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?7th. Interanerican

Congress of Radiology

September, 1951

Sao Paulo, Brazil

National Cancer Insti-

tute of Guatenala-

Hovenber, 1961

Guatenala City

12th, National Congress

in Medicine of the Col-

Lege of Physicians and

Surgeons of Guateuala-

Novenber, 1961

Guatenala city

1th. National Congress

in Medicine of the Col-

Lege of Physicians and

Surgeons of Guatenala-

Hovenber, 1961

Guatenala City

?Annual Meeting of the

Radiological Society of

North America~ Nov., 1961

Chicago, Illinois

Caribbean Chenistry

Conference- April, 1961

University College of

the West Indies

Kingston, Jamaica

2nd. Annual Meeting of

the University of P.R.,

School of Medicine-

June, 1962.

San Juan, Puerto Rico

caribbean Chenistry

Conference- April, 1961

University College of

tthe West Indies

Kingston, Jamaica

---Page Break---

70

?Author

Dr. HH, Szmant

Dr, Howard J. Teas

Dr. José M. Tomé

Dr.Mario Vuksanovic

Dr. J.A. del Regato

Mr. Héctor Barcelé

Dr. Antonio Bosch

Dr. Malcolm Daniels

pr. Juan Facetti

Title

Chemistry in latin

America,

Application of Atonie

Energy in Agriculture

Carcinoma of the Anterior

?Two-Thirds of the Tongue

Carcinoma of the Skin

Overlying Cartilage

62

Comparison of Rod Worth

vy Period and Analog

Computer Methods

Elimination of Control

Rod Vibration Caused by

Water Flow

Effects of L-Triiodo-

thyronine in Altering

?the Response of Kidneys

to Cobalt-60 Irradiation

Photochemistry of Thymine

Solutions

Distribution of Radio~
active Antimony Formed by
Muclear Transformation
in Antimony Oxides

1st. Interanerican Con
of Chemical Engineers a
October, 1G1

San Juan, Pierto Rico

In response to Jotat
invitation of ABC and
the Governor of
Nebraska- Oct., 1961
Lincoln, Nebraska

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

San Juan, Puerto Rico

Annual Meeting of the

Radiological Society of

W.A.~ Novenber, 1961

Chicago, TLlinois

Conference on Light

Water Moderated Research

Reactors- June, 1962

Oak Ridge, Tennessee

Conference on Light

Water Moderated Research

Reactors June, 192

Oak Ridge, Tennessee

4th, Annual Meeting of

?the Radiological Society

of N.A.- November, 1962

Chicago, Illinois

Colloquium on Photo-

chenical Transformation

of Natural Products, 2nd,

Int. Symposiun- Sept., 1%:

Prague, Czechoslovakia

Eastern Regional Neet

Anerican Chemical Society

Novenber, 1962

Gatlinburg, Tennessee

---Page Break---

Author

Title

Dr, Henry J. Gonberg Utilization of Nuclear

Dr. Sergio Irizarry

Dr, Francis KS.

Koo

Dr, Duane B, Linden

Dr, Frank G. Lowman

Dr. Victor Marcial

Dr. Pablo L. Morales

Dr. Victor Marcial

Dr. Andrew Maretzki

Energy for Civilian

Purposi

Case Report of Patient

with Carcinoma of Thyroid

?Treated with I-13.

The Use of Renogram in

the Clinical Evaluation of

Carcinoma of the Cervix

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Polygenic Variability

Induced by Thermal

Neutron Irradiation

Bffects of Ionizing
Radiation on Peramite-
tion

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

Prognostic Factors in
Cancer of the Esophagus

Cancer Mortality in
Puerto Rico

Aspects of Ascorbic Acid
Metabolism in Acerola

Ascorbic Acid Synthesis

n

?Tth Convention of the
PAU of Engineering

Bocieties= Aug.» 1962

San Juan, Puerto Rico

59th. Meeting of the PLR.

Medical Association

Novenber, 1962

San Juan, Puerto Rico

4th, Interanerican

Symposium on the Peace-

ful Applic. of Nuclear

Bnergy- April, 1962

Mexico City, Mexico

Annual Meeting of the

Radiation Research Soc.

May, 1962

Colérado Springs, Colorado

American Society of

Agricultural Scienc

October, 1962

Mayaguez, Puerto Rico

3rd, International

Symposium on Water

Pollution- Aug., 1962

Cincinnati, Onid

Annual Meeting of the

Radiological Soc. of PR.

and the Anerican 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~ Nov., 1962

San Juan, Puerto Rico

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Author

Dr. Vicente J.

Medina,

Dr. Eddie ortiz

Dr. Edwin Roig

Dr. Harry Semant

Dr, William Stucki

Title

?The Influence of Copper,

Iron, and Form of Nitrogen

on M099 Uptake in Cajanus

indicas

Inelastic Scattering of
Iron Using a Neutron
Source

?The Thallous-TMallic
Exchange at Various
Acidities in Perchlorate
Media

Scientific Documentation
in the Field of Chemis.
try

The Structure of Beta-
Hydroxysulfides Obtained
by the Oxidative Addition
of Thiols to Olefine

?The Synthesis of Intra~
molecularly Coordinated
Boron Compounds

Scientific and Techno-
logical Resources of

Iatin Anerica

The Scientific and Tech-
nological Resources of
L.A. and the Alliance for
Progress

?An Investigation of the
Carotenoid Pignents of
Achiote

Place Presented

American Society of
Agricultural Sciences
October, 1962

Mayaguez, Puerto Rico

Meeting of the Auerican
Physical Society
Samary, 1%2

Wew York

8th, Tatin Anerican

Congress of Chenistry

Septenber, 1962

Buenos Aizes, Argentina

Seninar on Scientific

Documentation in L.A.

sponsored by UNESCO

Septenber, 1962

Tima, Pert

Sth, Latin American

Congress of Chenistry

September, 1962

Buenos Aires, Argentina

@th. Latin Anerican

Congress of Chenistry

Beptenber, 1962

Buenos Aires, Argentina

Seninar on Chemical.

Industry of L.A, and the

Connon Market, 8th. LoA-

Congress of Chenistry

September, 1962

Buenos Aires, Argentina

The Johns Hopkins Uni-

versity- April, 1962

Baltimore, Maryland

American Society of

Agricultural Sciences

October, 1962

Mayaguez, Puerto Rico

---Page Break---

Author

Dr. Howard J. Teas

Dr. José M, Tomé

Dr. Jeanne Ubiias

Dr, John Villella

Dr. J.A. Wethington

'. Ismael Almodévar

Titre

Keto Acide in 5

Tropical Planta

Inhibition of Banana

Fruit Ripening by Gama

Radiation ae

Hodgkin's Disease: Our

Experience at the Dr. I.

Gonzélez Martinez

Oneologic Hospital

Carcinoma of the Tonsil.

Inmune Responses to

Irradiated Cercariae of

Schistosoma Mansoni.

Dosimetry fron Photon

Spectra and Pulse-Height

Distributions

1963

A Neutron Diffraction

Refinement of the Ca WO,

Structure

Method for the Isolation

of Thorium fron Siliceous

Materials

ew Results in the Search

for Alpha Particles from

?the Thermal Neutron

Enduced Ue3® (n, 0) TH235

Reaction

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Flace Presented

Annual Meeting of the

Society for Economie

Botany= June, 1962

Washington, D.C.

2nd. International

Congress of Radiation

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

P.R. and the Anerican

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-

Septender, 1963,

Rone, Italy

2nd. Caribbean Chemical

Syrposium- August, 1963

(o Piedras and Mayaguez,

Puerto Rico

Physics Department of

the University of Bonn

September, 1963

Bonn, Gernany

---Page Break---

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Author

Dr.Tenael AlnodSvar

Rev. Ignacio

Cantrell

Dr. Helmut Bielen

Dr. Helmt Bielen

Dr. John C. Bugher

Rev. Ignacio

Cantarell

Dr, Julio A.

Gonzalo

Rev. Ignacio

Cantarell

Dr, Malcolm Daniels

Dr. Alec Grimison

Dr. B. Chalmers

Frazer

Dr. Sergio Irizarry

Dr. Mortimer Kay

Tithe

Search for Alpha Particles
from Thermal Neutron~
Induced Ue39 (n,
?m23> Reaction

Determination of Dis-
sociation Vapour Pressure
and Structure of Sone
Heavy Metal Sulfides

Maclear Centers in Latin
America: their part in
Scientific Development.

?Transient Radiation

Effects on Electron

Bnission of High-

Resistivity Layers

?Time-Dependent Schottky

Enission in Photomlti-

plier Tubes

Photochenistry of

?Taymine

Magnetic Ordering in Some

Related Orthorhombic Gacn

and Poma Structures

Fat Absorption Study with

I-13l Labelled Oleic. Acid

in Patients with Cancer

of the Uterine Cervix

Receiving Cobalt Radiation

to the Abdomen

Neutron Diffraction

Studies at the Puerto

Rico Nuclear Center

Place Presented

2nd. Caribbean Chentcat

Symposiun- August, 1963

Rfo Piedras and Mayaguez,

Puerto Rico

2nd, Caribbean Chemical

Symposium- August, 1963

Rfo Piedras and Mayaguez,

Puerto Rico

Study Group Meeting on

Research Reactor

Utilization

American Nuclear Soc.

November, 1963

New York

American Nuclear Soc.

Novenber, 1963

New York?

2nd. Caribbean Chenical
Symposium August, 1963
Rfo Piedras and Mayaguen,
Puerto Rico

?Symposium on Ferro-
Magnetism and Ferro-
electricity, June, 1963
Leningrad, Russia

Thirty Second Annual
Meeting of the P.R.
Dietetic Association
Sune, 1963

San Juan, Puerto Rico

International Collo-
quium of Neutron Dif-
fusion and Diffraction
September, 1963
Grenoble, France

---Page Break---

Author

Title

Dr. Francis KS, Actions of 5-Bronouracit

nea Deoxyriboside on Plant

somes

Dr. Duane B. Linden Effects of Radiation on

Paremutation

Radiation Induced Modi~

fication of Paramutation

Expression

Dr, Duane B. Linden Uses of the PRNC Gamma

Mr, José Cuevas Irradiation Facility in

Mr. Vicente Rodr{- Agricultural Research

guez

Dr. Frank @, Lovman Activation Analysis

Method for Scandium,

Antimony, and Phosphorus

Dr. Robert A, Iuse Resonance Radiation Ef-

Dr. Henry J. Gomberg fects of Low-Energy

?Monochromatic X-rays on

Catalase

Resonance Radiation Ef-

fects of Low-Energy

Monochromatic X-rays on

the Mettaloenzyme

Catalase

Dr. Robert A. Luse Basic Mechanisms in the

Radiation Chemistry of

Proteins and Nucleic

?Acids in Aqueous Media

Lith, International

Congress of Genetics

ptember, 1963

Scheveningen, The

Netherlands

1th, Annual Meeting

of the Radiation Re-

arch Society

May, 1963

Milwaukee, Wisconsin

1ith, International

Congress of Genetics

September, 1963

Scheveningen, The

Netherlands

Fall Meeting of the

American Society of

Agricultural Sci-

ences Oct., 1963

Mayaguez, Puerto Rico

2nd, Caritbean Chen

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?August, 1963

Rfo Piedras and Ma-

yaguez, Puerto Rico

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of the Radiation Re-

search Society

May, 1963

Milwaukee, Wisconsin

2nd. Caribbean Chem-

ical Symposium

?August, 1963

Rfo Piedras and Ma~

yaguez, Puerto Rico

Conference on Basic

Mechanisms in the

Radiation Chemistry of

?Aqueous Media

May, 1963

Gatlinburg, Tennessee

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Dr. Victor Marcial Cancer of the Penis

Dr. Victor Marcial Radiotherapy in Garcinona

Dr, Joo& Toné of Cervix Wert

Dr, Fausto J. Mufioz Effect of Copper Sulfate

Ribadeneira |, on the Ceric Dosinetry

Miss Milagros Miré System

Dr. Eadie Ortiz ?High Energy Gamma Photons-

Dr. Juan Facetti Neutron Conversion Device

for Half-Life Measurenents

Dr. H. Harry Samant Base-catalyzed Formation

Mr, EP, Olavarria of Inidates

Dr. H, Harry Samant Association Constants

Dr, Bdyin Roig for Sulfoxide-Phenol.

Mr, Rail H. Figueroa Complexes

Dr. David Walker Longevity of Adult Diatre

Mre, Adela Alemafy saccharalis (Fab.)

Granbinse, Pyralididee,

Lepidoptera

Dr. David Walker Mating Behavior and

Fecundity of Distrea

saccharalis

Mating Behavior of the

Sugar-Cane Borer,

Diatrea saccharalis (Feb.)

Cranbine, Pyraiididee,

Lepidoptera

Place Presented

th. Congress of the

Pan Pacific Surgical

Association

November, 1963,

Honolulu, Haveli

?Annual Meeting of the

Western Branch of the

P.R, Medical Associ

ation April, 1963

Mayaguez, Puerto Rico

2nd. Caribbean Chenical

Symposium August, 1963

Rio Pledras and Vaya

guiez, Puerto Rico

American Physical Soc,

Tanuary, 1963

ew York

Bnd, Caribbean Chenoa

Symposiun- August, 1963

Rfo Piedras and Maya-

guez, Puerto Rico

2nd, Caribbean Chemical

Symposiun- August, 1963,

Piedras and Maya

guez, Puerto Rico

Fall Meeting of the

?Anerican Society of

Agricultural Sci~

ences Oct., 1963

Mayaguez, Puerto Rico

Bntomological. Society of

America Neeting

December, 1963

St. Louis, Missouri

Fall Meeting of the

?American Society of

Agricultural Sci-

ences- Oct., 1963

Mayaguez, Puerto Rico

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Author Title Place Presented

Dr. David Walker Oviposition ty Diatren Fal.

re Meeting of the

Mr. Miguel Figueroa saccharalis (Fab.) ~~ _narican Society oe

Granbinae, Pyralidiase, Agricultural Sclences

Lepidoptera October, 1963

Mayaguez, Puerto Rico

Dr. M.P, Weinbren Rift Valley Fever and ?th International

Nairobi Sheep Disease Cong. of Tropical

Medicine and Malaria

September, 1963

Rio de Janeiro, Brazil

Dr. Owen H. Wheeler Acid-catalyzed Solvolysis 2nd. Caribbean Chemical

of Some Substituted -Y" Symposium August, 1963

Butyrolactones and -y~ Rio Piedras and Maya-

Valerolactones guez, Puerto Rico

Dr. Owen H. Wheeler Oxidation of Primary 2nd. Caribbean Chemical

Mr. D. Gonzélez Aromatic Amines with Symposiun- August, 1963

Manganese Dioxide Rfo Piedras and Maya

guez, Puerto Rico

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STUDENTS TRAINED AT PRNC

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ACADEMIC YEARS

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Student Statistics

FE 1958 - FY 1964

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?Argentina

Bolivia,

Chile

Colonbia

Costa Rica,

Cuba

Ecuador

BL Salvador

Great Britain

Guatemala

Haiti

India

Japan

Mexico

Micaragua

Panama

Paraguay

Peru

Philippine Islands

Santo Domingo

South Africa

Spain

Uruguay

Venemela.

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otal NonU.S. Citizens 9 2 2 A 2 BH 35 169

U.S, Citizens 50 52 7h 7h ll 161 176 687

TOTAL STUDENTS 59 72 98 95 122 97 al 8%

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EMPLOVMENT STATISTICS

Program O7 - Training & Education

Program 05 - Biology & Medicine

Program 05 - Physical Seiences

¥Y-1958 FY.1955 ¥Y-1960 Fv-1961

Category Progran o7 | Program o7 | Program 07 | Progran o7

Scientific y 6 a 25

Technical B 23 3L 3

Other 7 6 35 28

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Total 43 63 87 120

FY-1962 ¥Y-1963 ¥Y-196!

Program Prograns | Progran Prograns | Program Progrens

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?Total 213 5 176 50 201 3

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