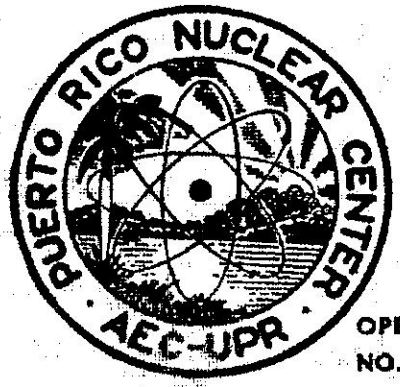
PRNC-77

PUERTO RICO NUCLEAR CENTER

TWELFTH BIO-MEDICAL ADVISORY
COMMITTEE MEETING

November 4-5, 1965



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

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

Revised
10/19/65

TWELFTH MEETING OF BIO-MEDICAL ADVISORY COMMITTEE
November 4-5, 1965

Thursday, November 4, 1965

9:00 - 10:00 a.m.	Executive Session
10:00 - 10:15 a.m.	Coffee Served
10:15 - 10:45 a.m.	TERRESTRIAL ECOLOGY II - VIROLOGY Dr. M.P. Weinbren
10:45 - 12:00 noon	TERRESTRIAL ECOLOGY I - EL VERDE Dr. Howard T. Odum Dr. Jerry Kline
	Lunch
2:00 - 4:00 p.m.	EL VERDE FIELD TRIP

Friday, November 5, 1965

9:00 - 11:00 a.m.	CLINICAL APPLICATIONS DIVISION Dr. Sergio Irizarry
	RADIOTHERAPY AND CANCER DIVISION Dr. Víctor Marcial
	RADIOISOTOPE APPLICATIONS DIVISION Dr. Edwin Roig
	AGRICULTURAL BIO-SCIENCES DIVISION Dr. Robert Luse
	MEDICAL SCIENCES AND RADIOBIOLOGY DIVISION Dr. M.P. Weinbren
	INTERNATIONAL EXHIBIT PROGRAM Mr. F. Muñoz Ribadeneira
11:00 - 11:20 a.m.	SCIENTIFIC NEEDS IN LATIN AMERICA AND PRNC PROGRAMS Dr. Jorge Chiriboga
11:20 - 11:40 a.m.	INTERNATIONAL ASPECTS OF RADIOLOGICAL HEALTH AND SAFETY Dr. Howard L. Andrews
11:40 - 12:00 noon	Discussion
1:00 - 4:00 p.m.	Executive Session

PRNC BIO-MEDICAL ADVISORY COMMITTEE MEMBERS

Dr. John A. D. Cooper
Dean of Sciences
Northwestern University
619 Clark Street
Evanston, Illinois

Dr. Juan A. del Regato
The Penrose Cancer Hospital
2215 North Cascade Avenue
Colorado Springs, Colorado

Dr. James G. Horsfall
The Connecticut Agricultural
Experiment Station
P. O. Box 1106
New Haven, Connecticut

Dr. Paul B. Pearson
The Nutrition Foundation, Inc.
99 Park Avenue
New York 16, New York

Dr. Shields Warren, Chairman
Cancer Research Institute
New England Deaconess Hospital
195 Pilgrim Road
Boston 15, Massachusetts

Radiation Induced Variability in Indigenous Arthropod-Borne Animal Viruses of Puerto Rico

STAFF

M. P. Weinbren, B.Sc. (Hons), M.D., M.R.C.S., L.R.C.P., Half time Head, Division of Medical Sciences and Radiobiology; B. M. Weinbren, B.Sc. (Hons) M.A., B.M.B.Ch., 1/3 time, Associate Scientist, Division of Medical Sciences and Radiobiology.

SCOPE

This program is designed specifically to study the effects on natural virus cycles (especially Arboviruses) in gamma-irradiated portions of Tropical Rain Forest. Evidence of Arbovirus activity is being sought by attempting direct virus isolation (in infant white mice and tissue cultures) from trapped arthropods and blood samples collected from vertebrates in the area. The blood samples are also used to obtain indirect evidence of virus activity by the results of various serological tests. Although some aspects of this study might be covered by laboratory experiments, the program as designed takes advantage of an unique opportunity for study in nature. One hypothesis that we are particularly interested in testing is that of re-activation of latent virus, which has become latent through identification of its nucleic acid with that of the arthropod host.

CURRENT STATUS

In the pre-irradiation period 90 rodent traps were placed on set lines, and in them, trapping weekly, 327 Rattus rattus (the only rodent in the area) have been trapped, marked and released and 758 recaptures were made. The highest retrapping score being 27. On 99 occasions in this period light traps were set to catch flying arthropods and in them 7,103 mosquitoes of 5 genera were taken. More than 386 rat sera and all the mosquitoes were tested but yielded no viruses. Four hundred rat sera were tested for Arbo-virus antibody and 15 gave a positive reaction to Casals Group B. When irradiation began an additional 50 rodent traps were positioned outside the irradiated area and both rat and mosquito trapping has continued on a regular weekly basis outside the irradiated area and also in the irradiated area on the two occasions on which the source was lowered for 24 hours, and, of course since the period of irradiation ceased. About six weeks after the irradiation began, we started isolating viral agents, mainly from rat sera, but have also obtained them from a few mosquito pools and from the brain of two rats which were sick when trapped. After exhaustive testing these agents have been identified as being, if not Coxsackie A10, then so closely related to this virus as to be indistinguishable by normal laboratory methods.

Terrestrial Ecology Program, Part I
The Rain Forest Project

STAFF:

Howard T. Odum, Ph. D., Chief Scientist II, Principal Investigator; Francis K. S. Koo, Ph. D., Associate Scientist II; Jerry R. Kline, Ph.D., Associate Scientist I; George Drewry, Associate Scientist I; Robert F. Smith, Oak Ridge Graduate Fellow; and Visiting Scientists. H. B. Tukey, on sabbatical leave from Cornell University.

PURPOSE:

(1) To study effects of gamma irradiation from 10,000 Curies Cesium on the Rain Forest system at El Verde.

(2) To study hydrological balance and some mineral cycles of the rain-forest in relation to fall-out and atomic excavation.

(3) To characterize the circuits and metabolic energy pulses of a complex terrestrial ecological system so as to understand the consequence of irradiation and fall out storage.

CURRENT STATUS:

A. Radiation Effects Studies

The Rain Forest Project at El Verde involves irradiation of a plot of lower montane forest with gamma radiation from a 10,000 Curies Cesium source. After 15 months of pre-irradiation studies and preparations at the radiation and control areas, irradiation began January 19, 1965. The main site was irradiated for 3 months, the innermost zones receiving a million R. Post irradiation measurements are in progress showing effects of radiation according to dosage received, according to species, and according to various categories of ecological and cytological structure and function. Data emerging provide some factual basis for predicting effects of radiation on rainforests and the rates of regeneration of the living system.

Various methods for appraising effect and recovery include optical density, frog noise, microclimate, measurements of new growth, seedling growths, germination, micro-organismal populations, soil metabolism, animal populations, aerial photographs, etc.

B. Mineral Cycles

Quantitative understanding of the mineral circuits through tropical systems is essential to understanding of the nature of such machinery, the soils, and the ways such systems may process radioactivity entering in relation to AEC related activities. Understanding mineral cycling will be the primary objectives of new measurements in the rain forest project.

1. Radionuclide Balance in the Rain Forest

The experience of investigators in the temperate zones indicates that a substantial proportion of fission products found in plant communities is in the form of surface contamination on leaves and that only a minor part of these isotopes ever enter the metabolic pathways of the plants. Nevertheless, such observations at El Verde as the extensive surface root development, and root invasion of organic litter and logs suggests that this forest might be well adapted to the conservation of minerals by maintaining them in reasonably closed cycles. This view is reinforced by preliminary observations of soils which indicate an almost complete absence of fission products while the decaying litter at the soil surface contains large amount of radioactive isotopes. The contrast between temperate zone experience and circumstantial evidence of the tropical forest requires that a specific experiment be carried out to gain more information on mineral cycling in the tropics.

The suggested experiment is visualized as consisting of a basic input-output investigation in which incoming radionuclides, canopy burdens, soil burdens, and losses of radionuclides from the forest are measured over a period of time.

The experience gained from these observations may suggest the necessity of a supplemented tracer experiment in which the specific objective is to determine the degree of Cs-137, Mn-54 uptake by roots from soils.

2. Effect of Gamma Irradiation on Fission Product Retention by Forest Trees

Samples were taken before and after the irradiation from forest trees in the irradiated and control centers. The measurement of Cs-137 and Mn-54 in these samples by gamma-ray spectrometry provide a measure of the effect of irradiation on the cycling of these elements in the forest system.

3. Neutron Irradiation Studies

Plans are being formulated for the irradiation with neutrons of forest materials such as soils, plants, rocks, and litter. Information expected to result from such irradiations includes the determination of dose exposures, and gross half lives of irradiated materials under known flux and irradiation times. In addition the identification and measurement

of many elements as for example, Cu, Co, Fe, Zn, Cs, Mn, Sc, La, Na, and others can be carried out on neutron irradiated speciments. Some samples from Panama and Virgin forest of Dominica were collected for comparisons.

4. Natural Radioactivity in the environment

Preliminary surveys of soil specimens from various locations in Puerto Rico have revealed certain sites of unusually high levels of radium daughters. These sites which contain a factor of 6 more natural radioactivity than the El Verde site may be of considerable value in future studies of the behavior of radioisotopes of the Uranium decay series in natural environments.

A suggested preliminary use for these sites is to study the possibility of radon transpiration by plant by examining wood from the trees of these locations for equilibrium mixtures of lead-210 and polonium-210.

5. Leaf Leaching

Coincident with Dr. Tukey's sabbatical work here, special effort is being made to measure the leaching rates of the leaves of the rain forest trees and two species of rain forest climate agricultural species for comparison.

C. Circuits and Metabolism

A special proposal PRNC was prepared outlining the electrical analog circuits that might be prepared if authorized and budgeted.

The system on the passive principle allows for flows in 36 compartments for which there are data available to set storage constants and rates.

The work on a giant cylinder to measure forest metabolism and transpiration when the plastic tore loose in the wind after being in position 10 days. A stronger plastic has been ordered. Priorities on this experiment may go up now since the giant cylinder provides rates of transpiration for a section of rain forest, an item necessary to calculate the tritium balance in any consideration of Panama canal feasibilities.

Clinical Applications Division

STAFF

Sergio Irizarry, M.D., Chief Scientist III, Head; Aldo E. Lanaro, M.D., Associate Scientist II; Oscar N. Vázquez, M.D., Associate Scientist II; Pedro Juan Santiago, M.D., Research Associate I.

PURPOSE

The main purpose of the program of this Division is teaching and training of Latin American physicians in the diagnostic and therapeutic uses of radioisotopes in humans.

CURRENT STATUS

Courses Available:

(1) Basic Course Clinical Applications of Radioisotopes. This course consists of formal lectures, demonstrations, periods of discussion and laboratory work. Its main purpose is to emphasize training in the use of clinical radioisotopic techniques.

(2) Orientation Course Clinical Applications of Radioisotopes for Medical Residents. This is a non credit semester course for Medical Residents designed for orientation only in the medical uses of radioisotopes.

(3) Course in a Medical Specialty. This is a course emphasizing the application of nuclear techniques in a special field of Medicine. A course in the field of Renal Diseases was given in June and September; two new courses are scheduled for the next semester (February and June, 1966).

(4) Training in Clinical Research. This course stresses research aspects in Clinical Medicine, and is designed to provide research facilities to trainees interested in clinical radioisotope research work.

Special activities to increase training capacity:

(1) Trip to South America. During the past fiscal year (1964) Dr. Aldo E. Lanaro visited 12 cities in 8 South American countries and interviewed 99 prospective candidates out of which 34 were considered possible candidates for training in programs at the Puerto Rico Nuclear Center.

(2) In addition to applications for formal training we have received requests for informal training. As a result of this activity 4 persons have already been trained, 24 have been accepted for training, and 13 candidates are pending decision.

(3) Evidence has been obtained that many prospective trainees could come to Puerto Rico for taining provided maintenance expenses could be given.

Clinical Research:

To complement the training program, research projects are active in the areas indicated:

(1) Thyroid disorders: diagnosis and therapy.

(2) Gastrointestinal malabsorption.

(3) Renal disorders.

(4) Organ and tumor localization.

Radiotherapy and Cancer Division

STAFF

Víctor A. Marcial, M.D., Chief Scientist II, Head; José M. Tomé, M.D., Chief Scientist I; Jeanne Ubiñas, M.D., Associate Scientist II; José N. Correa, M.D., Associate Scientist II; Antonio Bosch, M.D., Associate Scientist II; Graciela Serna Maytorena, M.D., Associate Scientist II; María P. de Lozano, M.S., Research Associate I; Zenaida Frías, M.S., Research Associate I.

PURPOSE

The main purpose of this Division is to train physicians and allied personnel in all aspects of the application of nuclear energy to cancer. A second purpose is to develop and carry out a research program to improve our knowledge in the cancer and radiation fields.

CURRENT STATUS

This Division offers two programs in Radiotherapy Training:

(1) Radiotherapy Residency Program. The objective of this program is to prepare qualified radiation therapists. This is an approved program that fulfills the requirements of the American Board of Radiology. Physicians with a year's internship or equivalent clinical experience are accepted for this training. The total training period lasts three years, but trainees are required to take an additional fourth year of supervised practice (preceptorship) before admission to the specialty examinations. Trainees acquire a solid background in clinical cancer through supervised work with new, follow-up, and hospitalized cancer patients. They learn to diagnose the disease, determine the extent of the same, choose the appropriate treatment, and plan and conduct radiological therapy. Radiation therapy experience is acquired by working with roentgentherapy machines of various voltages and teletherapy units, which include cobalt and cesium, and with the application of radioactive material such as: radium, strontium, cobalt, and iridium.

Trainees also become familiar with non-radiological cancer treatment methods, such as surgery and chemotherapy. In addition, they learn of cancer control activities in Puerto Rico; this includes the operation of a Central Cancer Registry, tumor clinic work, cancer detection, and public and professional education in cancer.

(2) Special Short Term Radiotherapy Training Course. Special programs are prepared according to the needs of the person. 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.

An additional training activity is offered for Fourth Year Medical Students. Selected candidates receive one month of intensive in-service training, where they are exposed to cancer and radiotherapy clinical problems.

Experienced radiotherapists from Latin America are hired as visiting staff. This permits them to become acquainted with the work of this Division and to carry out research projects.

To complement the training programs, a number of research projects are active in this Division. These include: (1) Investigation of the Role of Surgical Sterilization in the Etiology of Cancer of the Uterine Cervix; (2) Study of Fractionation of Weekly Radiation Doses in Cancer Patients Under Radiotherapy; (3) Carcinoma of the Uterine Cervix Associated with Pregnancy; (4) Biochemical Changes in the Blood of Cancer Patients Receiving Radiotherapy; (5) Determination of Optimal Tumor-Dose in Radiation Therapy of Cancer of the Esophagus; (6) Controlled Study of the Split-Dose Technique in Radiotherapy of Cancer; (7) Study of Chromosome Changes in Patients Undergoing Radiation Therapy for Cancer; (8) Lymphangiography in Cancer Patients; (9) Exfoliative Cytology as a Tool for Determining Prognosis in Cases with Cervical Carcinoma Submitted to Irradiation; (10) Surgical Adjuvant Breast Project; (11) Study of the Incidence of Leukemia in Patients with Cervical Cancer Treated with Radiation; (12) Quantitative Fractionated Irradiation Studies in a Transplantable Mouse Chondrosarcoma; (13) Clinical Dose-Time-Fractionation Relationships.

This division is collaborating in various research projects conducted by other Divisions of PRNC.

Radioisotope Applications Division

STAFF

Edwin Roig, Ph.D., Chief Scientist II, Head; H. Harry Szmant, Ph.D., Chief Scientist II; Alec Grimison, Ph.D., Associate Scientist II (Part-Time); J. P. A. Castrillón, Ph.D., Associate Scientist I; Rosa Santana de Tirado, M.S., Research Associate I; Ederlyna V. Belardo, B.S., Research Assistant II; Awilda R. Sandoval, B.S., Research Assistant II; Raúl Figueroa, B.S., Research Assistant I; Jaime L. Colón, B.S., Research Assistant I (Part-Time)

FORMAL INSTRUCTION

PURPOSE

The main objective of the program is the offering of sufficient training to scientists in the application of radioisotopes and ionizing radiation to the physical sciences to provide technical competence for their future work. A second objective is the offering of introductory training to scientists, irrespective of their fields of interest, in radioisotopes and ionizing radiation as a background or as complementary preparation for their participation in other programs of PRNC.

CURRENT STATUS

Courses with University credit:

(1) Radiochemistry Course (Chemistry 465--4 credit hours). A one-semester course offered once a year for advanced undergraduate and graduate students. Three one-hour lectures and one four-hour laboratory period per week. Approximate enrollment: 4 to 6.

(2) Nuclear Techniques in Biological Research (Biology 372--4 credit hours). A one-semester course offered once a year for advanced undergraduate students. Three one-hour lectures and one four-hour laboratory period per week. Approximate enrollment: 4 to 6.

(3) Radioisotope Applications in Organic Chemistry--Lecture course (2 credit hours). A one-semester graduate course to be offered for the first time the second semester of this academic year. Two one-hour lectures per week. The Radiochemistry course mentioned above is a pre-requisite.

(4) Radioisotope Applications in Organic Chemistry--Laboratory course (2 credit hours). A one-semester laboratory course to be offered for the first time next academic year. Two four-hour laboratory periods per week. The lecture course is a prerequisite.

Special Training Courses:

(1) Basic Course in Radioisotope Techniques - Four-week course now being offered four or five times a year. We have had a total of 272 participants (36 sessions) including 69 Latin Americans. The present rate of participants is approximately 30 per year. (This course was incorporated in the curriculum of the graduate programs of Biochemistry and Microbiology at the UPR School of Medicine as Biochemistry and Nutrition 410, 2 credit hours.)

(2) Radiological Physics - A special course offered to M.D. Residents in Radiology when requested.

ORGANIC CHEMISTRY PROGRAM

PURPOSE

The purpose of the program is to provide advanced chemical training in organic chemistry with special emphasis of its nuclear aspects. The projects cover a relatively wide range of subjects in order to offer a broad experience to all members of the group, and the diffusion of the varied aspects of organic chemistry is promoted by group seminars and discussions.

CURRENT STATUS

The research topics include the use of S-35 in exchange reactions, the use of Cl-37 and C-14 for the determination of reaction mechanisms, the synthesis of boron compounds of potential use in neutron activation therapy, and the radiolysis of dimethyl sulfoxide.

The study of the radiolysis of dimethyl sulfoxide is of recent origin, but correlative studies concerned with the physical properties of this substance have been in progress for some time. The boron project is currently inactive because of the departure of the research assistant who was involved in this work.

PHOTOCHEMISTRY AND RADIATION CHEMISTRY PROGRAM

PURPOSE

The purpose of the program is to provide advanced chemical training in photochemistry and radiation chemistry, with special emphasis on the relations and distinctions between these. Also included are projects giving training in the use of quantum chemical calculations for evaluation of the experimental results.

CURRENT STATUS

The research topics involve studies of transient species formed by γ-irradiation of heterocyclic molecules, and trapped in rigid matrices of 77°K, and similar projects on transient species formed by photoionization and photodecomposition. The allied theoretical projects involve Molecular Orbital and Valence Bond calculations on heterocyclic molecules.

The γ-radiolysis and photolysis studies have been begun very recently, and are in their preliminary stages of measuring control absorption spectra, and determining optimum experimental conditions with systems previously studied elsewhere.

The Molecular Orbital calculations (in collaboration with Dr. W. Adam) are being actively carried out, and a large number of heterocyclic molecules have already been calculated. Valence bond calculations (in collaboration with Prof. C. Zauli, University of Bologna, Italy) in triplet states of heterocylic molecules are in progress.

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Medical Sciences and Radiobiology Division

STAFF

M. P. Weinbren, B.Sc.(Hons), Rand, M.D., (Rand), M.R.C.S., L.R.C.P., Head; B. M. Weinbren, B.Sc., (Hons), M.A., B.M.B.Ch., Associate Scientist; J.M. Segarra, M.Sc. - Full time since July, previously 1/2 time in unit and 1/2 time in unit on N.I.H. grant to Radiotherapy Division; N. Enriquez, M.Sc.

PROGRAM

The Division of Medical Sciences was established in February 1962 and in July 1962 was combined with the pre-existing but barely functioning Division of Radiobiology. The primary objectives of the new Division were:

1. To establish a tissue culture facility to serve as a medium for training and research.

2. To develop a series of research projects based on the tissue culture unit.

3. To establish the program which is now separately financed as Terrestrial Ecology Part II.

4. To establish projects which have a bearing on the problems of Tropical Medicine and which utilize the facilities of the Puerto Rico Nuclear Center for studying radiation: such as the now separately financed schistosomiasis Project.

STATUS

This can best be dealt with in separate sub-sections.

1. The tissue culture unit has been established and, after a number of "false starts" due to bacterial or fungal contamination, we have developed a system of "clean tissue culture methods" for the tropics or any heavily contaminated area. This works so well that on a test basis we have been safely carrying cell lines in the animal quarters. The system utilizes a Whitfield Ultra Clean Workbench, a semi non touch working technique and scrupulous attention to "hygiene". All conventional tissue culture procedures are carried out in this section.

2. Probably the most important of the research projects using the tissue culture unit is that which is designed to study at the cellular level the effects of neutron capture by Boron 10. Using Hela cells, a 10 Curie

PuBe neutron source (with 10 cm paraffin moderator) and triethanolamine borate as a tagging compound we have evolved a system with which, starting cells growing and dividing in synchrony we have established the conditions necessary to reduce the plating efficiency of the tagged and irradiated cells to half that of the controls.

A cooperative study of human chromosomes in normal individuals and those receiving radiation therapy was set up with the U.S. Army Tropical Research Medical Laboratory (C.O. Col. M. Dacquisto) and the Division of Radiotherapy but with the reorientation of the Army program and transfer of Col. Dacquisto to Washington we lost the considerable support we had been receiving from that quarter and the program has been greatly curtailed. Dr. Barbara Weinbren has assumed the responsibility for the Chromosome projects which continue, these may be divided into the following sub-sections

a) We are continuing the collection of specimens from Puerto Rico Nuclear Center staff to establish a reference collection.

b) A study of the karyotypes of individuals of two distinct asthma patterns with specimens provided by Dr. J. A. de Jesus (this was the last sub-project begun with Col. Dacquisto).

c) The study of chromosome patterns in our "normal" HeLa cell cultures for comparison with those affected by Boron 10 neutron capture.

d) Occasional clinical studies which derive from associated programs or anomalies found in our volunteers.

At one time we were cooperating in a study of the factors which bring small children into hospital with acute neurological disorders - although this was progressing well and producing very interesting results, a combination of several factors forced us to abandon our part in this program.

The DC2 chondrosarcoma brought from the National Cancer Institute by Dr. Correa has been adapted to our CF1 mice and from them has been established in tissue culture where it has yielded three distinct morphological cell types which appear to be stable.

3 and 4 separate reports are given for the virus and Schistosomiasis programs.

The series of attempts to adapt the Dengue viruses, isolated during the 1963-64 epidemic, to tissue cultures has now been dropped, largely due to the fact that Dr. Wissman's group in Baltimore have achieved an adaptation to chilled baby mice.

Three mosquito species have been colonized and are being tagged with Sr89 for release and recapture to study flight pattern and range.

Groups of young and adult snails have been set up (with controls) in water containing 1 millimicrocurie of Sr^{89} per ml. These are being watched for variation in egg production and periodically snails are to be sectioned and studied by autoradiography and straight histology for accumulations of Sr^{89} and possible damage which the beta radiation might have caused.

A Study of the Mechanism of Antigen-Antibody Reactions Following the Inoculation of Mice with Irradiated and Normal Schistosoma mansoni cercariae

STAFF

M. P. Weinbren, B.Sc. (Hons), Rand, M.D., (Rand), M.R.C.S., L.R.C.P., Head, Division of Medical Sciences and Radiobiology, 1/5th time; J. B. Villella, Ph.D., Associate Scientist, Full time.

SCOPE

Authorization for this program was received on December 3rd, 1963 and it is based upon work by Villella and Gomberg while at the University of Michigan, and on similar work published by Sadun et al. Both these groups reported an acquired resistance to challenge with virulent S. mansoni cercariae after prior exposure to cercariae which had been damaged by exposure to gamma irradiation; the difference in the work of the groups lies in the route of exposure to the cercariae; while Villella used intraperitoneal infection, Sadun et al prefer the percutaneous route. It is the object of the present program to perfect a delicate means of assessing the degree of protection obtained and then to establish the conditions required to consistently produce maximal protection. Experiments have also been designed to test the duration of the protection conferred and the stages at which various serological tests yield positive results. When the parameters for inducing maximal protection have been established it is intended to make a detailed study of all detectable reactions which occur between the challenging parasite and the "immune" host, with special emphasis on the factors which lead to the disabling of those challenging cercariae which fail to mature. The problems attendant upon reasonably accurate quantitation of the "immune response" or degree of protection conferred upon a mouse which has been exposed to irradiated cercariae are virtually insuperable using techniques in current use by parasitologists.

STATUS

We have now perfected a method of assessing the degree of infection which is based on the number of S. mansoni ova which can be recovered from the feces of the infected mice, using standardized observation procedures. This is so sensitive that it readily shows variation in mouse susceptibility with age- most authorities have claimed that no such phenomenon exists. Experiments are currently in progress to determine the optimum amount of radiation for cercarial exposure, in order to induce the greatest degree of resistance to challenge. The results of the experiments should to be hand early in 1966 after which the final phase of the program can be mounted.

Scientific Needs in Latin America and PRNC Programs

Latin American countries need all kinds of technological and scientific improvements. Laboratories, classrooms, teachers, administrators, and well rounded programs are necessary. Of more importance are educational leaders aware of modern science, and political leaders who need to recognize that economic development is a scientific enterprise.

The scientific and technological needs of Latin American countries are not easily defined in this brief abstract. The degree of development varies not only among Latin American nations, but also within regions of the same countries. However, some generalizations may be made. The most important factor appears to be the transformation of Latin American Universities into integral parts of the communities in which they are located.

In general, Latin American universities need more economic assistance from their governments. An effort must be made to send more people abroad for training, and to develop sound graduate programs and research at home which are related to regional needs.

Educational efforts must be focused first on agriculture, and next on health, ecology and natural resources, and industry based on available resources, etc.

The Puerto Rico Nuclear Center, because it is located in the tropics--as are many Latin American countries--is in an excellent position to assist in the development of these countries:

(1) Train personnel in uses of atomic energy in biology, medicine, agriculture and industry.

(2) Assist in the development of basic science programs already started. Several Latin American universities have expressed interest in forming a close association with our laboratory.

(3) Institutes similar to PRNC could be established by Latin American governments within the framework of their universities with the specific mission of advancing the development of their countries. PRNC is in a position to assist.

Such an organized approach would be more beneficial to these countries than attempts to improve science in all directions simultaneously.

INTERNATIONAL ASPECTS OF RADIOLOGICAL HEALTH AND SAFETY

Dr. Howard L. Andrews
Assistant Director for Health and Safety

From the beginnings of the Manhattan Project to the present time the United States has pioneered in use of practices designed to insure the safe utilization of nuclear energy at all activity levels. As the use of nuclear energy spreads throughout the world, either with or without assistance from the United States, it becomes imperative that safety practices keep pace with technical developments. In many cases safety plans are adequate but fulfillment is sadly lacking. The situation in Europe is spotty with some outstanding programs and some others that are almost non-existent. The programs in South America leave a lot to be desired.

The Puerto Rico Nuclear Center has a unique opportunity to serve as a nucleus for radiation safety training in the Western hemisphere. Much of the competence is here and can be immediately utilized; in some other respects PRNC must put its own house in order before it can assume the leadership so badly needed. Some suggestions for program improvement will be offered.

Agricultural Bio-Sciences Division

STAFF

Robert A. Luse, Ph.D., Chief Scientist, Head; Francis K. S. Koo, Ph.D., Associate Scientist; Andrew Maretzki, Ph.D., Associate Scientist; David Walker, Ph.D., Associate Scientist; Julián Roldán Regús, M.S., Research Associate.

OUTLINE OF CURRENT STATUS

Major activities continue to be in two areas:

I. Education and training

a. Four persons currently are working toward M.S. degree.

b. Four trainees are carrying on research under IAEA, GRINS, and OAS sponsorship.

c. Advanced Radiobiology course given in Fall semester.

d. Three staff served as Scientific Advisors with AEC Exhibit in Central America.

II. Research

a. Radiobotany of sugarcane

1. Induction of high sucrose sugarcane mutants by neutron irradiation of seed - several thousand seeds and buds were irradiated, germinated and planted in the field (Luse, Roldán).

2. Induction of virus resistance in sugarcane by gamma and neutron irradiation of seed - several hundred buds were irradiated, germinated and field planted (Koo, Cuevas).

b. Radioisotope studies in sugarcane

1. Effect of soil factors on nutrient uptake in sugarcane - Pot experiments are in progress, tissue analysis continues (Kong).

2. Determination of mineral cycling in sugarcane - Zinc-65 studies are just beginning (Roldán, Lukey).

3. Effect of wetting agents on foliar absorption of phosphate - Experiments begun November 1 (Meyer, Roldán).

4. Protein synthesis in meristem tissue - C^{14}-labeled amino acid incorporation studies have established kinetics (Maretzki).

5. Identification of tissue nucleotides - several compounds found (Maretzki).

c. Radiation sterilization of sugarcane borer (Walker).

d. Radiation preservation of tropical foodstuffs

1. Shelf-life extension of mangoes - Thesis study is nearly completed (Cuevas).

2. Effect of radiation on pectins in mango - Extensive depolymerization occurred with 2 megarad dose, polygalacturanase activity was found (Deshpande).

3. Shelf-life extension of bananas - Effects of gamma radiation on shelf-life and nutrient levels now underway (Graham).

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