JOHN C. BUGHER PRNC 50 H3BHONG “OD NHOF PUERTO RICO NUCLEAR CENTER TRAINING AND EDUCATION PROGRAM OUTLINES. Volume AEC Ad Hoc Committee for Program Review October 15-16-17, 1964 ‘OPERATED BY UNIVERSITY NO. AT (40-1)-1833 FOR U. JERTO RICO UNDER CONTRACT . ATOMIC ENERGY COMMISSION ---Page Break--- see 1 Radioisotope Applications Division .... Clinical Applications Division ...sseeeseseeeeen 2 Medical Sciences & Radiobiology Division ... 3 Radiotherapy & Cancer Division seeseeee 4 Reactor Division Nuclear Science and Technology Division .... 6 Nuclear Engineering Division 1 Health Physics Division «+... oe 8 Agricultural Sciences Division sesseseeseeeeereeeete 9 International Nuclear Energy Exhibit « 10 October 1964 ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED TO AEC Ad Hoc Committee for Program Review RADIOISOTOPE APPLICATIONS DIVISION Dr. Edwin Roig, Head I. General Scope of Review Emphasis will be given to the achievements of the Division in fulfilling the main function as training center. £9 be considered A, Additional laboratory space 11, Factor Organic Chemistry |. A new temporary construction with an area of approximately 1600 sq. ft. at a cost of $15,000 including Laboratory benches, 4 hoods, and air conditioners, was finished at ‘the beginning of this fiscal year. At present 7 persons are working in this laboratory; maximum capacity is 14, b. Part of the original 9; the remaining space that was used for organic chemistry we are using for instrumentation 2, Radiation Chemistry and Photochemistry 4, The 2700 curie Co-60 source was installed in the irradiation basement during last FY. Access to the room has recently been modified substituting the spiral staircase for a safer type along the sides of the wall. This modification allowed for the installation of 2 platforms to be operated by a hoist thus providing a practical and safe means of transferring equipment to and from the basement. We are now providing safety requirements to allow for the utilization of the irradiation.

facilieie: b. Since January, 1964 this group has acquired a laboratory at the Chemistry Department (our old Radiochemistry laboratory) - 800 eq. ££. This lab is planned for organic photochemistry and flash photolysis under the NIH grant. Construction of the flash photolysis set-up is nearing completion. At present two persons are working in that laboratory; maximum capacity - 6. This laboratory at the University has released the crowdiness in our facilities in this building. B. Scientific Personnel Please refer to Table I summarizing the present staff situation, including the level we expect to reach with the existing facilities. Reference is also made to the number of students participating and maximum number of students that can be supervised under the different research programs. ---Page Break--- *suoTaTsed esau; Jo oun Aéno00 0% ATysONP aATEIY THEA *4aodane er ‘Eyseceayun nowgsy amy B8TOK *e crebas ---Page Break--- Cs Collaboration given to UF car ota? participates actively in the activities of the science departments of the University of Puerto Rico. They participate in the teaching of university courses. The following teaching load of the present academic year is typical of our collaboration: start with course credit hours Dr. Bavin Quantitative Analysis (undergraduate) Dr. H. Harry Sumant Organic Chemistry (undergraduate) Theory of Organic Chemistry (graduate) Physico Chemical Basis of Biological Processes (undergraduate) Dr. Walden Daniel Advanced Physical Chemistry (graduate) The following staff members are supervising Master's research: = 2 graduate students = 5 graduate students = 1 graduate student from UFR ‘The following staff members from the University of Puerto Rico hold ad-hoc appointments at PHOIO and participate in the teaching of some of our courses, and in our research programs: Department: Dr. Juan Dentel Caret, Dean, College of Natural Sciences Dr. L. Grimizon Chemistry Dr. Waldemar Agar Chemistry Dr. Graciela C. Candela Biology Be Form instruction Le Courses a, Basic Redtotectope

Techniques course - has been incorporated in the graduate curriculum of Microbiology and

Biochemistry at the School of Medicine as a two-credit course. Other participants receive no academic credit. b. Radiochemistry - taken by advanced undergraduate and graduates of the Chemistry Department, 1 credit. c. Nuclear Techniques in Biological Research - taken by advanced undergraduates or graduates of the Biology Department, 1 credit. d. Radiological Physics - taken by Residents in Radiology from the University Hospital; offered when requested. ---Page Break--- 2. Teaching staff Members of other PRIC divisions and of the science departments of the University of Puerto Rico collaborate in the teaching of courses. The situation is well taken care of and the collaboration will continue since it is impossible for the Division to have among its members specialists for all the topics covered in our courses. The persons more involved in the teaching of courses follow: same Division Special field Dr. B. Rodriguez (Ph.D.) — Radiotracers Radiochemistry and Instrumentation Mrs. Rosa S. Tirado (M.S.) Radiotracers Radiochemistry and Instrumentation Dr. Reins (Ph.D.) Agricultural Biosciences Radiobiology Miss Z. Frias (B.S.) Radiotherapy and Cancer Statistics Mrs. G. Candelas (M.S.) Biology Dept. (U.P.R.) Radiobiology Mrs. M.P. Lozano (B.S.) Radiotherapy and Cancer Physics and Health Physics Miss H. Pubén (B.S.) Health Physics Physics and Health Physics 3. students 4. Please refer to tables II and III and Graph for an analysis of participants. b. Comments and conclusions (2) significant increase in 1965 - due to ten students from the Dominican Republic who formed a group in an arrangement through the University of Puerto Rico to participate in our basic course. Also twelve PMC employees took the basic course. This number, large as compared to other years, is not typical. Disregarding the above events, which may be considered as special, the general trend of increase noticeable since 1962 brought the total number of

Students toe figure in the low forties. (2) The significant decrease in 1964 is mainly due to a sharp decrease in U.S.A. citizens. We must wait until the end of this year to analyze this situation. It could be that the local demand is being satisfied. However, recently the local sugar industry has shown interest in having their scientists trained in nuclear techniques and we are already receiving applications for said training. This training will require the basic Radioisotope Techniques course as an introduction to more advanced training in the bio-agricultural division. (3) As expected, the participation in the basic course (elementary level) has decreased. (i) The participation in academic courses (University credit) has reached a plateau of approximately ten students. This will remain in the coming years since it shows saturation of laboratory facilities. ---Page Break--- PARTICIPANTS IN FORMAL COURSES (basic course, Radiochemistry, and Nuclear Techniques in Biological Research) U.S.A. citizens will take national tests. Analysis by Phelps of work over... (5) Latin Americans participating in our course are mainly from the medical field. (6) Local participants come mainly from Chemistry and Biology. As for research, general comments indicate that in order for us to contribute to the scientific development of Puerto Rico and of Latin America, it is necessary that we first establish a continuous and high-level research program so that the institution, on its own merits, becomes an attractive training center. The Radioisotope Applications Division believes to have come a long way in this direction and support for this belief will be presented to you by the individual program leaders. Some of the aspects which we plan to promote, such as the utilization of the nuclear reactor as a research tool in atomic chemistry.

ead She wee of the Co-60 tor radiation chentistry, are still lagging behind scneders due to aifterent reasons: (1) the lack of space for organic chemistry (sekece recently vith the new laboratory: ‘BW vhich vao originally planned for thts sumer ant had to be postponed ave co eee kis agtigmment to FRUC and also due to finaneial difficulties; (141) the @elay in modifying access to the Co-60 source, 2 Student participation - Refer to Twble TV. 3s Research projects Ss Organic Chemistry - i. rey Samant (2) organic Boron Compounds (A. Carrasquitio, Rescarch Mpletant, MOC an graduate

otudent: Department of Chemisty, UP.2.) = sepa ration of vater soluble derivatives of boric ead cubvberte acid. (2) organte sulfur compounds 12) Dre Seymour Ss Block, Oak Ridge Research Partict- ‘wattion Program Fellow, July-August, 196; Metallic Chelates of auieciaen (b) Drs José P. A. Castriit6n (Argentina), Associate Sciertist, uc: (4) Exchange of oxygen between sulfaxides ant sultides, (11) Res Guction of sulfoxides by triphenylphospaine and carbon tetrachloride, (c) Mrs Osvadio Cox, Graduate Student, Departient of Chentatry, U.P.R.: Reaction of Sulrarides by Triphenylphosphine, (2) Mise Uetiant ortiz, undergraduate student, Depart ‘Rent of Chemistry, U.P.R.; Petroleum Research Fund grant of the Americen ¢herveey Scctety: Reaction of ‘Carbondiimides with thionyl ehisride, ---Page Break--- ‘woysormng ADsoiRT opuORY TeuoFamuTOWUE 24% Ay parosUods om oqUEpNAS On04 50 SORE smatoar uoTyedroraand MEIGO £4 paxosvods ¢ ---Page Break--- a0 (e) try J. J. Rtgou, Research AcsLetant, FRC nd greduste student, Deparinest of Chemistry, U.P.R.; Structure of the Seomeric 2-phenyloulMaylindanols., (2) Mee Rs 4, Figueroa, Research Assistant, PRIC, and graduate student, Departent of Chemistry, UsP.R.j Dre Be Rog: Association of Sulfoxides with Phenols. (3) Mcleophtlic Substitution Reactions of Datdates (vintional Institutes of Health Grant) - wr. Tate Brave Navarrete (Chile) end Miss Adele Youskad, both graduste ctadexte, Department of Chemistry, UPR (4)

Solvent Effects in Chemistry (a) Mes, Yolande Yatlant de Candelarto (Cubs), Research Assistant and graduate student, Department of Chemistry, U.P.Re: A study of the monosodium salt of phenolphthalein. (b) Mise Vitrte Ronin, graduate student, Department of Chemistry, U.PsR.: Solvent effects in the Wolff-Kishner reduction. (c) Photochemistry and Radiation Chemistry (1) Oxyanion solutions - Miss Vickt Meyers, Research Associate, FIC, and Mrs. Bleriyns V. Belardo, Research Assistant, ENC (e) Photolysis of Hitrate at 300 nm: Effects of Concentration, intensity, pH, and scavenger. (2) DAWA, and Constituents (a) Photooxidation of thymine at 185 nm - Dr. Alec Grimison, Associate Professor, Chemistry Department, UPR, and Associate Scientist, ad honorem, PRNC; Miss Steriyna V. Belanio, and Mrs. Avilda R. Sandoval, Research Assistant, Chemistry Department, U.P.Re (b) Photodeamination of cytosine at 2537°A: Deamination kinetics - Dr. Alec Grimison and Mrs. Avilda R. Sandoval. (c) Deamination of cytosine in aqueous solution: Discovery of pH dependence, quenching kinetics. - Dr. Alec Grimison and Mrs. Avilda R. Sandoval. (d) Deamination of thymine and Dr. Alec Grimison and Mrs. Avilda R. Sandoval. (c) Deamination of D.A.T. at 537 nm - German Santiago, Graduate Student, Chemistry Department, U.P.Re ---Page Break--- “(f) Energy Transfer between Cytosine and Thymine - Dr. Alec Grimison and Mrs. Avilda R. Sandoval. (g) Viscosity and optical Studies on D.N.A.s - Mrs. Bleriyns V. Belardo and Mrs. Avilda R. Sandoval. (h) Solid State Physics Project of Organic Crystals (2) Equipment Development has been built to purify anthracene by sublimation and zone refining and to make crystals from solution and from the melt. Equipment has been built to make steady state and transient measurements of electrical conductivity in anthracene crystals. (2) Measurements Steady state measurements of electrical conductivity of anthracene crystals using the Hallmann-Pope iodine electrode indicate that the conductivity increases after irradiation of

neutrons. There does not seem to be changes in nobility of carriers measured using transient techniques, Plane fare being made to make these measurements after irradiating with gamma and X-rays. “Measurements will also be made in other organic crystals. G+ Publications give Thallous = Thallic Exchange at Various Activities in Perchlorate Media” = 2. Rotg and Rlotard i, Dodson, J. Of Phys. Chem. 65, 2175 (1961) "isotope Demonstration of Common Ton Effect on Solubility", B. Rotg, IoG, Rieckhoff, C.S, Musso and J.D, Curet, J, Chem. Bis, Vol. 38, 3961, ps 350s the Radiation Chemistry of Arsenite, Pts II, Oxygen-Free Solution", My Daniele, J. Of Phys. Chem. 65,

1875 (1962) *Photochemically-Induced Oxidation of Arsenite: Evidence for the Existence of Arsenic(IV)", MoDantels, J. of Phys. Chem. 65, 1475 (1962) *synchrotron of Thymine", H, Daniels and Alec Orinteca, Nature, 197, 484 (1965) ‘the Deuterium Isotope Effect in the Hydrogen Bonding of Triazole in Naphthalene Solutions", Alec Grimison, J. of Phys. Chem, Vol. 962 (1963) fluorescence of cytosine in Aqueous Solutions", M Daniels and ‘ee Grintson, RIC. some Photochemical Deamination of Cytosine at S37°A", Me and Alec Grtziceny Stochastic and Stories. Research Communications 45, 528 (1959) ---Page Break--- ole “Radiation Chemistry of Arsenite Solutions, Pt. II. Effect of Arsenite Concentration in Oxygen: Daniels, J. Phys. Chem. 58 2067 (1964). The Wolff-Kishner Reaction of hydrazones", i. A Samunt, J. Am. Chem. Soc 86 2502 (1954), Informe Acerca de las Revistas Científicas y Tesis Latinoamericanas - Guimien", in commemorative volume published by UNBECO, Centro de Cooperación Científica para América Latina, Montevideo, summarizing the activities of "Grupo de Trabajo para la Selección de Revistas Científicas Latinoamericanas", in don Juan, ---Page Break--- ---Page Break--- ‘OUTLINE OF MATERIAL TO BE PRESENTED TO AEC Ad Hoc Committee for Program Review CLINICAL APPLICATIONS DIVISION Dr. Sergio Irizarry, Head 1, Purpose and Scope of Program The main purpose of the program

of this Division is the teaching and training of Latin American physicians in the diagnostic and therapeutic use of radioisotopes in humans. This goal is accomplished in two ways: 1) providing special training courses of basic clinical radiostopic techniques for the diagnosis and treatment of human diseases, and 2) providing special training in clinical research.

Types of Training Available

Introduction

Initially, this Division began operating under the direction of Dr. A. A. Cintrén Rivers in 1958 at the Radiostotope unit of the School of Medicine at the San Juan City Hospital. A total of 36 trainees have completed the clinical course, of which 28 have come from various Latin American countries (Table I). The average output of trainees during the past 7 years has been 5 per year (Graph I).

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Argentina, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, Guatemala, Mexico, Uruguay, Venezuela

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Types of Courses Available

There are two general types of courses available according to breadth and scope of the course: orientation courses and training courses. Considered in the light of duration and type of training desired, two courses are offered: a short 4-week or 8-week clinical applications training course, or a long 6-month to 12-month clinical research training course.

Description of the Courses:

The Short Course

The short course is basically a 2-month program consisting of lectures, demonstrations, informal laboratory exercises for training, and periods of discussion. Emphasis is placed on mastering techniques, their indications and uses, correct interpretation, limitations, and correlation with clinical problems. The 8-week course contemplates the completion of 80 laboratory exercises in which a wide variety of techniques are employed. A list of the teaching units covered by the laboratory procedures utilized appears in Table II.

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Units of Study:

1. Thyroid Function: routine uptake measurements and assay of radioactive blood thyroid hormone

levels as modified tests of thyroid function (5) 2, Dynamic functions of the hepatic, renal, and vascular systems 3, Hematologic applications of radioisotopes 4, Tumor localization study 5, Gastrointestinal absorption 6, Electrolyte and Fluid balance 7, Therapeutic procedures 38 20 10 ---Page Break--- ‘A weeks course, of similar nature to the 8 weeks course, is also given. The procedures are similar but the total number of training exercises is cut in half, so that 40 teaching exercises are completed by each trainee. ‘The Long Course ‘There are two long-term courses being offered by this Division: ‘A Semester course for medical residents; orientation in medical uses of radioisotopes. = Semester to 1-year course in clinical research. Description of courses The Semester course for medical residents is a non-credit course designed for orientation in the medical aspects and uses of radioisotopes for diagnosis and therapy in clinical practice. It consists of 12 sessions of 2 hours each for laboratory demonstrations: The Semester to 1-year clinical research course is offered to candidates who have already gone through the basic training at Puerto Rico Nuclear Center or elsewhere, and who want advanced specialized training in clinical research. The trainee would have no formalized teaching but would be assigned special responsibility within a project being carried out at the Division and be supervised at regular intervals to evaluate progress being made and for the solution of problems that may arise during the course of the investigation. The trainee may have a special problem of his own that he would like to investigate. In this case, he discusses his project with us for a ---Page Break--- decision as to feasibility and scientific value. If approved, he is given the necessary assistance and supervision for its completion. ‘The trainee is responsible for the design of his project, selection and standardization of the method, collection of the data, analysis, and reporting. A final report at the end of

The year is submitted to the Director for evaluation and publication if it fulfills the requirements for communication. New Proposed Course: Following previous recommendations of the Bio-Medical Advisory Committee, the Division is setting up a special advanced course for training in renal pathology. This is a 4-week course offered to candidates with previous experience in the field of nuclear medicine, who want specialized training in the particular area of renal diseases. Registration capacity for full training is 4 trainees; the course may be offered twice a year, for at least 2 years, before another course of similar nature on another subject. The organization of the course allows the first week to be a general review of nuclear physics, mathematics, and statistics; the second week covers the pathologic and physiologic aspects of the renal apparatus; the third

week defines the clinical pictures of various pathologic entities, and the fourth week is dedicated entirely to radioisotope techniques for the evaluation of renal function. A second new proposal: As a general course of orientation to Nuclear Medicine of one week duration, this course is intended for the general practitioner and doctors in other medical specialties. The subject matter of this course will try to cover the general applications of radioisotopes for diagnosis and current use in medical practice. Demonstrations and case presentations will be used to strengthen the theoretical presentations. A program of each of the formal courses described above is appended. Appendix A. Diagnostic Service Load and its relation to training courses. The laboratory, as already mentioned, began operations in 1957-58 at which time a total of 438 diagnostic procedures were performed. Since then, yearly reports indicate increased output in the diagnostic service load until the years 62-63 and 63-66 in which the output leveled off at or around 3,300 procedures. This is illustrated in Chart I, graph 2. The diagnostic load has

always been considered a necessity for the training program. It is generally admitted that the necessities of the training program can be well met by a ceiling of 200 diagnostic procedures per month. This level of activity had already been reached by 1960-61. An increase beyond this level during the past 2 years can be explained by the combined operations of the University Radioisotope Unit and PRC Clinical Applications laboratory. It should be mentioned that a semester course for medical residents of general orientation to the clinical uses of radioisotopes was completed by 26 participants of the University Hospital. A new course is scheduled for the next semester, January - June, 1965. In all instances, training procedures are performed by trainees whenever possible; a parallel run is made by the instructor for control of technique. ---Page Break--- Chart 1 BY YEAR FLD CHART DIAGNOSTIC PROCEDURES BY GASTROINTESTINAL UTILIZATION 08, i 4 masceniaxeous 2680 3092312642 1623 438 # No statistical date September 17, 1964 ---Page Break--- see the data ---Page Break--- In the flow chart presented before, training procedures make a substantial figure of the total diagnostic load from which it is taken. This is more apparent in the last five years during which time we have had better reporting of this activity. The 1, Thyroid Function Studies 2, Cardiovascular 3. Kidney Function 4, Liver functions 5. Hematology washing procedures include the following techniques: uptakes, 2, 24, 48 hours PEI-131 Conversion ratios, I-131 plasma levels, EONS discharge test, TSH stimulation test, Triiodothyronine suppression test, Iodine inhibition test, Thyroid Scans, Cardiac output, Stroke Volume, Circulation time, Central Volume, Circulatory rates for shunts, Cardiac scanning, I-131 renogram, Nephrogram, I-203 renogram, Blood clearance, Renal scans, Hepatogram, Liver uptake, excretion, Intestinal catheters, Blood clearance, Liver Blood Flow, Liver scanning, Blood volume, red blood cell survival, Splenic uptake, In vitro red cell uptake.

Gastrointestinal blood loss Splenic scanning Tron Plasma Clearance Daily plasma tron turnover Red blood cell tron uptake = Red cell iron turnover ‘Total red cell iron Percent hemoglobin renewal per day ---Page Break--- 2 Total hemoglobin formed average red cell life span Total circulating hemoglobin 6, Gastrointestinal function = absorption Vitamin B12 + Absorption labelled neutral fat fatty acid (Olete T-131 and exfolein I-131) Blood curve absorption levels Urinary excretion levels Stool elimination of radioactive fat and 7. Tumor Localization + Gamma-scintigraphy Paper dot scanning Photo dot scanning = Gamma-photography Other methods of tumor localization © Progress in instrumentation 8. Electrolyte Balance and Fluid Compartments Plasma Volume Extracellular volume Total Body water Intracellular volume Sodium and Potassium turnover and exchangeable pools Sodium component 9, Therapeutic procedures Hyperthyroidism Cancer of the Thyroid Intractable Coronary Disease Polycythemia Vera Chronic Leukemia Pleural and Peritoneal Malignant Effusions Research Program A number of clinical research projects are being carried out

by the Medical Staff of the Division on patients referred for diagnostic studies or on patients undergoing treatment at the University Hospital or the I. Gonzalez Martinez Oncology Hospital. The rationale for this activity is that it enters into the teaching material offered to the trainees in the various courses in the formal presentations or at informal discussions. Trainees are encouraged to design and carry out their own projects. During the last training course given at this Division two new proposals or projects of investigation were submitted ---Page Break--- as a result largely of the initiative of the trainee proposals 1. Clinical and Radiotracer Evaluation of the cardiovascular States in Diabetics - initiative on the part of trainee Dr. Mario Iturralde from Bolivia. 2. Iodine Metabolism in Endemic Goiter in Mexico, initiative on the part of trainee Dr. Antonio Quiñonez Blanca from Mexico. ‘The project

of the clinical and radiotoxic evaluation of the cardiovascular states of diabetic patients was approved and is underway. The project for the study of endemic goiter in Mexico is under consideration for approval pending financial support. All other projects are tuned to the needs of the teaching program: ‘This relation is best shown if we compare the units of study of the various courses and the project title of the clinical studies. This is given below, Table III. Comparison Unit of Study for Training and Projects of Investigation Units of Study-Clinical Applications Project 1, Tests of Thyroid Function = Clinical and Laboratory Evaluation of Thyroid Disorders + Evaluation of in vitro tests of thyroid function for use as diagnostic procedures + Study of the effect of anticonceptive therapy on the 26-hour I-131 thyroid uptake ---Page Break--- cardiovascular Kidney function Liver function Gastrointestinal function Hematology Tumor Localization Electrolyte Balance and Fluid Compartments Therapeutic procedures on Coronary blood flow in angina Cardiovascular studies in diabetics Renogram follow-up Study in Cancer of the Cervix Combined clinical, renographic and scintigraphic studies in kidney diseases Renogram studies in diabetics I-131 Rose Bengal localization studies - sialography ‘The effect of radiotherapy on intestinal absorption of iodine 131 labelled fat and Vitamin A (in humans). The thyroid gland as an Indicator of intestinal absorption of I-131 labelled fat Instrumentation improvement Organ and tumor localization Electrolyte and fluid disorders due to diarrhea. Electrolyte and Fluid Balance in women under anticonceptive therapy Review of Patients treated with I-131, ----Page Break--- Advanced Course in Nuclear Medicine: RADIOISOTOPES IN RENAL DISEASES ‘The Clinical Applications Division of the Puerto Rico Nuclear Center will offer an advanced course in Nuclear Medicine applied to the study of diseases of the renal apparatus. The course contains an introduction unit which will review basic aspects of

nuclear Physics. This will be followed immediately by a workshop in anatomo-pathology study of renal morphology, normal and abnormal, with presentation of pertinent illustrative material derived from surgical specimens and related to clinical pictures and case discussions. This area will be taken up in two units: A. A unit of anatomo-pathology studies of the kidneys, in which the basic considerations will be the study of normal anatomy of the kidney which includes: gross anatomy, histology, embryology, anatomo-pathology of the kidney, physio-pathology and special techniques of histopathology (histochemistry). B. Special syndromes or clinical pictures of renal diseases. This includes nephritis and nephrosis, metabolic diseases, vascular lesions and obstructive syndromes, including tumors and renal infectious processes. The fourth unit will be dedicated to the study of the renal apparatus by the use of several radioisotopic techniques. Emphasis will be placed on methodology of the different tests and their interpretation and correlation with physio-pathologic mechanisms presented or demonstrated in the various clinical pictures. ---Page Break--- The duration of the course is four weeks, with 18 hours for lecture time and 116 hours for practice, demonstrations, discussions, seminars and other activities. The course will be offered utilizing

various methods available for transmission of information. This will be based on the formal lecture, panel discussion and methods in which the active participation of the trainee will be encouraged, such as case presentations, bed rounds, seminars, discussions, laboratory practice and clinical evaluation and workup of patients under supervision. Information will be presented using available audio-visual means, such as, movies, slides, surgical specimens, visits to autopsy rooms, recorded lectures, etc. Requirements for diploma: Doctor or Senior Medical Student who have had previous training in radioisotopes (Basic Course Radioisotope Techniques) or equivalent experience. Requirements for

other participants not entitled to diploma: Doctor, Medical Student or paramedical professional, for example technician. A certificate of participation may be issued in this category for full attendance to lectures and demonstrations but persons in this category are not responsible to perform or render any special assigned work. Capacity of enrollment for diploma - 8 trainees Participants with no diploma - no limitations. Stipends - A fee of $25 will be charged to all enrollees to the formal course with credit. Other participants no charge, A program of the course is submitted: ---Page Break--- RADIOISOTOPES IN RENAL DISEASE Program for the Special Advanced Course: I. Introduction: Biophysics Mathematics review Lecture - 1 hour laboratory - 3 hours 2. Statistics review lecture - 1 hour laboratory - 3 hours 3. Review basic Concepts Nuclear Physics lecture - 1 hour laboratory - 3 hours 4. Review Nuclear Physics Lecture - 1 hour laboratory - 3 hours 5. Anatomic Pathology of the Kidney 6. Anatomy of the kidney: Embryology lecture - 1 hour laboratory - 3 hours 7. Anatomic pathology of the kidney lecture - 1 hour laboratory - 3 hours 8. Histopathology of kidneys lecture - 1 hour laboratory - 3 hours 9. Renal Physiology and Clinical Laboratory lecture - 1 hour laboratory - 3 hours 10. Spectral histopathologic techniques (histochemistry) lecture - 1 hour laboratory - 3 hours 11. Clinical Syndrome: Renal Disease: 12. Nephritis and Nephrosis Lecture - 1 hour Laboratory - 3 hours 13. Metabolic diseases lectures - 1 hour laboratory - 3 hours 14. Vascular defects lecture - 1 hour Laboratory - 3 hours 15. Obstructive Uropathies including tumors and infectious processes of the kidney IV. Radiotracers 16. Renographic studies, part I lecture - 1 hour laboratory - 3 hours 17. Renographic Studies, part II lecture - 1 hour Laboratory - 3 hours 18. Gamma Scintigraphy, part I lecture - 1 hour laboratory - 3 hours 19. Gamma Scintigraphy, part II lecture - 1 hour

‘Laboratory - 3 hours 19. Electrolyte studies; Sodium turnover, Sodium space and Sodium excretion lecture - 1 hour Laboratory - 3 hours ---Page Break--- 20. Fluid compartments - total body water lecture - 1 hour laboratory = 3 hours 21. Differential test of renal function using stable sodium and radioactive sodium lecture - 1 hour Laboratory - 3 hours 22. Miscellaneous tests of renal function: renal cystogram and radiocystometry, excretion half-life, renal clearance and renal blood flow. ---Page Break--- ‘ORIENTATION IN THE MEDICAL USES OF ISOTOPES FOR ONE WEEK DURATION 1. Introduction to basic concepts of Nuclear Physics and radioactive protection, and handling radiotracers. 2. Radioactive applications in the study of thyroid disease. 3. Study of dynamic functions of the cardiovascular apparatus, renal and hepatobiliary systems. 4. Studies of gastrointestinal absorption. 5. Tumor Localization. 6. Body spaces and fluid compartments: disorders, electrolyte and fluid. 7. Therapeutic applications. Lecture time - 10 hours Laboratory sessions - characterized mainly by demonstrations, case presentations and group discussions - 26 hours ---Page Break--- ---Page Break--- ‘OUTLINE OF MATERIAL TO BE PRESENTED TO ABC AD HOC COMMITTEE FOR PROGRAM REVIEW MEDICAL SCIENCES AND RADIOBIOLOGY DIVISION Dr. Maurice Paul Weinbren, Head ‘This division is composed of three theoretically separate programs, though, in fact, these have become interdependent in many ways. The interdependence avoids unnecessary duplication of skills and facilities and has enabled the division

as a whole to operate with considerably greater efficiency. ‘The basic program was established to: 1. To conduct training and research in radiobiology at the cellular and subcellular level with emphasis on medical applications. 2. To establish and operate tissue culture facilities for its own program and also to serve others. 3. To explore the utilization of nuclear energy in developing new knowledge of tropical diseases of man. 4. To organize and operate a small animal.

Is laboratory needed for its own program and those of others. In this area we have established a well-trained staff who are adept in most of the techniques of tissue culture. Little progress has been made with the program designed to study the effects on individual cells resulting from neutron capture by Boron 10, because no sooner did Dr. Samant's group succeed in synthesizing soluble 3° containing compounds, than we lost our standard cell lines due to persistent and refractory contamination. A program to study human chromosomes in cultured leucocytes was established as a cooperative effort between the U.S. Army Tropical Medicine Research Laboratories (Col. H. Dacquiste), this Division (Dr. I. Fy Weimbren), and the Division of Radiotherapy and Cancer (Dr. José Ton). The program is designed primarily to establish a normal pattern and to compare this with material drawn from cases with “Tropical Sprue”, Radiotherapy patients receiving radiation to the abdomen and in both “sprue-like” condition results, and patients receiving similar doses of chemotherapy to areas excluding the abdomen. The study is not, however, ---Page Break--- limited to this type of material and we have received a number of specimens from physicians at the University Hospital and the forces. Our first cultures were made on October 22, 1963 and we have now (September 14) processed 10. Now that this facility has been established, it is proposed to file material from the members of the Puerto Rico Nuclear Center staff, and in particular to follow those individuals who were accidentally exposed to radiation in Mayaguez. The Dengue Epidemic This Division was invited to participate in a study of the epidemic of Dengue fever which was first recognized as being of epidemic proportions in the town of Manati in late August 1963. The part played by the Mosquito Culture Unit was an attempt to isolate virus from sera collected from patients in the first 12 hours of illness. The tissues used for this purpose were African Green Monkey.

(Cereopithecus) Kidney monolayers which were purchased in tubes from Flow Laboratories. From 36 of the sera inoculated into the tissues a "positive reaction” was obtained. The term "reaction" has been used because as yet we have been unable to achieve the usual end point of specific cytopathogenic effect which is transmissible for an indefinite number of passages. In tissue culture two types of changes were seen and may be referred to as "early" and "late". The early change consists of a fleeting cyto-pathogenic effect where areas of degeneration of the cell sheet occur and the affected cells detach and can be seen floating in the medium. This usually occurs on the 3rd day following inoculation and would appear to be confined to a hypersusceptible cell population as the detached cells are replaced in a matter of hours by the cells not affected at this time. The "late" phenomenon occurs between the 6th and 10th post inoculation days when the monolayer's appearance becomes that of Madeira Lace or drawn-thread needlework; there are "holes" of varying sizes up to 300μ in diameter separated by bands of cells piled several deep. At this stage there is little or no increase in the number of cells floating free in the medium but if the process is allowed to continue for a further 2 or 3 days all the cells detach. In many instances both "early" and "late" phenomena occur in the same cell sheet but this is not invariably the case. Sometimes, when the specimen was inoculated at different dilutions, the lower dosage resulted in only the "late" form while the more concentrated inoculum produced both types. In some instances the “effects” are transmissible by means of the supernatant medium from the "early" stage and in others only from the “late”. In any event after 2 or 3 passages the virus assumed a condition of latency and although

demonstrable in the cells by means of the indirect fluorescent antibody technique, no overt manifestations of any type were ---Page Break--- -3- Altogether 299 fluorescent antibody tests were

carried out in this unit in the course of testing tissue culture cells or mouse train impression for the presence of the Dengue virus. We have recently been able to obtain a supply of BHK (Baby Hamster Kidney) cells through the kindness of Dr. Michael Siegel of the Variety Children's Research Foundation, Miami. Dr. Siegel obtained this established diploid cell line from its originator, Dr. Stoker, in Scotland. Our particular interest in these cells lies in the fact that they have been shown to be unusually sensitive to the Dengue viruses and we hope to use them to further study the material collected during the Dengue epidemic. Another approach to the problem of unmasking the latent Dengue Virus has been to use irradiated infant mice as a medium. The mice received 300 or 400 rad before inoculation. The system used was one of continuous passage in both irradiated and normal mice. On some occasions the virulence appeared to be enhanced but this effect was temporary though it is true that larger quantities of the virus may be demonstrated in the brains of the mice from the irradiated series by the indirect fluorescent antibody technique (T.F.A.). Up till now this T.F.A. technique has been carried out on impressions made from the cut surface of the brain being studied but in the last few days we have received a cryostat microtome and will now be able to use tissue sections for the purpose and this should be much more satisfactory. The dosage of 300 or 400 rad was derived from an estimated LD50 in the region of 650 rad (based on previous experience with rats). It was further assumed that the R.B.E. for baby mice of radiation from a 350 KVP "Maxitron" would be similar to that from Cobalt-60, subsequent experiments have shown however that this is not so, at least for the units at the Puerto Rico Nuclear Center and the Oncological Hospital. The attached table shows the results of the experiments which may be summarized as follows ---Page Break--- =e DATE 900 KVP_MAXITRON 08 LD, DEATHS-DAYS LD, | DEATHS~DAYS

50 50 T/K/64 (PRNC) 456 5-24 (PRNC) 912 bal4 B/11/64 (PRNC) 456 4a20 (PRC) 912 ue 8/28/64 (PRNC) 486 bend (Hosp) 920 ais wos? 455 wea In all cases the animals were observed for 3 weeks and no deaths occurred after those noted about 718 MAXITRON (PRNC) cof? (pane) Doser # Time of Dead Alive Death Dead Alive 2200 aso ° ° 1000 18 as 1 Se8 Sea 800 aso ° 16 600 aso cats ° 4 400 o 8 ° 16 200 o 16 ° as to ese >, 922 s/n 1600 wo 46 cy ° 8 800 woo 7-10 ° a4 oo o 1s ° as 200 ow ° as LD, 456 F Lp, 912 F MAK, PRNC 1800 woe s 200 wo ea 400 o ow vp, 86 ---Page Break--- Pog &eoaa g a4 gota 8 8 gaaec. g g 88 ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED TO AEC AD HOC COMMITTEE FOR PROGRAM REVIEW RADIOTHERAPY AND CANCER DIVISION Dr. Victor As Norcal, Head A. RADIOTHERAPY RESIDENCY PROGRAM 1. Training Program ‘The purpose of this program is the training of radiologists. The second most common cause of death in the nation requires that radiation therapy be utilized at some time in the disease in over 50% of patients. Adequate radiation therapy is best provided by properly trained specialists with full-time interest and dedication to this aspect of medicine. This program attempts to train academically and research-oriented radiation therapists. The ultimate goal is to serve the cancer patient better, providing him with well-trained specialists and more efficient treatment methods. The present program of training constitutes a collaborative project between the Puerto Rico Nuclear Center, the I. Gonzélez Martinez Oncologic Hospital, and the University of Puerto Rico School of Medicine. The main objectives of the Puerto Rico Nuclear Center and the University of Puerto Rico School of Medicine are training and research, and that of the Oncologic Hospital is the service to cancer patients; consequently, the efforts of these institutions complement each other. The total training period lasts three years, but trainees are required to take an additional fourth year of supervised practice before admission to the Board.

certification exams. The program enjoys full approval from the American College of Radiology. Trainees acquire a solid background in cancer through supervised work with new, follow-up, and hospital patients. They learn to diagnose the disease, determine the extent of the tumor, choose the appropriate treatment, and plan and conduct radiological therapy. Additional therapy experience is acquired by working with radiotherapy 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. The present program permits trainees to 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.

Since July 1, 1964 some changes have been introduced in the curriculum that affect mainly the first-year trainees. Radiotherapy trainees in the first year will be offered a course of cancer pathology for three months, a course in radiological physics for three months, and a course in radiobiology. In addition, they will take the Basic Radioisotopes Techniques Course and will be given radioisotopes clinical training for two months. A lecture course in biostatistics and refresher conferences in biochemistry will be offered during the training period. Latin American trainees have faced three major obstacles in coming to receive long-term radiotherapy training at American centers. These are: the certification from the Council on Foreign Medical Graduates of the American Medical Association, which is a requisite for training in approved residency programs, licensure by the State Board to practice medicine on a temporary basis, and adequate financing during the training period. Since the requirement of certification by the ECFMG was introduced, the number of trainees has decreased in all American centers.

centers. 8, SHORT TERM RADIOTHERAPY TRAINING The short term radiotherapy trainees are those that come to the Division as observers for a period of a month or longer. As a rule they are experienced radiologists who want to become familiar with our program. This constitutes a less desirable type of training for Latin Americans in view of the fact that they do not acquire a solid basis in radiotherapy. Short term trainees face the following problems: as a rule they have permanent positions at home and cannot afford to leave their departments for long periods of time and they are older individuals who cannot afford to bring their families with them in view of the limited economic support they receive while away. C. FOURTH YEAR MEDICAL STUDENTS TRAINING The fourth year medical students have been offered a training period of one month in the Radiotherapy and Cancer Division on a voluntary basis. The students do not enjoy free time in their fourth year other than a month of vacation. During the vacation some students choose to come to the Radiotherapy Division to learn about cancer and radiation therapy. D. RADIOTHERAPY TECHNICIANS COURSE the operation ions. Radiotherapy ing for two years. Our Div ing course that will be offered to a group of nurses from the Oncologic Hospital and the Puerto Rico Nuclear Center beginning early in fiscal year 1964-65. The proposed course follows the pattern required by the American Board of Radiology; it consists of four hundred hours of didactic activities and over a thousand hours of supervised experience. ---Page Break--- E. VISITING RADIOTHERAPISTS Young radiotherapists from Latin America have been given the opportunity to work as visiting radiotherapists for periods of one year or longer. This has permitted them to become familiar with our program and has proved stimulating to our staff. The research activities at the Radiotherapy and Cancer Division continue being of clinical nature in the majority of projects. As no laboratory facilities are available in the Division, we

have to request the help of the Medical Sciences Division for such services. It is expected that when the animal house is finished, basic research facilities will be enhanced considerably. The following projects are underway in the Division, 1. Evaluation of Radiation Response by Means of Exfoliative Cytology in Cases with Cancer of the Cervix Treated with Radiation - this is a long-term project which is being carried out at the Radiotherapy Division with the objective of determining the value of exfoliative cytology as a prognostic tool in cases with carcinoma of the cervix treated with radiation. An initial analysis relates to patients with a minimum of two years follow-up who showed the presence of persistent tumor cells in the vaginal smear after irradiation. The significance of this finding and its relationship to tumor-free survival has been determined. 2. Surgical Adjuvant Breast Project. This is a national project with the objective of improving prognoses in patients with breast cancer treated with radical mastectomy with additional therapy. Post-operative irradiation of the lymph node areas, and systemic chemotherapy are being investigated. So far, 29 patients from the GonzGlez Martinez Oncologic Hospital have been contributed to the study. 3. Study of the Incidence of Leukemia in Patients with Cervical Cancer Treated with Radiation. This is an international study with the objective of determining the risk of developing leukemia in patients who have been irradiated for cancer of the uterine cervix. As of the end of June 1964, all the collaborating institutions have contributed 33,000 person-years to the study and 2 cases have developed leukemia. The expected number of leukemia cases based on normal population incidence would be 2 cases. ---Page Break--- 4. Study of Chromosome Changes in Patients Undergoing Radiation Therapy. The aim of this study is to determine chromosome changes in irradiated cancer patients that may have prognostic value. The samples are taken before, during, and after irradiation and the

Lymphocytes are separately cultured, the cultures are then treated with colchicine and the lymphocytes are stained and observed for chromosome abnormalities.

Study of Fractionation of Weekly Doses in Cancer Patients

This is a clinical study aimed at determining the optimal fractionation of weekly tumor doses in patients undergoing irradiation for cancer. Half of the patients at the Department are receiving the weekly tumor dose divided into three applications versus five applications in the other half. Tumor effect, survival, and normal reactions are being observed. Six hundred and twenty-two patients have been incorporated into this study.

Study of Optimal Tumor Dose in Radiation Therapy of Cancer of the Esophagus

This is a clinical study to determine the optimal radiation tumor dose in the treatment of cancer of the esophagus. Half of the cases have been treated with cobalt teletherapy doses of 5000 rads in 4 weeks versus 6000 rads in 6 weeks in the other half. Disappearance of dysphagia and twelve-month survival will be compared in each group. Fifty-four cases have been included in the study.

The Influence of Whole Body Irradiation on the Enzyme Activity of the Intestinal Wall

This is a project to determine changes in enzyme levels in the intestinal wall caused by radiation. Mice have been studied as to acid and alkaline phosphatase levels in the small intestine, which has been divided into two equal halves. Acid phosphatase levels have been found equal in both halves, but alkaline phosphatase in the upper half is twice the amount found in the lower half. Total

irradiation of the animal, up to 500 rads, 48 hours before the animal is killed, has shown no change in phosphatase levels. G.O.T. and G.P.T. levels will be investigated.

Controlled Study of the Split-Dose Technique in Radiotherapy of Cancer

The purpose of this study is to compare the results obtained by means of the usual uninterrupted treatment (6000 rads in 6 weeks) versus a similar dose given in two separate two-week periods with a...

rest interval of two to three weeks halfway in the treatment (2000 r in two weeks / 2 to 3 weeks rest / 3000 r in 2 weeks). Only tumors measuring 5 cm or more (excluding pelvis and esophagus) are included in this study. Half of the cases in ---Page Break--- the study are being treated with the usual technique and the other half receives the split-dose technique. Results will be evaluated in terms of tumor regression, normal tissue reactions and curability. Fifty cases have been included. 9. Adenocarcinoma of the Cervix. This is a retrospective clinical study which has as objective to corroborate the clinical impression that adenocarcinoma of the cervix uteri is more radioresistant than epidermoid carcinoma of this structure. Eventually we wish to determine whether the combined use of radical hysterectomy after radiation would improve the survival. 10. Carcinoma of the Cervix Uteri and Pregnancy. Carcinoma of the Cervix Uteri and Pregnancy. In this retrospective study the incidence of carcinoma of the cervix uteri associated with pregnancy was determined in a group of 2554 cases of uterine cancer treated at the Gonzblez Morttnez Oncologic Hospital. Sixty-two patients had their cancer associated with pregnancy. The optimal way of handling this complication has been determined from the revised material. 11. Carcinoma of the Cervix Uteri in Sterilized Women. Carcinoma of the Cervix Uteri in Sterilized Women. The aim of this study is to analyze the cervix uteri and preview the possible relationship of carcinoma to the reproductive capacity by surgical sterilization. It has been observed that in patients under 50 years of age with carcinoma of the cervix uteri, 25.4% have had previous surgical sterilization. The true significance of this finding is being evaluated. Future Project 1. Combined Irradiation and Chemotherapy In the Treatment of Carcinoma of the Esophagus. The objective of this study has the objective of improving the curability of carcinoma of the esophagus by irradiation therapy adding methotrexate. The study

will include controls and ‘will be initiated during fiscal year 1964-65. 2. Study of Dose Fractionation and the Combination of Radiation and Chemical agents on Mouse Tumor. The objective of this study is to observe the effects of various fractions of radiation alone or in combination with chemical agents on chondrosarcoma grown in mice. A correlation of radiation dose and histologic changes in the transplantable chondrosarcoma will be attempted. ---Page Break--- Available radiobiological and clinical data suggests that the response of anoxic [upon] is best when the patients receive oxygen while being irradiated. The study suggested for discussion with the Advisory Committee. Patients with bulky anoxia will be selected and half will be administered oxygen during radiation while the other half receives identical doses of radiation but no oxygen. Tumor regression and cure year curability will be evaluated. WL. SERVICE ACTIVITIES ‘An adequate load of clinical cases is necessary for good training and for clinical research. As there exist hundreds of different types of cancerous tumors, the must be exposed to a significant and varied load of patients to be able to become familiar with all types of neoplasia and the problems involved. Most clinical studies require a good volume of cancer patients to be able to accumulate data of statistical significance therapy and Cancer Division has not suffered from lack of good clinical data; it has access to all the patients seen at the Dr. I. González Martínez Oncologic Hospital. During last year 21,794 teletherapy

applications were given, 20 teletherapy insertions were made, and 723 new patients were registered for radiation treatment. ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED AT AEG REVIEW OF PENC PROGRAMS October 15-17, 1964 REACTOR DIVISION Presented by Mr. Héctor Barcelé Head of Reactor Division Functions ‘This program includes the operation and maintenance of a 1 megawatt swimming pool reactor and a 10 watt homogeneous reactor and the related equipment.

necessary to operate these facilities Organization 1 Division Head 1 Reactor Supervisor 1 Associate Reactor Supervisor 4 Reactor Operators 1 Mechanic 1 Janitor 1 Secretary HLotory, 1. Operation ‘The 10 watt homogeneous reactor was first made critical on August 12, 1959. The 1 megawatt swimming pool reactor was made critical for the first time on August 16, 1960. The test period for this reactor extended through November 1960, after which it was turned over to the PRC for operation. ---Page Break--- -2- Megawatt-hours of operation Year 1951-1962 287.19 Megawatt-hours Year 1962-1963, 996.76 Megawatt-hours Year 1963-1964 1,163.67 Megawatt-hours one term beam tube experiments In July, 1962, the {ese tong cera experiment was inserted in the reactor in beam tube No. 2. In this experiment a graphite calorimeter was used to measure the effects of radiation on graphite with respect to its sensitivity. In October, 1962, the first neutron spectrometer for the Neutron Diffraction Program was installed in beam tube No. 4 and the second neutron spectrometer was installed in beam tube No. 3 in July, 1963. ‘Training 1959-1960 Training course given to four reactor operators for the PRNC 1961-1962 a. Training course given to twelve reactor operators for the BONUS reactor b. Short course in instrument trouble diagnosis offered to two PENG electronic technicians 1962-1963 Reactor supervision training program given to six BONUS supervisors 1963-1964 On-the-Job training of two reactor supervisors from Colombia, South America D. Improvements and developments Beam tube No. 1 has been provided with a fast flux collimator and a borated-water neutron shutter ‘The thermal column was improved to provide a higher and more uniform flux distribution over the vertical access opening. ‘A new core configuration has been developed which provides a higher neutron flux density at the beam tubes and gives a higher value of rod worth. ---Page Break--- 10. ne -3- Rod vibration caused by water flow has been reduced without the reduction in size of the water

channels ‘A mechanized system was installed to permit the transfer of radioactive material from the swimming pool into the hot cells under water. A voltage regulator was designed and built by the reactor division for the safety amplifiers to correct rise in magnet current with power increase. A Nitrogen 16 detector was installed in the primary water outlet to monitor power level more accurately than is possible with the equipment for the differential temperature method originally installed. An aire scanner was built by the division to scan copper wires used for flux mapping. Techniques have been developed for constructing and overhauling rod magnets. One overhauled magnet has been in service for a period of four months with no indication of deterioration. An analog computer is under construction for the calibration of rods. Studies of a Liquid gamma-loop using toluene have been completed. A new instrument is being designed to enable the instrumentation console to be checked without removal from the system. E. Publications and papers 1. Presented by H. Barcelé at Gatlinburg, Tennessee: PRN reports completed 4, Record Keeping - H. Barcelé. Hazards Summary Report for the I-77 Reactor - H. Barcelé and R. Brown. Operating Limits for the I-77 Reactor - H. Barcelé. Reactor Operating Procedures - H. Barcelé. Reactor Operators Training Course (Academic Phase) - H. Barcelé. FING reports in progress. Summary of the Hazards Report for the 1 Megawatt Reactor. Operating Limits for the 1 Megawatt Reactor. Papers presented at "Light Water Moderated Research Reactors" meeting: Comparison of Rod Worth by Period and Analog Computer Methods; Elimination of Control Rod Vibration Caused

by Water Flow in June, 1962. ---Page Break--- F. Engineering assistance to others. BONUS reactor, Rincén. Calibration of ionization chambers for power reactor. Participation on BONUS Safety Committee. Participation as guest member on the Oak Ridge Reactor Safety Committee during 1963 for the inspection of OAR, LITR and X-10.

reactor (H. Barceló) ‘trol Sugar mill operations in Puerto Rico - Development of production methods using radioisotopes 4. Control of crusher feed input for constant density instead of constant volume D. Monitoring of feed to detect ‘tramp iron’ fe. Interstage crusher output monitoring to improve crusher efficiency G. Future plans for increase in megawatt-hour output ‘The present operation of the 1 megawatt reactor is limited to one shift (8 hours) per day at a maximum power level of 1 megawatt. It is expected that in the near future the hours of operation and the power level of this according to the following schedule: reactor will be increased 1, Two-shift operation ~ 1 megawatt power level 2 megawatt power level = 2 megawatt power level = 5 megawatt power level ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED TO ‘ABC AD HOC COMMITTEE FOR PROGRAM REVIEW October 15-17, 1961 NUCLEAR SCIENCE AND TECHNOLOGY Dr. Owen H. Wheeler, Head ‘A. EDUCATION Is teaching and research in Chemistry and Physics in support of M.S. programs offered by the Departments of Chemistry and Physics of the University of Puerto Rico in Mayagüez. STAFF Scientists: Chemistry - O. H. Wheeler (1/2 time), T.F. Facet Physics - B. Ortiz (1/10 time), J. A. Gonzalo Chemical Technology - J. Huflot (Special Projects) Research Assistants - Chemistry-2, Physics-1/2 Technical Assistants - Chemistry-2, Physics-1, ‘Other-1 Graduate Students (PRIC) - Chemistry-2, Physics-2, The Future plans call for the addition of another physicist and another research assistant in physics and an increase to 6 graduate student appointments. Inter developments envisage increases to 3 chemists and 3 physicists with a supporting group ratio of 2 assistants and 2 graduate students per scientist. ---Page Break--- c. TEACHING The staff members of the Division teach courses in Chemistry and Physics directly related to Nuclear Science (radiochemistry, nuclear physics) and other courses as a service to the University (statistical mechanics, inorganic chemistry). ‘The

Division also organizes the weekly general seminars and special seminars in solid state physics and radiochemistry. The orientation of groups of visitors, including local high school students, on the activities of the Center in Mayaguez, is also carried out by Division leaders. D. RESEARCH is offered for graduate students in the U.P.R., M.S. programs in chemistry and physics, and currently most of the programs are carried out through PRNC. In addition, research for a Ph.D. is available through the ORINS program. B. Cruz (Physics Dept.) is a candidate for Ph.D. (Physics) at Harvard. Staff members and visiting scientists also carry out independent research. RESEARCH FIELDS include radiochemistry, nuclear chemistry, hot-atom chemistry, synthetic organic chemistry, physical organic chemistry, radiation chemistry, chemical technology, solid state physics, neutron physics, radiation physics. ---Page Break--- -3- Members of the Division, including graduate students, also cooperate with the Neutron Diffraction and Resonance in Radiation Effects programs. The addition of research in neutron inelastic scattering and other fields of neutron physics is expected in the future. It is hoped to cooperate in these fields with newly established groups in Colombia, Venezuela, and Mexico. RESEARCH ACTIVITIES cover the study of (i,q) reactions in heavy elements, range of fission products in aluminum, hot-atom chemistry of tin, antimony, and rhenium compounds and of organic phosphorus compounds, mechanisms of organic reactions using isotopic tracers, radiation-induced brominations and hydroxylations of steroids, synthesis of steroids of radiological interest, use of ultrasonics in uranium extraction, chemical dosimetry, photomultiplier fatigue, radiation damage in ferroelectrics, radiation damage in alkali halide crystals, and neutron diffraction study of magnetic structures. PUBLICATIONS during the

last year 15 publications have appeared or have been accepted for publication in the following journals: Journal of

Physics and Chemistry of Solids, Journal of Inorganic and Nuclear Chemistry, Nuclear Science and Engineering, Bulletin of the American Physical Society, Radiochemica Acta, Transactions of the American Nuclear Society, Journal of Organic Chemistry, Tetrahedron, Canadian Journal of Chemistry, International Journal of Applied Radiation and Isotopes, Zeitschrift für Physik. ---Page Break--- ---Page Break--- A OUTLINE OF MATERIAL TO BE PRESENTED TO 'ABC AD HOC COMMITTEE FOR REVIEW OF PRNC PROGRAMS October 15-16-17, 1964 NUCLEAR ENGINEERING Dr. José Luis García de Quevedo, Head Master's Degree Programs in Mayaguez in which PRNC Cooperates Through Provision of Support, Laboratory and Research Facilities and/or Teachers of Advanced Subjects 1. Nuclear Engineering 2. Health Physics 3. Biology 4. Chemistry 5. Physics 6. Agriculture 7. Mathematics Master's Degree Program Requirements of ORING Fellowship in Nuclear Science and Engineering (originally Nuclear Science and Technology) Original Organization of Nuclear Science and Technology Program and Division Within the University and Within PRNC: 1. Use of sub-specialties under Nuclear Science and Technology to cover all fields of graduate studies. 2. Lack of direct academic cognizance over degree programs. New Organizational Structure 1. Direct cooperation with department with cognizance over general discipline involved, and with program orientation toward nuclear topics. (Biology, Chemistry, etc.) 2. Creation of new degree program and new academic department by the University to cover truly new discipline created by advent of nuclear energy - Department of Nuclear Engineering. 3. Creation of new PRIC division to meet engineering research and teaching requirements within PRIC - Division of Nuclear Engineering. ---Page Break--- a. B. Division of Nuclear Engineering 1. Teaching responsibilities 48) cooperation with Department of Nuclear Engineering in supporting development of nuclear engineering degree. 1b) cooperation with other departments of the College of Engineering in

developing the nuclear aspects of their disciplines: 1) electrical engineering 2) mechanical engineering 3) chemical engineering 4) civil engineering c) development of specialized terminal training programs to serve requirements of ABC and Puerto Rico nuclear energy development in the power and engineering areas. PEWRA is now planning a reactor power plant per year for the next ten years, starting 1970. 1) Reactor Operators Training 2) Reactor Supervisors Training 3) Nuclear Engineering Training (In this case, a degree may be granted simultaneous to academically qualified students through the Nuclear Engineering Department of the College. PRIC issues certificates only.) 2. Research responsibilities a) thesis research for graduate students in Engineering. b) engineering faculty research on educational and tutorial subjects. c) open research and development in Engineering. (PRWRA is negotiating for a combined electricity - desalination plant) International a) development of exchange teaching and research proposals with Latin-American engineering schools and laboratories. b) development of residence training and research programs at PRIC for Latin-American engineers. c) development of tutorial and training opportunities for engineers in Puerto Rico nuclear energy installations such as Bonus, PRWRA, etc. ---Page Break--- -3- 4) development of conference and institute activity in engineering pertaining to Nuclear Energy development. This will be based on: (1) special interest, facilities, and capability at PRIC. (2) aim for Puerto Rico 4, IABA Conference on Medium Size Reactor Power Plants. February 1965. Participation in UPADI Conference in Caracas, 1954, San Juan, 1952. PRIC participants: Soderstrom, Knight, Gonberg. (Also representing United States Atomic Energy Commission and Energy Joint Council). c) Projected Institute on the Bonus Reactor Plant, for Latin America and United States participants. (3) support and development of activity in new areas. a)

Projected A.S.E.E. - C.D. Institute for Instructors on Shelter

Requiresments (joint project with CAAM), Present Status of Engineering and laboratory training Teaching Activity in Division) students working toward M.S. - Current enrollment (1) Boms trainees - 19 (2) tocar = 8 (3) Latin America a, self or government - 1 bl TARA : 1 'TOTAL - 20 b) special trainees (Primarily Reactor Division) (1) Reactor operator training - Summer 1964 'a, Boms - 10 b. Local = 1. ce. PRIC >. TOTAL - 12 New group expected by January 1 (2) Reactor Supervisor training (men are graduates of Nuclear Science and Technology programs) Two from Colombia. ---Page Break--- 4 ¢) special engineering research and study within Division and laboratory (2) Thermal sensitivity of graphite (2) Neutron sonochromator based on total reflection (3) Nuclear afterheat in case of water loss - PRNC reactor t) Development of Reactor Lab teaching manual for use in Spanish (5) Rework of sections - Hazards Summary Report (6) Leaching of Uranium Ores with help of Ultrasonics (7) Use of tracers in Chemical Engineering Processes a, Study of mixing DI Determination of Particle velocity in Rotary Kiln ce: Diffusion in Metallurgy 4) personnel of Nuclear Engineering Division Head: Dr. José Luis Garefa de Quevedo*, Ph.D., also SRatiaan, Besariont oF Misia fngtnecting, Members: Dr. Donald B. Sasscer*, Ph.D., Jo; Department of Mechanical Engineering. Dr. Aviva B. Giledsdi (full time starting October 15, 1951). Dr. Peter Paraskevoudakis (on loan from Health Physics Division). Dr. Phillip W. Osborne; Department of Mechanical Engineering Metallurgy. Prof. Kenneth Soderstrom*; Department of Mechanical Engineering. Prof. Carlos V. Wheelers; Department of Mechanical Engineering. F, laboratory Assistance in Nuclear Engineering to Others. 1. Bonus 4) Calibration of Ionization Chambers for Power Reactor b) Participation on Boms Safety Committee: Gonberg, Barce1é FCAAM Faculty - Part Time PRKC ---Page Break--- =5- ¢) Construction of N.A.D. equipment (Other non-engineering services in health physics and operations area also supplied) Sugar Mill Operations in

Pierto Rico ~ Development in Production Control using Radioisotopes. a) Control of feed for constant weight input to crusher. b) Foreign material detector for sugar mill feed line. ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED AT ABC REVIEW OF PRNC PROGRAMS October 15-17, 1964 HEALTH Paste Presented by Dr. José A. Ferrer Monge, Ph. D. Head of Health Physics Division I, Health Physics Division A, AEC Operating Requirements B. Service and training objectives TL. Services AL Present services Puerto Rico Nuclear Center a. Personnel and waste monitoring D. Consulting E. Environmental surveillance 4. Medical service fe. Instrument calibration £. Waste disposal 2. BONUS reactor at Rincon a. Film badge service b. Environmental surveillance fe. Consulting Advising government agencies, private companies, and various departments of the University of Puerto Rico in Health Physics B. Future plans 1. Immediate completion of a disaster center for dosages received in criticality incidents termination of 2. Development and construction of instruments for calibration of research equipment and for highly accurate dosimetry. ---Page Break--- mm. Ww. Education A current program Special features of PRNC and its relationship to Latin America 2. Status of Health Physics in Latin America 3. Re-evaluation of the Atomic Energy Commission Fellowship program in Health Physics 4. Degree program in Health Physics in cooperation with the Biology Department 5. Cooperation with departments of physics, chemistry, and nuclear engineering to develop aspects of Health Physics as related to these fields 3. Future programs in education for Latin America 1. Exchange coaching 2. Teaching in residence for Health Physicists from Latin America development of Health Physics conferences and institutes in Latin American countries ec. state 1. Personnel for regular Health Physics program Specialized personnel for advanced electives Research A. Areas of concentration 1. Interaction of radiation with matter 2. Medical aspects of Health Physics 3.

Radiation protection and dosimetry 4, Radiation ecology 5, Radiobiology Present programs 1. Ecological studies 2. Supervision of thesis research for graduate students in Health Physics ---Page Break--- ©. Future plans 1. Cooperative programs with various laboratories in Latin America 2. Research programs for Health Physicists in residence from Latin America ---Page Break--- ---Page Break--- OUTLINE OF MATERIAL TO BE PRESENTED TO 'AD BOC COMMITTEE FOR PROGRAM REVIEW October 15-17, 1964 Agricultural Biosciences Division T, Activities in Education and Training 1. Courses given by ABS Division personnel in FY-1964 2. Biology 617 = Advanced Genetics (Linden, 3 credits) 3. Biology 618 = Cytogenetics (Koo, 3 credits) 4. Biology 645 = Special Problems in Nuclear Biology (Linden, 3 credits) 5. Biology 670 = Research Thesis (Koo, 4 credits) 6. Biology 690 = Graduate Seminar (Linden, 1 credit) 7. Biology 691 = Seminar in Radiobiology (staff, 1 credit) 2. In San Juan 2, Biology 372 Nuclear Techniques in Biological Research (Luse, Roig, 4 credits) 3. Biochemistry 311 Seminar in Biochemistry and Nutrition (Aretski, et al, 2 credits) 4. Masters degree thesis programs with (BS staff participation (in Mayaguez only). (Linden, Koo) 1. Supported by PRNC a. Full-time assistants who are taking one course per semester 5 in Biology 2 in Agriculture 2 in Chemistry b. Part-time assistants who are working toward M.S. degree 2 in Biology 2. Thesis work at PRNC but no financial support given to student College of Agriculture plans new program with 23 students: 10 of which wish to do thesis at PRNC. ---Page Break--- ©. Special training, as part of research activities 1. Project - "Isotope Applications in Soils" given to IAEA Fellow (Luse) 2. Project - "Radiation Effects on Forest Structure" - Ph.D. thesis by ORINS graduate Fellow (Luse, Odua) 3. Other Oak Ridge Graduate Fellowships and Research Participants are potential trainees, TL, Research Projects of 18S staff at PRKE 1. Agorole Metabolomics - Andrew Hor 2. Mechanism

of Bock Mitation - Francis K.S. Koo okt 3, Radiation and Chemical Effects in Plant Chromosomes - Francis K.S. Koo and Edith Fobles de Irtearry 4, Uptake of Sr and Ca by Sorghum vulgare and Pueraria hirsute in Pure Stands and in Combination in Relation to the Relative Concentration of these Elements in the Soil Flavio Pedovani under Joint supervision of Francis K.S. Koo and Frank + 5, Nuclear Volume and Radiosensitivity in Rain Forest Tre Irlearty 6. Biochemistry of Sugar Cane - Robert A. Luse 7. Element Cycling in the Tropical Rain Forest - Robert A. Luse and Rosaed To ous ots Peepcst Rein Forest 8. Insect Control by Induced Sterility - David Walker 9. Rearing, and Radiation studies of Diatraea Secchorelis - David Walker and Adele V. de Tlenaty: and Miguel Figueros 10, Trailing Indigo Project - Jean Gareto AL. Service Irradiation with CoO - José Cuevas Rute 12, Tropical Fruit Irradiation - Duane B. Linden and Jot Rote ee teeadltion Species - Cuevas ---Page Break--- B. In cooperation with other organizations 1, U.P.R. Agricultural Experiment Station staff (Mayaguez and San Juan) 'Azeem - Gamma Radiation in Plant Breeding 'Abrens de Leon - Gamma Radiation in Plant Breeding Pennock - Gamma Radiation in Plant Breeding Alexander - Isotope applications Roldaa - Isotope applications 2, U.P.R., College of Agriculture staff (Mayaguez): Gamma radiation and isotope techniques 3, U.P.R. College of Medicine staff: Enzyme characterization 4, U.S. Army Tropical Research Medical Laboratory staff: Chromatography C. Publications, a= index of increasing productivity 1961 = Division established 1962 - 8 we - 3 1964 - 20 (including in press) ---Page Break--- ---Page Break--- Participation of the Puerto Rico Nuclear Center in the Atomic Energy Commission "Atoms at Work" exhibit progress in Latin America Fausto J. Milos Ritedeneire, Director 'The Atomic Energy Commission has assigned to the Puerto Rico Nuclear Center responsibility for conducting investigations in the physical and Biological sciences as part of the new program of "Atoms at

Work exhibits in Latin America during the fiscal year 1965-1955. The program will be inaugurated in San Salvador, El Salvador, C. A. on February 25, 1965. The PRIC coordinator for the exhibit, the

author of this report was invited by the ABC Division of Special Projects to visit El Salvador and Guatemala during the last part of June, 1965, as part of an advance team. The group visited officials of the Ministry of Agriculture of El Salvador and the University of San Salvador. Information concerning the special needs and interests of El Salvador gathered at this time has been used as a basis for selecting research and lecture topics for the exhibit. The program of research to be performed at El Salvador suggests the possibility of cooperation in the future between the University of El Salvador and the Puerto Rico Nuclear Center. A tentative follow-up program in which students of the University of San Salvador might carry on graduate study at the University of Puerto Rico has been outlined. ---Page Break--- Activities of the PAC Scientific Lecturers and PANC Coordinator at the ABC "Atoms At Work" exhibit in San Salvador, El Salvador, Central America. 1) General Introductory Lectures Person in Charge: Fausto J. Muñoz Ribadeneira "The Nuclear Sciences and the Liberal Professions" February 12, 1965 "Chemical Dosimetry of Gamma Radiation" February 18, 1965 "Use of Tracers in Unit Operations of Chemical Engineering" February 19, 1965 "Gamma Radiation and Industrial Processes" 2) Lectures on Radiobiology Dr. David W. Walker Title of Lectures February 25, 1965 "Application of Radiation Effects on Entomological Studies" February 26, 1965 "Studies of Entomological Problems in Sugar Cane in Puerto Rico" and Food Conservation Problems March 4, "Preservation of Tropical Fruit" March 5, "Gamma Radiation at the FRAC" 4) Lectures on Radiochemistry Person in Charge: Dr. Juan F. Pacetti Dates of Lectures March 12, 1965 "Activation Analysis" March 12, 1965 "Stilbard-Chemists Reactions" ---Page Break--- 5) Lecture on Neutron ce

Person in Charge: Dr. Badte Ortiz
Date Title of Lecture
March 16, 1965 "Descriptive Experiments Using a Neutron Source"
6) Lectures on Applied Mathematics in Engineering Problems
Person in Charge: Dr. Badte Ortiz
Date Title of Lecture
March 16, 1965 "Boundary Value Problems"
(morning) March 17, 1965 "Transform Calculus"
(afternoon) March 18, 1965 "Finite Difference Applications"
March 19, 1965 "Matrices and Tensors"
(morning)
Dr. Modesto Irtarte (Power Authority of P. R.)
Title of Lecture "Factors to be Considered in Economics of Nuclear Power Plants"
March 22, 1965 "The BONUS Reactor and the Nuclear Power Program in Puerto Rico"
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