PRNC208A

PUERTO RICO NUCLEAR CENTER

TENTH OAK RIDGE REGIONAL SYMPOSIUM,

UNIVERSITY OF PUERTO RICO,

SAN JUAN, PUERTO RICO

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ATOMIC EITRGY AFPLICATIONS TO AGRICULTURE

John Be Rust

(A synopsis of talks to be presanted at the University of Puerto Rico,

Qoeicires campus on Jomuery 26, 0°, and on the Mayaques Carus on

Sanuary 28, 1957+)

?The application of atemie energy to egricultural rroblens holds

crest promise though one mist confees that there does rot appear to be Gly spectacular chances in sie field. A221 the gains that cen be anticipated Mail be through the ingen?ous aud intelligent oyplicaticn of this new tool Shas unemtteing work. Tt ie likely thet the avances vill be onal] and Fopeeted but Uhen sumed up neon a Significant contrévutions At present The epplications of atomic energy to agricuitwral probleas seen to be Soncine: principally to dncressing crop yields throu the develorment 0° Elucase reeistant oF heavier yielding foce plants by opplica genetics, the Control of plant parasites, the improvement o, the quality of fertilisers Ged thoi utilization, insect control, the control of plant and animal Giseeses, improvenent in the preservation of foods, and in some special ecricuitural industrial cyplications. One should te varncd that it does hot seem necessary to conzine investigations to these fielis alone for Over fields nay vell be wore Inortant if looked et closely.

?The applications of atomic energy to agriculture can be broken

down into two Broad caesories waich are based upon physiesi considerations. The firet fe the utilization of tracers or isotope techniques. The

Zecond 12 concerned with the effects of lerge anounts of radiation upon Genetic or schematic cell materials. In order to understand some o: the GRny vaye in uhich etonie enercy has been applicd to ecr-culture, it wil Se well to review scne of the succecefd uses which have been reporvel.

Tertilizer studies are enong these which have been conducted for the lowest period of sine end yet nev information te being constantly Vietiel for as everyone can gcc, and there are endless conbinations of ?ients and soil tyjes vhich need to be studied. ?There ere rony elegant xGbinigues hich can be presented here but for illustration cae ean mention puch avgimrle etsdy es the comparative uptaie of fert?lizers labeled with Fedicphosphorcus by the eaves and by the roots. Tt ts rother gurprie!n fo tie conventions] minged thet the leaves vere more effective (iaotopes Division eifte Nor 277a) in absorbing the fertilizer. A practice derived Fron tive fact aso developed particularly on the Vest Coast where orcherdist Grray dorsent {vcit treea with fertilizers. This method of fertilization has firmed out to be Particularly successful innovation. Urea, an inexpensive Ypcvroduct oF the chemical incustry, is being used extensively as a folier ferciliser by orcbardist and vesetable gardeners. The urea molecule when attacked by the naturally cecurring plant uressc yields enmonia which can

So vused in nitrogen setabolien by sany plante. By labelinz the carbon in the trea molecule the ability of the verious Plants to use urea has been determined by thefornation of ra@icactive 00>. Tuese new techniques of foliar fertilization 4n combination with urea have given @ cheep effective fertilizer for several crops. It is interesting to note thet foliar fertilizers are not effective for a2 pla:ts nor for all nutritional needs - for je calcium se not satisfactorily utilized.

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42 interesting application of radiocuifur with the problem of oranve

Sformge vas concerned vith sulfur coatain'ig spray residues. "A bresk deen

OF ihe sPray Fesidue into sone svostances waten were inimtesble t0 store Of

Grates, Usins a radioecitur caber in tac sprays, tie depth of penetretion

Under various conditions ant the suture of the tole subsrences pene

dee rmined, Tt was thea found that the sun Licht and heat would promote

{he formation of the toxic eubstance in question. Proper stepa were essen

Se gorrect the trouble and the renovai of vexing problen for orance

Growers was nade (Isotopes Division siide No. hl}.

Soli scientists have been pressed for many years for a technique

fo mesure soil moisturcuithout disturbance to tie soil structure ee the

Senociated plants, A probe systen wus developed in hich a fact neatene

Source vas ?inserted into the soil at one point ant at aisther soils neta: foil, for capturing slow neutroca was placed. The resulting redioe activity in the fold was then measured, ?Advantage vee talten of the fae Sint Bost of the eloving of feat neutrons was by the Light tyarosen secon Ck water, The resulting radioativity uae therefore e direct essere as ?the vater content of the soil.

Forest trees are an iuportect netural resource. For a good number

Of years now there has deen concer about the depletion ot ow fone resources through diseases of trees. Thus anything that can be aoe to give sone aid in silviculture has economic inert, taney Shere occurs natural root refciny among the trees in the forest whick

len an important part in the movenant ef water cad muttiente ad wee Particularly in the transport of disease inducin. orjauiose free on tree Seanother. The extent of this was not realized until labeled mteienes Wire used, | The use of recioiectopes has czarified some speciol probless Peers Pesvect, In @ representative experiment where trees wese some ten fect apart the treatment o° one tres with a radioactive substance dieclesed that five nearby trees vere greftec to it ty the reste, ?liken these Aad?tional sive were trented eweaty more trees were proved £0 be seine?. When these tventy-one trees were created ton nore trees were fOuDd to oe juyolvea. Thus with only three successive radioactive trestmente thirts-eix frees vere found to be crafted directly of indirectly with one anowreee ae $e casy to see that by rcane 0: ite say @ disease coull be spread. quite Tapldly throug: @ fores:. ?The basic tisermation developed proved Of fetue

Am developing control neasures for tree diseases. For exaxple, in laws end Paris creas where indivicual trees have e rather large valle eeverine wit oe Gouneetions to a depth of about 36 inches around the Qeeused tree was alee Grate to prevent the spread of the disease by means of rect aysteae wed SreRe Where sndsviduat trees are of low value the yoLsoning of hexithy orces Within 25 feet o° the diseased tree usually could control the infectin: Usias these methods t ves rossiole to control the spread of sone disesses of trees that were becominy a eerioue ecsuomie problem,

Ore of the most interestine of all recent developments in vhich radiosctive isotopes were uso hee Yeen that of the role of certeie substances in che miik, in rromoting the absorption cr ratiocalsiim Ia a series oF studies, calves vere being observed for their ability to abenc Calcium row the diet. It vas noticed thet there wes a marised @ifferenes between calves at two months of age and those at eix months of age in the

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Yotal calcium absorbed from dietary scurces. ?This age difference wes Anveatignted more closely ana + wee soul thet the cifZerence was related

to weaning Sine. ?The weaned aniuals, on stanlard commerical diets of good quality, vere not abie to ebsoxl nearly as mich calcium es those that were Still mirsing their mothers, It ues then established thet it vas substances in ilk that prowoted the abecrption and these are priiospally lysine, aruinine, and lactose, Thie 6 even true in old anicais, Tor even when

fan syed cov given lik solids vith celcium, ves abie to alsorb a considerebly Greater anocnt of caleiua ?rou her Met, Thus a nev eyeten of feeding wes ?ecablieued, one in which the milk solade vere incorporated with caleium here St vas desired to cet cood calcium atsorption in grovine artanis.

Inother interesting aspect of the resiccalcium studies came shout through the study of tae Total traneve: oF fetel urilizction of calesin fron the maternal blood stroan. ?Tue fetus draws heavily uzon the nother's store or calcium so mich so that it has been succested that the irritabiiity Trenent eothers often shou it relaved to the hypocalcemia. Ryyoseleeria or iow calcium in the blcod bas bean now fox many Yeare (0 produse eel @ condition in wan and aniuale. stucive ws Mocaletum have sliown thet the fetus wild draw celeium rem the dictavy celcium Pixs: 4f it is avaslable end if it is not {twill drev .rom he skoictel caletun the reserve stores of the mother. ?The ordirary threo nesle de Jy permitted ekeletal stores

to be drew uron to a lere e: ?Therefore, ?n order to protect the mother ?ron excessive dreins upo> her celcium stores it has been a rolicy to a.vise ?requeat seotincs vith an etequste calcium éiet for pregnant mothers. chis in turn ice e tendency, in the eyes of sone authorities, to reduce the irritability of rrecmant mithers by preventing the low blood calciua ?evels which develop vieu cuoteta? calcium 1s being mobilize?.

Please rardon ne ?or insluding a rcrsonal incident involved with tracers. Tt will serve to let you ?mo? that there are pit-felie that

befall the investigators veln: Tefioactive tracere. Tor sone years it hos been roticed thet form fot Phenouazine, and enchelmintic, would vain veigrt end this vee ute an mary easee to the rewo.el of she paraaste froa the intestinai tract. It has atso been observed by the more astute observers that aniuals without verasites woulé sige goin weight. A troublinc

paradox indeed. ?These facts vere linoun to we and vo come of ny callee-uee.

Sn sone rrior vori: ty a colleazue ra:e vere ?ed phenothiazine and th: 1ytake

Of vagioestive iodine measured. Animals irceted with paerothiogine did sot

concentrate radiosctive iodine to any extent et ali. This work was repeated

vith burros and sheep viv: e?milar results. Tala ied us to believe tae

Decarse the thyroid ac-iv ty ves depressed ve ned uncovered the cause for the

Weight caine noted. Sone veny cxatecive etvdiea vere done in explerine

ths poss?bitity ead a0 ov der ?was resronsivie tor

?the ?eilure to pick up radioactive iodine vas wcozered. Insteed it was

found. 2h used as @ cetulyst in the proyaretion o° the

phenctatazine con ?adioingine. ?te still le:t ursagwered the cain

gestion az te wiy enizale ?ein welsh: wien ~iven phamothiazine. Sone tiae

Aster T noticed that the dscleuy o Wie ;Lendthtaztne molecule was very Silxilar

0 shat of the aucieus of tie chtuceyrenacine molecvic. If you w.ll recall,

Chicrozronazine 4¢ ¢ dru: what ie ite vudely vasa i furan medicine a

tranquiliging efieci. Ib thes coeurred to ne that rhenothiazine ital? nicit

be a tranquilizing agent cid thot che an'mals thet were being given Phenotiazine

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=k

were in effect getting a trenquitizing drug as vell as en anthelmintic. This year in a report ina scientific journal it cane to my attention thet sone Imestigatore had studied phenothiazine sn respect to ite tranguilizins ability and sure enough it does have sone effect of that type. iow I believe that the weight gain noved vas at least in part due to this. Incidentally sone vory highly respected race horse omers think that phenothiaaine will cause @ horee to run slower.

?Another aspect of the use oF radioactive substances ie in the eteri2: son of foods. ?This requires large sources of radiation and ie depenser upon destruction of enayzes or bacter?a. T have a number of slides showin: various Zoods vhich have been treated vith radioactivity in large amounts axd ?the:r Neeping quality has been imroved (Isotopes Division slide Iie.). Recent uethoas by which various moste can be effectively pasteurized have involved destruction of proteolytic enaymes before irradiation. ?The reeults are quite effective.

A use of lange expocures of serm plasma hae been where corn ara other

Geping have been irradiated and to basten the mucetion rrocessca. Thin side

?Isotepes Divicion slide Tio.) shove the relative muuher of grains of corn ?thet one hes to inspect to see under various circumstances @ sizeable increace in the mmber of mitatione; somatic mitations as iiviieated by this slide (Teotores Division slide Ho.) of the carnation plant, The plant in the center Ss red compared with ite mies which are white. This e considered to bes somatic mutation. Similar reports have been male vbich indicate that early maturing, disease resistance, and various other things can be induced by radia: ton.

Another, and very interesting, use of larse doses of radiation has been to expose the larva of the ccrey worm fly to sterilizing doses of radiation and releasing the males. The irradiated sterile males uate vith the rennies in competition with fertile males. So mony sterile matings, with sterile cugs, are made in such lerse a misber that the total population of the screv worm? flies inan isolated area can be reduced to essentially none. This ime done by the Department of Agriculture on the Island of Curacao and a very serious economic hazard vas removed from aniwal poptletion.

?These silustrations are meant to stimlate more of your thoughts elong

?the Line or vhat can be done and viet has been done in the field of egricul-
tere. ?They are certainly not ali that are possible and as I said carlier that
possible uses of atomic energy in agriculture are Linited entirely by one'e ince
nuity and intelligent approach to rroblens. It scons to me that the venefite
from the use of atomic energy in agricalture are vell on the vay to surpass the
Seadvantages.

1 thant you.

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UNIVERSITY CF PUER *D RICO

Rio Piadkas, Pueria Rico

ATOMIC ENERGY AND THEY ORLD TODAY

By: A.M. V einberg, Director

(Cok Ridge National Loboratory

|" is @ great pleasure to be in Pusrt> Rico to toik to you about atomic energy.

?Many of you may be puzzled about this atomic energy "Chatougua?

jnich we bring

to you. I should explain that this

one of a series of Regional Atomic Energy

Symposia sponsored by the CRN! the CRIN"? and the Atomic Energy Commission,

(Our purpose is to present first an overall view of the current status of the nuclear

?energy arts, and second, to indicate, in each of the regions where we put on our

show, how nuclear energy, in its many ramifications, can hove importont implication

for that re

?You will therefore hear, during this symposium, talks on economics ond education,

talks on cancer and agricuiture, talks on radioisotopes and power.-~ In short, you

will be told that nuclear energy bears, in some way or onot

fon © remorkably wide

Gamut of human activities. Our medi

ine show, $0 Yo speak, it selling very strong

medicine indoed: yet, ot the outset I should make clear thet we do not seek to

represent our product-nuclear energy at a ponacea. If we should sound too

enthusiostic remember always that no single technical achievement, no matter how

?magnificent, can solve all of mankind's prabloms-- that the releate of nuclear

?energy, by i

If, has certainly not ?Set the ¥ orld Free

os H.

= ells predicted

in 1713.

?My talk will be concerned mainly with the present state of nuclear power, and

its implications for Puerto Rico. The possibl

?TGak Ridge Nationa? Laboratory ~~

2 Ook Ridge Institute of Nuclear Studies

interest of Puerto

0 in nuclear power

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wor well stated in o paper protentad at He Intorncticrs:t Conferenc

of Atomic,

Energy ot Geneva by A. Mayne of the A.

nthe Peaceful soe

}2 Riso Mlanning Board and P. Mullenbach

of the National Planning Astociction. Tse economy of Puerto Rico is expanding

very rapidly. Fundamental to any such ex:ansion is adequate power. In Puerto Rico

?most of whote eneray comes from burning important oil, this meant that two questions

?con one count on oil at, the present price of about $2.10 one berre!

te Future; end can one see ony clterrate energy source which would

ther ot lower cest thon oil, or should! oi! become tcorce, in greter

?bundance than oil. Iti my belief that nuclear powor might vory walt be such on

?alternate rource fr Puerto Rice should ait become scarce for any reason in the Futur.

As measured by U.S.A. standards, 1

First sight not very high. Moyne ond Mullenbach in th

about 7.510 0 mills por kwh. Of this obout 4 mills per kwh is the cost of fuel,

?about 1/2 mill per kwh goes for operation and maintenance, and 3.5 te 4 mills

per kwh goes for depreciation and other Fixed costs. The fraction of the total cost

of electricity which goes for fixed casts is very low by L

comporad to 13.594,the mojor di

i

costs were os high

(5 on the moinland, the cost of conventional electric power in Puerto Rico would

bbe neorer 10 10 12 mills per kwh rather than 7.5 to 3 mills por kwh.

It is very important in discussing the economies of nuclear power thot one reduce

cll such discussions to a common base of computing costs, Thus by mainland cost

1 the target which nuclear power must meet is not the very low figu

of 7.5 mills per kwh but rather the much higher igure of 19-12

Is per kwh.

Moreover, again because of accounting, fixed costs ore much less important in

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costessing electrical costs in Puerto Rico than on the mainland. Insofar ot we can

ivdg

future of nuclear energy tec!:nology, it appears thet nuclear reactors

will be expensive devices. Low fixed costs would therefore be extremely important

in making

possible for nuciear energy to be competitive with conventional power.

To summarize then, the quoted conventional electrical costs in Puerto Rico-- 7-2 mills per kwh unusually low becouse the Fixed charges are computed at such a low

Tate. If the Fixed chorges ore computed by U.3.A. standords, Puerto Rico becomes

?one of the moderately high electric cost areas of the world; or conversely, if the

fixed chorges on a nuclear plant are computed at the low Puerto Rican rate, the

posibility of nucleor power competing with conventional power in the relatively

?ear future is good- at any rate much better than in the states where the fuel costs

?are often less than half what they are in Puerto Ri

Prosent Stotut of Nuclear Power

Just where does the Nuciear Power Enterprice of the world stand today=- how

close are we to achieving 7.5 mills per kovh (at 6.75% fixed charges) (2) To give an

?idea of the current state of the

nology» | shal! describe in some detail three of

the currently operating or nearly built nuclear power plants=- The British gas cooled Colder Holl Reactors, the American Pressurized ater Reactor (pwp) and the

American Homogeneous Reactor Test (HRT). As you will see, the

sh Reactor,

built in country which faces @ drastic energy shortage right now, represents @ relotively conservative technology. The American HRT, builtin a country for which

nuclear power can make little imm

}e contribution becouse Fuel is s0 abundant and s0 choap, isa very advanced device.

In between, porhaps in the

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Two major lines of development of nuctear power have emerged during the post

decode-- one based on the exploitation of natural, unenriched uranium, the other

bosed on the exploitation of uranium which has been enriched in Urantum@35, The

'¢ of development is foliowed largely by countries such es Englond and Fronce:

which possess only limited facilities for separating Uranium?35 from Uranium, the second

line

of development strongly domi

tes the United States atomic energy program.

Broadly speaking, reactors based on natural uranium tend to be larger thon reactors

boted on enriched uranium. In consequence, one has the impression, though this is

not proved, that natural uronium reactors may be more expensive to build than ars.

enriched reactors. On the othar hand they will probably be cheaper to operate than

ot least some enriched machines. Thus in situations whers operating costs are more

important then capital costs as in Puerto Rico-- unenriched types moy be very

attractive; in places like the U.S. where copia

?operating costs, er

between the European and American programs corresponds rather well to the technical tand economic needs of the two arest.

1 is well to point out that even the enriched non-reganerative systams will hove

fairly low operating costs ifthe reprocessing of the ?vel can be done cheaply enough.

Consider U235 ot $17 per gram, then ot 25% ovarall thermal efficieney, and

completebumnip,the fuel cost is cbout 3 mills per kwh, Such economics is offen

?unapperling to countries outside the United States since it implies thot the country?s

fuel would always depend on U. 2.

iffusion plants. Such en argument loses its

od States. == In

force when one specks of Puerto Rico which is closely tied to the Uni

?other words, burning of U5, even without regeneration ought to be en economic

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possibility in Puerto Rico relatively soon; ond such e possibility would not resolve the some problem of power self-sufficiency which seams to trouble mony other countries.

| turn now to a short description of the three nuclear power plants which represent the major developmental lines-~ Calder Hall, @ natural Uranium gos cooled aystem, PVR, @ water cooled enriched U system, and HRT, a liquid fuel, enriched

cand possibly regenerative reactor. | shall describe each of these reactions by means

of o number of slides.

Broader Aspects of Nuclear Eneesy

While the possible utilization of nuclear fuel es an energy source in Puerto itself sufficient reoton for the interest in nuclear development here, | believe

mediate roasors for this interest. |

there are other, possibly more persuasive or

refer first to the possibility of using nuclear energy technology as 2 jumping off

point for the expansion of technological activity of all kinds=~ not only nuclear

?energy-- here in Puerto Rico; ond I refer secondly to the significance of nuclear

energy of « symbol of the newly orrived Scientific Era.

?The breadth of nucleor technology=~ the fact that on the one hand it mokes

demands on all the fields of science and that on the ether hond it can give impetus

to a wide variety of scientific o

of great vorioty-~ means that institutions which

?ore established firstly os atomic-onergy institutes ia fact require the capability of

pursuing every phase of scientific ond technicol investigation. For exomel

Oak

Ridge National Loboratory== the largest of the American national laboratories=~ has

on its staf ropresentatives from every branch of science and technology.

core on

?atomic~eneray laboratory, yet we are competent in computers, in biology, in

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seelogy, in ecology. Thus, the trend towards establishment of notional sctentific

loboratori

even in smaller countries, eround prices of atomic-energy hardware,

{view as 0 trend which will, in the long run, hove implic

ns beyond atomic

?eneray per se. It has been argued thot nuclear-energy laboratories give to @

spacial segment of technology=~ nucleor

Ice too large @ fraction of ovcilable

talent; to this, I rejoin that scientific activity is infectious. A science

troditicn having its roots in nuclear energy can well be used as « bate for expansion

into-other

ields of science. Thi

+ for example, exemplified by the Boris

Kidric Institue in Jugostavia; this laboratory, of moderate size, serves not only at

ional nucleor-energy laboratory, but also os a notional physical laboratory for

Jugoslovia. \ ith the ropid industrilization of Puerto

+ on educationally oriented

laboratory whose original mistion lies in the fiald of nuclear energy, but which has

the flexi

ity necessary to expand into other Fields of

significant to the Puerto Rican economy, s

| tum now to nuclear energy os « symbol of the new Scientific Era which mankind

is now entering. {trust that #

symposium, and perhaps even my remarks, will

sive you some idea of the ultimate significance of nuclear energy to science and technology. Great though this signi

?cannot help but feel that the

incredible public reaction to the possibilities of peaceful nuclear energy is not

justified by the actual possibiliti

of nuclaar energy. Rother,

seems to me thot

?nuclear energy hos been seized ypon by mankind to symbotize what mankind has

suddenly realized: that our science and our technology generally= not only nucleer

?onergy-- have become s0 successful os to open the possibility of dealing with all

of our human wants in a drastically more effec fe monner than in the post. in short,

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the real fuss about peaceful nuclear energy hat to do with nuclear energy o& symbol
?nd harbinger of what het been called the Scientific Era.

The first-order achievement of nuclear science has been the imposition on mankind
ofthe Thermonucleer Peoce. om one of those who believe that monknd can hardly

bbe reatoned, or cojoled, or subverted into peace-- mankind ean muck more effectively

ed ond frightened into peace. I is this belief which bosically hos sustained
2th scientist who has been concerned with nuclear weapon development.

But, othe current events have shown, a Thermonuclear Peace isnot o stable
thing. Its true thatthe ectivation energy required for war hos been rated by the
existence of thermanuclear weapons; yet, without @ boric amelioration of mankind's
lot, itis hord to believe thet the Thermonuclear Peace will lot forever.

Wis this most worhhile accomplishment ~~ the amaliorotion ofthe condition of

life, and the consequent stabilization of the Thermonuclear Peace-- that we optiits

believe is ponible through our science.

Is it wishful thinking to belie

thot @ world which has solved, by science, its

shortage-- food, water, energy, moterials-- will, under the threat of thermonuclear

war, in fact become a world without war? IF we look at the trouble spats in today's

world:

we look ot history's trouble spots

is almost ne exaggeration to say

?thot major trouble hos always been the result of a lack of abundonce.

tists have strong hope that this lack of obundance is amenable to solution by the techniques of modern science-- that the tr

jonal causes of wor, insofar at

they lie in poverty ond want con be eliminated by science; thet even extreme political

doctrines such os Communism, which were based on the assumption that there was

?not enough to go around for everyone, will be s

1 to be irrelevant in the new age of

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ebundance which modern science is making possible.

In the achievement of 1

10, nucleor energy development will certainly play

cn important role. But other branches of science will be no les important. Ye

shell require new methods of agriculture; we shal require new methods of collecting

cand computing dota; we shall require new mathods of extracting minerals from rocks.

© e shall require new techniques for dealing with humon relations; we shall need to

lear how to maintain our population below the explosion point; we shall requi

better ways to deal with the new

sre ot our disposal; we shall need achievements

in psychological science of the samo order ot our achievements in physical science.

And finally, we shall need people t

din the new techniques-~ people who

see the possibilities in the new era of science end who are in position to give advice

conceming the impact of these developments on sociaty. ?uch people have come ond

?come from your great university here; we trust that, ina small woy, our
symposium will help give further impetus and encouragement to you here in Puerto

Rico who hove started the exponsion of your scientific bate, and who ore prepored to

Use nuclear energy 0s the vehicle for Furthering this expansion.

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Senarks Prepared by Levio 1, Strauss, Chetmman,

U.S. Atonte

nerzy Comission,

for eettvery to

Regione) Syspostun on Foaceful Wes of stonte Energy

Uatveretty of Pusrts Rico, Rio Pleérae Cenpue

San Juan, January 25, 1957

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Tt 1s a great plosoure to retum to Puorto Rico for your SeMehtful teland hes, for sary years, hed e very secure spot tn ny sttections, On this occasion thet pleasure is enriched because of

?the orportunity witch do afforded me to participate tn this Sympetun on the Peaceful Uses of Atonte nengy,

Ae © sunll toy vith on atsost pasctonate interest in the otory of Guristoster Columbus end his voyages, I, of course, ome to nov stost Rierto Reco, and determines thet tt ves one of the roaantie opota ?ich T would viett et the earliest oportuntty. aut T wee serpleved Wy oonething of a contradiction atoxt the place, cotuntue -~ according 1% my ochool tools ? vhen he stepped estore here 463 years ago naned ?te deland San Juen -- Sen Juan Soutiste. and fifteen year tater, ven Ponce do Leon cane back to explore and colonise, he setled into ?hie Beautifur bey and eetebiished a settienent vnfch he called Fuerto Meo. I never could understand the etrange inversion of nanee ?- vty ?the dalend whiten Columbus christened Sun Juan cane to be celled Puerto Rio, and uty the city -- christened Fuerto Rico == came t0 be Imm 6 San Juan, Ferhaze there 42 cose simple explanation, watch hoe Sserped ny mtfce, tut Teust confess thct I am otill perplexed; st se

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1m historteal aystory vith I hope someone will elerity for me before

T leave fer hone.

=o

During the past tho days you have, in your various seminars ?and panel prograns, éiscussed in considerable deteii the rapidly expanding progress end prospects in the field of stone energy -- in medioine, biology, basic research, agriculture and industry. Such outstanding authorities os lr, Hall, Ur, Sapirie, Dr, Follerd, Dr. Veinturg, Dr, Goodsan, Dr. Grigorieff, Dr. Rust, Dr. sndreve end others have outlined for you various aspects of the United States program. I shall not, therefore, engage in any repetitious account of these activities. Instead, I chall endeavor to deseribe the tzoad vaste parses and policies vtech underlie President Eisentover'e progran of Atoms for Pesce.

As preface to ay resaxks I chould Ike to recall to you an unusual message which vas telephoned from Chicago on the afternoon of Deceaber 2, 1942, I believe thet message bears a relevant historical ssoctation vith thie éelightful delend, as vel.

with the topic of

our interest,

You wit no coubt recall thet Columbus, vken he stepped ashore

fon the west coast of this islend one November day in 1493, was very

?epprehensive as to vhat kind of a greeting he and his men would receive

from the Doringueno natives, The natives fortunstely tumed out to

te very friendiy,

But to return to the date of Decenber 2, 1942, and the telephone

message from Chicago:

?The cell vas placed by Dr. Arthur H, Compton, a Nobel leureate

---Page Break---

?then in charge of the highty-secret laboratory operated ty the U.S.

Goverment et the University of Chteago. On the otter end of the

Me -- at larverd Untversity, in Ceabrigge, Massachusetts -- vee

Dr. Juneo 5, Conant, at thot tine essocinted vith the vertine ofrice

of Sodentifie Research and Develorsent.

The conversation of the tio nen vas brief and exyptic. There were no wasted worde of erecting sen Dr. Compton spoke into the

?eteptione and announced,

"The Italien navigator has resched the new world."

"And how did he find the natives?? asked Conant, anxiously.

"ery friendly," anavered Compton.

421 of you, T an sure, must te familiar with that episode. The "Ttelian Navigator" vas Enrico Fermi, ?2lustrove con of Itely. ?The "nstives" in this instance ?vere not the Indians of San Salvador, nor

?the Eorinquenos of Sen Juan; they wore the neutrons Libereted in countless billions thet Deceater afterncon
?they had submitted to Femi's design as they penetreted and oplit epart ?the heart of uranium stoms. In controlling end sustaining nuclear fsoion, man, for the first tine, had tapped vat appeared to be the

"friendly" natives because

desic energy of the Universe.

The nev world of the atox -- eti11 only in its fifteenth year, tnd not yot of the full stature of its growth -- presents to man the moet fatefud choice of his entize efvilized existence; For the power of the atom can be used to creete a nev sorld, rich in abundance and Unitless blessings, or {t om be perverted to fashion a barren and Primitive world, The choice tetueen these alternatives sti22 remaina

---Page Break---

oa

to be made by the peoples of the world ?- in their combined endighten-rent or their mass blindness, a0 they nay decide,

(on that wintry afternoon in Chicago a Little over fourteen years ogo, end in thet ronent of eternity uben Femi and his assoctates cautiously inched the control rods out of their pile of eraniun and graphite to start the world's fizst atone rector, they hed Little ?tine to speculate on the future ond the altematives it would pose. reams of etonfe poser for man's poneeful pursuits, and of redtation to conbat the diseases which tesct his and enrich the harvests of his felts, had to be pet aside, for ve were then at var, Freedom, not slone of our Nester Hentephore but of vast areas of the world, was in @eadly peril and would be lost were ue to lose the deadly serious rece to produce an atomic weazen before it might become the ultinete mens of world enslavenent in the hands of the aggressors, Yet Fert and is coteagues fores:

ty even then, @ tine when the "friendly natives!

Of his discovery vould shov us the wey to richer extstenc

Ve Americans are furtunste that our lend tecane the refuge of

eo many colentists and scholars of other countries -- such zen a

Einstein, Fem{, Wigner, Teller, von Neunam end mary others. We é

rot regard the great progress mace tn nuclear sefeneo in the United

States as an achievenont pecu2or to our American culture. On the

contrary, it ie « vivid exemple

Anternational teamork -- and proof

?that scientific excellence and achievenent te not sociated with any

particular birthright, This teamork aung men of eifferent nations

te not teas easentiel today than it une during the grim vartine rece

Yo develop the atonie toxb, for the poeceful, productive potentielities

---Page Break---

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Tt was obvious, hovever, that any comprehensive system of

Aisernenent could be realized on2y through the most serious end

conscientious effort. en, in sll his recorded existence, hes never

doen able to achicve voluntary disarmament. Sonething new end told

vas called for if the dead voight of the world's fears ues to be

Lifted and the stom put to work for peace on a truly intemnetional

scale.

In 1959 the President's thoughts were running in this vein:

Ferhape 4f the peoples of the earth could te brought to realize

?end comprehend the many weys in viteh the atom stcod reedy to serve

then and improve their Lives, they wold reject even the suggestion

of etonio wer ap unrelioved {aioey.

The President vas eager to strike out into the new world and

to enlist Sts "friendly netives" in the couse of peaceful progres:

He decked, therefore, that, Just as ve hed offered ao far

ack 08 1946 to give up our nuclear weazons in the interest of peace,

ve would ?- in the game epirit -- share with the rest of the world

#22 we had Ieammed stout the tenefeent atom.

hits inspiretion vas translated into sincere, concrete proposed

hen he went before the United Nations Generel Assembly on Decesber

&, 1953, and, in an historic message, rejected the thesis of "atonte

coloeei doomed nelevolently to eye each other eozose @ tresbling

world." tie sala thet to resign one's self to that kind of thinking

would be to accept helplessly the probability of civilization destroyed

and the amnthiation of the irreplacecble heritage of menicind handed

cow to us from generetions,

---Page Break---

Be vent on to sey:

me United States Imows thet {f the fearful trend of

atomic nilitery bullding can be reversed, this greatest

of destructive forees can te developed into a great toon,

for the benefit of ell mankind, The United States Inova

thet peaceful pover from atomic energy is no éreen of the

future, That capability, already proved, is here

totay."

He then proposed that the atomfe povers of the world establish,

and contribute to, on international "pool" of fectonsbie materials,

to be devoted to the pursuits of peace, and administered under prudent

sefeguands by sn Internetional Atonte Enorey Agency. This, a2 the

President explained, vould be on effective otart tovard diminishing

?the potential destructive power of the world!

stockpiles of nuclear

nsteria!

Accordingly, a Little later, the United States Goverment

allocated 200 Kilogrene of ftesionsble material to serve ss fuel for

?cxperinentel research reactors in foreign countries.

We have not been content to pay mere 1ip-service to peace and

nuclear progress, It has been our ain to carry cut President Eisenhover'

objectives by promoting the fullest neesure of intemational cooperation

4n exploiting the benign ston while -- at the sane tine -~ ve strive

vith steady purpose to establish a basis for éisamanent. Ve mean

to continue these efforts.

In translating the President's words into action and substance

ve hve negotiated agreenents of ecoperstion with 42 nations and

@tecusstons have been undertaken with seven others. These 49 countries

---Page Break---

yepresent almoet every area of the free vorld and eleven of then are vith our sister republics of the Amerieas. The agreenents facilitate ?an immediate exchange of information and nuclear materials as voll fas technical assistance for the development of atomic energy progrens tn those countries.

The state of atonte art varies widely exong the countries with which ve have negotiated such Agreements of Cooperation, ranging from countries with e minisun of people trained tn basic science to ?those with a real cepecity for advancing nuclear technology. There-fore, the assistance contemplated under the agreenente Likevise enccupasses wide scope,

Some provide for assistance in research and training programs in order thet those countries may establish the necessary basis for en atomic industry of their om, Other agreenents, Imown as "pover ?Dileterals" provide for cooperation in the design, construction and operation of nuclear power plants.

?The progran of Agreenents of Cooperation hes been underway ?now only shout tuo years -- eince early 1955 -- yet there te substantial and gratifying progress to report.

For wzample, eight Aneriesn research reactors have been contracted for by friendly countries with whoa we have agreenents, and several other countries are discussing cintlar contracts. Ve anticipate thet « number of these researeh reactors vill be buflt in ?Averiean Republics vith U, S, financial and technicel

sistance.

?Also, seven pover reactor projects sbroad ere currently being Alscuased by Anerican and foreign interesto.

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T feo that mich enphasis should be placed upon the prograce provided for in the "research bilaterala" -- thet is to eay, the construction and use of research reactors. There is ro better mane ?to create a sound basis for mucleer developsent an¢ progress.

Bven one resoerch reactor vill, in itself, pemit e wide range of activity in the fie1é of nuclear energy. Tt will produce amy of ?the radtonctive isotopes of various kinds which can be of benefit to Redical setence, agriculture, industry and vasic receareh -- radiosetive todine for use in the trestuent of cancer, or radfoactive gold to ?trest other malignancies, Tt will produce Carton 2% vith tte many epplicetions in biologics) rescarch, and other isotopes capeble of performing the most Gel cate neasurenonts and of testing materials in

countless Industrial appleations. These sane redioisctopes, applied

to agriculture] research, vill show the way to suproving fertiiizers,

inoreasing orop yielés through mitations, and cosbatting plant

Ateeesee and pe

4nd nost smportent of e12, ouch research reactors cerve ea a

mgniticent device for training youg miclear scientists, eneineers

and technictane, wo represent the prise requirenert for eny sound

and productive atoate a

Dey program, util o reservoir of euch

scientitic and technologies?

ule has been established, no country

om reasonably expect thet {t s:11 have stoate powr to ght ite homes and operate ite factories ont transportation foctlittes, cki1ted

Ranpover ie a component of an effective atonte procran not leas es

sential than nuclesr aeteriele or money.

The oystem of uiletersi agreenente of cooperation, covering

Yoth research and pouer development, ia but one facet of the U. S.

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program of international esoreration for the development of the

peaceftl ston.

Tt was the United Stetes which origineted the Intemetions?

Conference on the Peaceful Uses of Atomfe Energy in Geneva, in

August 1995, when L4-hunéred éelegetes from 73 countries broke the

seals of oitence on scientific comunteation thet hed lasted for

any years.

Tt vas the United Stetes elso vhieh eut through the inter

national deadlock and, in President Elsenhover's inspired address

?to the United Nations -- to which T have stready referred -- called

for the ereation of an Internstional Atomfe nergy Agency and a world

"pooling" of muclesr materials to extend and accelerate the peeceful

Uses of the atom, The President's told end inoginetive propose) hed

Sto drematic fultilinent last Ostober 2 at the United Nations in New

York when some 60 nations of the world adopted his plan and sfgned a

statute creating ouch a worlé agency dedicated to serving man's

velfere, This represents @ great stride forvard in internet ione?

cooperetion to promote the peaceful atom and to draw avay fron veapons

production, here and in other countries, the atonie nateriels required

for the develognent of the peacetine uses of nuclear energy.

In our estre to encourage, to the fullest extent poseitie,

?te busiaing and operation of research reactore in other eountri

?the United States 4s not only supplying enriched urentun fuel for

?such reactora, but ve stand ready to grant up to $350,000 in each

ease toward the building of euch a reactor. One of these Averiean

research reactors is elready in Svitcerland and grante for siniler

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?ue

reactors have either been made or car-narked for a nmunber of other

countries, including, of course, tata tmeriea, Furthermore, to encourage activity by our friends abroad under ?the so-called "pover bilsterela," President Bteenhover on Februazy 22 of last year epzroved the Atcate Snergy Commission's recomentation and designated 40 retric tons of enriched uranium for civilian usea 4n our country end overseas, and primarily es fuel for muclesr power Plante, This s2location ? which will be inereased as moy become necessary -- was evenly divided betwen the United States and our foreign friends, 20-thousend kitograns for each, Thus far, the com nitmenta of epecia? miclear metertal vnich the United Stetes hes made to other nations axounts to nearly tio-thousand kilograns of Uraniun-235. Sales of heavy vater to other countries exeeed 250 tons.

We have sought to e2iminete, wherever possible, the roadblocis Voich hamper our friends abroad {n efforts to determine the econonte foctora in the atomic energy prograns on vhich they hope to embark. We have helyed to solve many of these problens ty means of @ two-uey ?spprocch, Firat, ve have relecsed fron @11 classification large seounts of tecinfcol infomation, and secondly, ve have established price echedules for special nuclear meterfal -- applying not only to prices to be charged for such materials, but also the prices ve vill Poy for by-product materials generated in reactors using fuel from the United States. These policies, vhtch vere announced in mid-tovenber, will assist soportantly in arranging dnvestoent and financing for muciesr projects, In the matter of technical information, hich ve are sharing

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4m large volume with our frtends of the free world, theze has been

ndervey for sone tho years nov a greatly accelerated effort to

Geclassity euch data, within the Linits of prudent regerd for military

Security, The Commission has revicved all the thousands of secret

end top secret reports accumulated over the past 15 yeare with the

result that est year over tho-thinds of them were widely available

?and over one-third of then vere declassified completely. Recently --

4n ogreenent with the United Kingdom and Canada -- our vertine partners

in atone energy develoruent -- we proceeded to mcke public eo-

sentially ell the inforsstion on reactors designed for zesearch ond

coumeroial power, ?This &nformeticn is freely available to our friends

ebroad with viom we ere cooperating end continues to be added to the

stomic energy libraries vbich we are happy to have sent thus far to

48 countries,

Since 1947, ve have been supplying radioisotopes -- those

mirecle-noriing by-products of atomfe sectors -- to our friends

?broad for use in nedieal research and therepy, in agrteulture and in industry. To dato, ve have made more than 5,000 shipments to a

total of 54 countries,

T have cpolen of the coninent need for projects and facilities

?to train larger nusbers of our young people in the miclear arta, if

we aze to tole advantage of the promisce of the peaceful atom, The

Jack of trained telext stands as the only liniting factor, of any

sertous proportions, 1 nuclear develornent -- in the thited States

and in atl the nations of the free world.

In the Untted Stetes, for exumple, it 42 eotinated that during

?the 1955-56 acodonis year there were about 200 college students

---Page Break---

?majoring in nucleer engineering, and thet in the current year there

fare about 600 such students. Next year the muiber nay te doubled -~

?to nearer 12-hundred. However, this increase -- encoureging though

itis

is considerably short of our requirements. Based on the

?test estinates of anticipated metesr grovth and expansion ve vill

need a mich lerger crop of post-graduate scientists and engineers qualified to teke their place in the ranks of nuclear specialists.

The existing and future shortage pos

difficulties not only

for our ovm domestic nuclear program -- particularly in reaching the gol of plentiful, economis ond safe nuclear power; it also serves as ® Limiting factor to the anount of siellled manpower which ve can as- ?ofgn to our program of international cooperation, we are determined ?to continue to extend, to the fullest extent possible, our technical assistance to other friendly countries in helping them to obtain the required talents. The ultimate enaver and solution, of course, ?decomes one of helping those nations to train their oim nationale ?thet they may become ekilled in the nuclear arte and qualified to guige the creation and operation of their oun atonfe enterprises,

?The Atonie Energy Coumission hes been avare for come yesrs of this urgent need and has ettached erect Snportance to tte solution, Toth as regards our oun requirenents in the United States and those of other friendly countries,

?We have esteblished and operated « nusber of echoole euch at ?the Oak Ridge Institute of tuclear Studies and the International School of Nulear Seience and Engineering at the Comission's Argonne Laboratory near Chicago, to vhich ere welconed students from our om end many other countries for training in the production and applications

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?Ue

of radioisotopes and in reactor technolory, I am happy to cay that

students from Puerto Rico and from @ number of the American Republics

exe among the enrollees.

Hovever, cur authority and our facilities for those eduet

ional activities must necessertly have their Linttations, There

a0 fo the language eizficuity, oo well as the additions! expense

of bringing stadenie to the United Stetes rether than affording euch

?training opportantties to thea nearer to their hoses,

Tt weo for this reason thet the Comission last year extended

te program of intemetions} cooperetion by helping to establish a micleer training center in Tuerto Rico, ot the Untveretty of Puerto Rico.

We are extrenely gratified ot the responce, and the extent of the enthusiastic colletoretion vhich has been evidenced by the edninistration of Governor livfos and ty the offietals ané faculty of the University of Tuerto Rteo.

Tere is a sound ent prosising basis for this éecisfon to expand the Spariish language treining facilities here in Puerto Pico, to serve as 0 bridge of sctentitie and teeirotogical cooperation eng the Acertean Republics.

4s for beck as 1950 your University, under auaptces of the Atomic Energy Corsission, wes engaged in important research in the field of electronte radtetion of cooaic rays. Ih the years since then, ?the University has cerrfed on still other major etudies for the Con lsclon, oo for example, the researches in radioactive iron contents

in soils and crops, vhich are presently teing conducted for the Com mission ty the University's Agricultural Experinent Station. This

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work 1s now to be extended through the opportunities afforded ty the ow rescereh center which will Include U, $, assistance to the

University's School of Vedteine, Schoo} of Seience, College of

sortcutture, echantce} Arts and, of course, the Agricultural Be

perimental Station,

Tata progren wilt provide the thiversity of Fusrto Reo with

unique training and research fastlitios, Because these fectiities will

ve truly outstanding -- and the most up-to-date in concept and esign ?

rotty of Puerto

?ico may well becone a training center of interest to many countries

of the hemisphere.

?and because instruction vill be in Spanteh, the Unt

Tan told thet atout 200 etudente from Central and South Ane~

rica are nov attending the Untverefty, sose of then under the Tech

nicel Assistance Progrun of the United States Intemational Cooreration

?Adsintotretion, Tt may ooon develop, vith the nuclear center in

?operetion here, that Puerto Meo will be ettracting steadily larger

numbers of Spenish-cpecking students from other countries, ve ?dll

scoperate enthusiastically and support thet expension.

Under thie training progren, a broad horizon of revanding

omortunity will be unfolded for the youth of Puerto Fico, ?The skits

fd tmovledge which they Vili acquire ? vorling with the peaceful tom here + will qualify then to asoure important roles in the

Gevoloment of this exciting nev art vhich atends tn urzent need of

ouch trained minca, There vill be a steadily increasing demand for

thete talents, here at hore,in the United Stetes end in the nattona

of Central and South dere

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As another component of the United States desize to promote --

in a epirit of friendly and netghvorty cooperation -- the etomte

dovoloprent of the Vester ?ientezhere, the Commission ie, a8 you now,

presently azranging for an Inter-Aneriean Syapooiun on luclear Foengy

?to be hold thie year at ite Brookhaven tational ?aboretory on Long

Island, Yew York, It is our plan thet this eyeposiim will eabrace

Doth the scientific and economfe aspects of nuclear enorgy and that

Ht Will be attended ty appropriate representatives of the 21 énortcen

Republics, ie hope to be able to amounce moze detailed plans in the

rear future, tot only will the delogates discuss auch toples as the

?see of radioisotores in industry, agriculture and redieine, the
various types and uses of reactore and the econonte factore involved,
?but also the feasible courses to be folloved in the esteDlishing end
operation of effective melesr energy prograns.

In conclusion, I choulé Iie to xefer again to thet prine
yequizesent of atonie grovth and progress -- thet 49 to eey, the
training of setentsste ang engineers,

We have given mich tought to vaye and means ty viich elt of
?tho Anertoan Ropubiice might accolecete the use of this new force to
bring grecter health end hoppinese and abundance into the lives of
oar people, se are convinced that the surest end eoundest eprroech
to that goa? is through educstionel proJects auch os the one being
estabisnes here.

Prosigent Risonhover et the signing of the Declarstion of
Principles at the
night be taken

ing of Parana last July spoke cf steps which
+ ++ to hasten the bonefiiotel use of nuclear forces

?throughout the heniszhere, toth in industry and in combatting disease."

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(n that occasion he gaia:

"The coming years vill bring to mankind Linitiess vays in

which this mucleer sedence can advenee husen velfare,

wt

lus progress together, as one fanily, in achieving for our

?peoples these results.?

That, Ladies and Gentlenen, is the very essence of the progran

of internetional cooperation to which we are pledged.

---Page Break---

MUCLEAR REACTORS FOR UNIVERSIETES

Excerpts fron the address of Dr. Robert A. Charpie, Assistant Tarector, Oak Ridge National Laboratory, at the aftrnoon seésion of the Symposítm on Atoate Energy, University of Puerto Rico, January 25, 1957.

Muclear energy 1s the most poverful force to appear on the world scene during the past tvo decetcs. ?The dramatic story of the military conquest of the nucleus vbich bas led to cur present uneasy "thermcnuclear peace" is nov connon knowledge. It is ny belief, however, that the ?taming of nuclear energy has brought us to the threshhold of even more aranatie changes in our vay of life. A new dimension is being added to imman experience--vhich dimension has been Varicusly designated as the Scientific Bra or the Bra of Science.

Tast evening, January 2k, Dr. Alvin M. Wetnberg cbaracterized nuclear energy as the harbinger of this Era of Science. In keeping with the changes vbich nuclear energy bes already wrought in inter-national affairs, we must anticipate that virtually every aspect of our way of life vill be affected by the rapid application of

sctentific methodology to vast nev areas of cur living experience.

It follove quite directly thet as ve gain increased understanding of the detaile of nature, of the origin of life and our universe, ?and of the payche of nan'that both our individual and collective liv-ng patterns must respond vith changes. So ve see, as Dr. Weinberg has pointed out, that our society must be increasingly sensitive, as ?time goes on, to the most recent discoveries at the very frontiers of science.

It is my belief that the proper degree of sctentific sensitivity

oan best be achieved in a grovth ecoiety such as Puerto Rico through

?the organizstion of a strong central scientific laboratory to vbich

doth the universities ana industry contribute as full partners.

To be most effective, such an establistnent must acquire

?the acatiente traiition end breadth of inquiry characteristic of the

university-ovhile at the sme tine retaining the organizational

flexibility and dedioation of purpose typically found in industrial

research.

I believe that the effect of such a central esteblisinent

on the university and industrial interests in Puerto Rico would serve

?the people of Puerto Rico vell in paving the vay for then to achieve

?the greatest possible beneficial impact trea the Era of Science.

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UIITED stares

?ATOMIC ENERGY cow2irstON

Veshington 25, D. C,

FOR RELEASE AT 10:0 A.M. (EST)

FRIDAY, JANUARY 25, 1957

?EVARIS PREPARED BY CLARK D. GOODIN

ASSISTANT DISECTOR, DIVISION OF REAGTOR DEVELORE?,

U.S, ATOMIC ENERGY ccuaMTSSION

FOR PRESENTATION AT

TENTH OAK RIDGE REGIONAL svwposrum,

UNIVERSITY OF PUERTO RICO,

?SAN JUAN, ?PUERTO RICO

JANUARY 25, 1997

ATOMIC ENERGY AND THE EDUCATIONAL PROBLEMS OF OUR AGE

Teen Bueso, esters of the feoulty, and otudents of the etonte age ~ ny colleagues, in the Atonte Energy Commission and in the Oak Ridge National Laboretory, end T are pleased and honored to participate tn this eymposiun, the firot of Ste Kind to te held on this lovely inland of Puerto Rico.

Te title of this telx to fer more iapostng than T would have chosen, ovever, T accept it se a challenge.

Aa students you nay have sone unpleasant associations with

?educational problens." You ney be thinking of these as problens that

must be solved to complete an assigment or to pase @ final examination.

On the other hand, as viewed by your professors, euch problens are

meinly necessary evils vhich aay serve the quostionsble functions of

Baking students study end of foming the basis for finel grades.

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?The "educational problems" to which T vish to dizect your atten

?tion are of quite a different sort, You have been living vith then

most of your life. You may have even become unavare of their existence.

?These educational problems are the obstacles you have met and will con

?tinue to neet in your preparetion for life, For education is surely the

preperation for life as vel as for professional accomplishment.

In this sense, I believe the number one educational problem of

our age is the increasing complexity of our culture. Science continues

to shrink distance, to increase leisure and confort, to reduce manual

Jabor, to widen conmunteations anong mankind and to open new vistes of

?the mind, But to partake of this expending existence you mst poy

for it. You must Imow and underetend more, As students of the etonic

?ege you mist learn more and lean it faster.

\net is mre

adults you mst keep on leaming in order to

otay sbroast of the tines. Dr. ortiner Gravee, executive eizector of

?the American Council of Learned Societies, in an address lest spring

put it aptly vhen he sold "to keep pace vith this new age the Americen

must leam as long es he Lives; termine] education ané the undertaker

will arrive on the same day."

In its first interim report the Presitent's Committee on

?Edueation emphasizes the need for every individual "to develop his or

her talent to the fullest? to meet national needs and the increasing

complexity of civilization, Furthemore,

ny good friend Aéetzed

H. G, Blokover recently steted before the Thonss A. Eétson Foundation,

?the more complex a society Becomes, the Langer proportionately fe

?the number of intelligent, highly treined en needed for its proper

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functioning."

He pointed out "thet = 3 per cent emnual inereese in our gross netfonal product will require 4 1/2 to 5 1/2 per cent annual ine erecse in scientific and engineering manpower. Or, to put it differently, in the last 20 years our population hss increased by 35 per cent, but ?the muster of scientists hes increased by 450 per cent, end engineers hy 225 per cent, Yet even thio trenendous incresse leaves us seriously short," \ith the rapid inductrtalizstion and population grovth which you are experiencing in Puerto Rico, it will be necessary to ineresse your production of scientists end engineers at en even greater rete since meny of your tectnically trained men end vonen migrate to the States or to South America,

?The purzose of this eyspostum 4s to

sist you and your leaders

in the effort that ac

ail of us to work out practical means of neet~

ing these educationel needs, In particular we feel that the pea

ful epplicetions of etonte energy provide 9 nev and etinclating area

in viuich to develop this expanded educational progran.

In order to carry out euch a procraz you vill need nore teachers,

perticulerly those treined in miclesr scfence and technology. This

brings us face to fece with the second big educational rroblen of tocey.

At a tine uhen good technical teaching is mot ungently needed,

Yoth in our eolleges and in our high schools, the nutber of trained

?Aeochere ip the United Steter Je decreasing st an gleraing rete. The

muniber of quelified teachers of high school science and mathenstics has fallen off stout £3 per cent in the pest five years while the

high school student body hes increase? 16 per cent and continues to

vise. The U, S, Atomic nergy Comission 1s keenly evare of this end

---Page Break---

+

42 doing « great deal to helpgotve the problen. Chatman L, 1, Straues and Comisotoner V, F. Libty have made minerous appeals to inéustriot, scadenio, goverment and philenthrepte groups to aveken to this national need and to assist in told, nev educations) prograns designed to £121 thie need.

They have opazkplugged vigorous trafning end edveation enotstance prograns by the Conission of which thts eyapoefum fs tut one exemple, Since your nev miclecr currioulus vi2i want to follow much the sane pattem as the Coomission's astivities in sone areas, I vill sunerize briefly our edueutional and treining progress. it the advanced level the Comission has established three special graduste schools, The Oak Ridge Sohool of Reactor Tectology which hes graduated 469 students sponsored by Anericen industries and goverment agencies, tho Inter national Schoo? of Itielear Sefense and Hngineering hich hes 100 alumt from 29 countries ond The Onk Pldge Institute of Nuolear Stuétes vhtch has provided treining ond spectaitzed reoecreh feot2ities for 4800 students and visiting feoulty, As Aneriean universities teke over

the reyonsitéiity, these eetools, which were established to moet

exergoray noode, aro graduelly being converted to advanced Inboretory

?reining centers, ADC Fellowships 4n Mucleer Energy Technology (150

por year) in Retiolngieel Myaies (69 for 1956-57), end tn Industriel

Medioine (7 in 1956-57) ere attracting talented scientists, engineers

and plysictans to thece fields in which the need ts esyectatiy acute,

Greduate student research training (about 1120 per year) 48 provided

?turough approxinately 300 reacersh contrasts with about 100 eoldeges

and univerestiee.

Sunner courses heve been conducted in ruclear reactor technology

---Page Break---

for engineering faculty (90 in 1956), Likewtoe an edaitional 265

university faculty nenbers participated in research programs at AEC

Istoretortes during the sumer of 1956.

49 you mou, the Comission is providing assistance to educstiona?

Anstitutions to acquire treining reactors, teaching aiés, cenonstration apparatus, Intoratory equignent, and certain nuclear seterials to be used

prinertly for educational end training puryoses in nuclear technology

courses. ?The Univeresty of Puerto Alco has eppifed for this a

stance,

Ve now cose to the thind major educational problem of cur age. This

4o the Jencunge berrler. Even if we hod an edequete number of qualified

teachers and students adjusted to the complexities of modern etvilizetion,

?there must be easy comunieation in the elaseroon. Language serves

?this purzo:

but 4% must be native, or nearly 0, to toth the teacher

and the student,

I recently opent a yoar in Japan as « Fulbright Professor st

cata Univeraity, Fortunately the students in uy nuclear physics

course could all read English, Despite this adventoge it was very

aieticult to communicate orally any but the simplest concepts -~ in a

subject in ton 1

ol coneepts are the real ays to understanding.

Needles to ay, hed it been necessary to communicate in written Jopanese

?the barrier between us Would have been almost inpenetreble, You are

indeed fortunate in heving en essentially bilingual untverstty, Spanteh

and English have comson roots and henee ere very similar both in the

written and in the opoien Ianguage, The University of Puerto Rico is,

therefore, ideally suited geocreshicclly, ealturstly and acadenicelly

?to corve ae an educational bridge betwen the Americens.

---Page Break---

e

?There is a veritable flood of technical information in English

?but this needs to be redueed to Latin tnerica's needs and presented

4in Spanien in onder to be of createst usefulness in most of the Central

and South American countries, Next ve cone to the fourth big educational

problem uhich is particularly close to ny heart tut which is difficult

?to express simply ond clearly, It is vhat I alluded to a moment ago.

You might call it conceptual teaching as contrasted to factuel teaching.

?This approsch 1s applicable to nearly all fields of Imowledge but is

essential in the physieel sciences,

In brief the student should be presented with the true eduest{ona) ageence of mathematics, physics and chemistry. This does mean that practical applications are ignored. Quite the opposite; for fn the ultinate gil lnowledge ie first derived from experience. The relevence of fundanental imovledge to resl situations mst be understood and put to practical use,

However, in learning applied science the basic principles ere often Jost in a plethora of practical details, As a result the student finds it not only difficult to mow where to hang his intelectual hat, tut he is also Likely to forget where ho hung it, It te truly amazing how Little ve reatly need to remeber and how mich ve can forget and still retain the real nourisiment of subject.

T submit that there aust te sonething wrong vith our teaching for ?this to be the cose, Clearly we an no longer afford the luxury of

gorging our minds in much the sane mamer ao ve so often gorge our

stomachs. We must vork out vays to make our teaching more effective,

to inerease our educational effieienoy, se it vere. Ressoning murt

---Page Break---

a

replace rote leering, The aecumulotion of fects ctout setence and technology is secondary to the mastery of a scientific method of ?thinking. The attainment of professionel stature in sofence and engineering ie test achieved through an orfentation of mind and habit ?ich begin in early childhood and follow sontinuousty through high sonool and college. The education of future tecchere in these fte1ée 4s an objective of equel tmortance to that of training scfentists ant engineere, We must inprove the instruction by eduction of éetalled content and by increased emphasis upon fundenental prinetples and uren ?the development of povero of Jutguent and diseriaination in the formulation and appltеation of these principles. vill i1tustrete Mist Ihave in mind vith only tho of the nuezcus examples which could

be cited, In clesoicc] nechenics as well ac in the nore modern vave

echenies, the principle of conservation of mocentum 1s eppltceble without imo exeeption, The beste prineiple 4s cemteinly simple, Tt hardly scene necessary to defer aoqucintence with this concept untt? ?the senior year in high school. Yet thet vas ny experience, and I Yelieve cuch 1s et£1l the cece in generel,

(m the other hat, valuable clenentery school tine ts spent tn Yeaching the child atout temperature, presunably because he meets this #0 frequently in everyday life and hence shoutd ourely iow stout {t.

Aotually the concept of tenperetune, at least its true phyetcel eeaning,

is mich sore aifficult than rosentun, Furthermore, because of its

commonplace nature, tenpereture in the everydey sense is something the

chfld wid pick up easily outoide of school. ty do we teach children

stout tenperature but not stout ronentan?

---Page Break---

?2

T believe the ansver to thie question lies et the root of the

problem. (ur elenentory selene teachers have mnt been trained to

avpreeiote viet are the truly simifionnt shvsiee) coneents. This te

no reflection on then, father it is part of the troad protien of the

gulf between cur professions} sefentists and engineers and those ho

have the responsibility of teaching our ehfidren,

updating of our texttooks. They contain too mich scientifie stuffing

Furthomore, there should be continuity

need a thorough

and not enough scientific neat

in content from grade to grade. In addition, for eech group of text=

?tooks there ahnuld be a teacher's companion reference took giving

?background information and perspective. Othervise how ean we expect

our teachers to keep abreast authoritatively on the mmy new discoveries

and develomments of the atomic age? Textbook publishers should take

more responsibility for providing the tesshere with such beskup

Infomation, Continuing sith the maentun example, this concept

wuld flow into the minés of our students in an unbrolen sequence uhich

aight go something 1ike this:

Grades 3 - 5....,First introduction of 1éea

Grades 6 - &..,,,Siople mumericel examples of conservation

of Mncar msentan in collisions vith sarble

and touneing bells as examples.

Grades 9 = 10..4.20 Sinensional notion with naserieel

examples and problens. Extension to angular renentim with epianing tops and the anmentum

of the earth and of the planets as classicel

examples.

---Page Break---

?9

Grades 11 = 12,,.U4neor and engular sosentun 6 nunerica)

examples in algebra end trigoronetry. The

mocentin of Fluide, gyroscopes, stone, nucle

and Light vaves vould be axong the examples.

Contege 2 - 2+..viav

quanta, relativistic aotion, space

quontication, stonfe ané nuclear selection

rules, Clessies] nechenios leed naturally

into modern nechanies at this level with the

proper preparation,

College 3 = 4.-.-(eve mechantos, quantun electrodynantes,meste feds, advanced zechentos and cenere)

relativity.

In this vay wo have teen able to cover An college mich of vhot is uoually reserved for grecuate school. However, we have setuelly expanded ether than telescoped the leering period largely by an early introdue- ?tion fotloved ty a slow scalding 4n which 1s 90 gradual that the student accepts the concept ee one of neture's avs and not a8 an esoterte edusetionai hundie. If hia technica education eas

at the end of

?the freskon or sophenore year, he would heve a much better understand- ing of the world eround hin than io now the ease, Likewise, the conservation of energy could follow a sinilar pattern, flere ve probably would begin with the gonerel prineiple that 1tke momentum the conserve~ ?tion of energy 42 applicable without Imown exception. Then as the understanding of the etugent gradually tnereases we would broaden the definition of energy to inelude the varfous forms ouch ss heat, chemical, electromegnetic, end mass (nuclesr). The introduction to kinetic and yotentie) enengy would be @ natural part of this subdivision.

---Page Break---

Likewise, the meane of transforming from one kind of energy to

smother would serve as fentiior practice] examples. By the tine the stadent bed reached the freshmen yoar in college he would be able to understand and appreciate the significance of experiments cush os thet of Dr, Frederick Seines and Dr. Clyde Covan, Jr. vbo recently established experinentally the existence of the neutrino, @ particle without

electrical charge and with vanishingly oneil mess. Ve have Imo for

20 yeare thet auch particles must exist -- othervise our laws of the conservation of monentun end of energy vould be vioisted. But until muclear reactore were aveileble es a source of neutrines, it vas not posoibie to measure these elusive 1ittle beasties, This trillent vork vss supported ty the U.S. stomfe Energy Commieston, Tt is only one of any examples of fundarertal discoveries wich heve been made under the sponsorship of the AEC, Heedless to say, ouch aiscoveries ere not made ?by more ?than a very email proportion of the sofenticte needed in this rapidly expanding field, Likeviee, not every engineer ean cone up vith

a revolutionary developzent in reactor technology. Still there is wealth of satisfaction in being e nember of e scientific group thet 1s cornying out fundenentel research or in being a nenber of en engineering team thet develops, constructs end places in operetion a nuclear pover plant.

?Talented people ere needed and needed in large numbers for these fobs, e axe not progusting nearly enough to f121 the demand, This 4s the fieth and final eduestional problem uaich I viii mention today.

?The speech of Admire) Mezover, from viich I quoted earlier, ves

Gevoted to this problem, "The Eduestion of our Telented Children

Be

---Page Break---

has gointed out that ?one half of our children who ere endoved with the abiiity to enter college and university éo not 60 #0. For every ?igh choot graduate sto eventusliy eams a doctoral degree there are 2% others vho have the mental capability to achieve that degree, but é mot.?

Riclover lays much of the Dlane for this "vaste of our sost

precious national esset" to the fact that with fow extptions the

talented chtléren, the top 15 to 20 per cent vho are capable of more

intensive and more extensive treining, "are being taught with the 80

ver cent of average and below average mentality.? Because the above

average child ta kept from oévensing at the epeed appropriate to his

ebiiity, Re often loses interest in leaming and may become © poor

stodent from sheer toredon. I certetaly agree with the Admtrel's

4, "We shall not do justice to our talented youth until we peek

?them out at an early age -- no later than 10 or 22 -- and

eduente then separetely", not neesesarily in a

parate

setool but in @ college preparatory section of the school;

b. "The schooling must be purely acadenio, and the teachers

must have professional competence in the subjects they teach

¢. "Adniasion as well es advancenent into each higher grade

should be by exenination";

4, "If possible, the school year should be extended to 210 days",

and

e, Industry, together with our educational foundations should

?set up model secondery schools (5th grade end stove) which

would be free but which would require passing entrance exe

Snations designed to select only the talented for spectelized

---Page Break---

a2

?training and preparation for entry {n college at age 16 oF

eeriter.

In sumary, I consider the five major educational problems to bet

1. The complexity of our culture 4s increasing fester then

?the efficiency of our education,

2, The nunber of trained teachers is decreesing ot en slamming

rate,

3+ Yanguege barriers impede our intemationa communication

of t4esa,

4+ There 8 too mich emphasis on factus) Imoviedge end not

enough educational effort on conceptual understanding, and

Cur educations) systen neglects the talented in favor of

the averege

?There ere undoubtedly other big eduectional problens, but thece

{five seem foremost to me. In formlating plans for the future of

?technical education at the University of Puerto Rico, I en sure your

Jeaders in goverment, industry and education are avere of tho

protien, The U, S, Atomfo Znengy Comission and ite latoretories

etend ready to help thom and you in every way that we can to build a

Spanish opeaking technicel education center vnich will te @ mo¢el for

21 the vorié to admire end to exutute.

---Page Break---

UNIVERSITY OF PUERTO RICO

Rfo Piedres, Puerto Rico

"A NUCLEAR PROGRAM FOR THE COLLBOES XD MAYAGUEZ?

. Background.

Active interest in miclear eticetion began on this campus of the

University of Puerto Rico about eight years ago vith the visit of DR. T

Overman, Heed of the Special Training Division and Dr. R. 5. Poor, then Head

of the University Relations Division of the Oak Ridge Inatitute of Wuclear tn thie field and the @oving

Studies, ?They mada clear to us the posssbilsts

eed of trained personnel for the various uses of the pesceful atom, As a re

uit one weber of our Physice Departaent vent, in the mumar of 1950, to Oak

Ridge and took the short course ta Inotape-bandling Techaiques, Toe folloving

?year a neuber of our Faculty of Agriculture took the sane course, and since

tua two others, both fron our Chesistry Departnest beve taken it, These men

pave kept up their interest in the nuclear field. One of thea, Dr. P, Siitero

4a nov using a radio isotope in bis current research. A recent activity of

ssother, Dr. B. Ortiz, is mentioned further on. We also vere visited by

Dr. Ralph Lapp in connection with the ranging Lecture Progres of the Oak

Ridge Institute and by Dr. W. G. Pollard ite Executive Director.

IT, Selection of the Type of Pmera.

Aaa remult of this activity, the {Gea soon developed that ve should

ofter to our ov stuients some Kind of course in muclear science, and ve vere

Aavating the question of the type of course or courses to be offered, vhen

?two years ago the Puerto Rico Mater Resources Authority announced ite interest

tn muclear eneray ant the possibility of establishing « nuclear pover plant om the Islend. This helped us in making a decision, ant ve settled oa four

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i

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aagstive courses of advanced undergraduate level: @ course in miclear

engineering 12 the Paoulty cf Bagineering end omrees in Atonic, Poclear end

Reecter Payeice in the Paculty of Scienee. ?This Wings us up to last eumer,

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a.

oes Dro. J. Le Garese de Quevedo of the ngineering Faculty and &, Ortis, of

Science? vere sent to the Brookbaven Rational Laboratory, vhere they took an

accelerated course in Muclear Engineering vhich vas offered under the aupices

Of the National Seience Foundation. It vas these professors vto vere to offer

?two of the eubjects mentioned above during the all semester. But things happened differently. On August 20, there vas a meeting in Rfo Piedras vith representatives of all sectors of the University attending, at vnich Admiral FF, Poster, of the International Relations Division of the Atomic Mersy Commission described the nev assistance progress of the Comission. shortly Ddefore this ve bed received an invitation to the Conference on Ragineering ?Miucation and Miclear Boergy at Catlinburg, Tennessee held unter the joint

misptove of the Oak Ridge Institute of Muclear Studi

» the Oak Ridge

National Laboratory and the American Soctety for Bugineering Bhucaticn, Deen Y. Gonsdles-Mandry of our Paculty of Bngineering and I attended this conference veere the nev programs of the ftonte nergy Comission vere described in detail. We vere also topressed vith the amount and variety of activity aiready existing in the nuclear ftelé and with its grovins necd of personnel of various types. It decane apparent that the ainimun type of offering ve

had planned vould soon become inadequate and upon our return started planning A more eabitious progran. Two other seetings in Rio Piedras folloved at

Walch ideas vere clarified and overall planning for the Univ tty vas

initiated. At the socood of these, the Chancellor, Dr. Denfter tescribed

?the remulte of the talk he and Dr. Marston Bates, Director of Recoarch for

the University had had vith representatives of the A. B.C. in Washington.

Te was thee decided that the offering on the Mayagier campus should be a

cue-your graduate progran in Ricloar Science and Tectnolowy.

Dean Consdlee-Wantry propared the first draft of this program and after

consultation abd discussion vith meabers of the Faculty of Science nnd vith

Fepresentatives of both the Atomic Bnergy Comission and the Oak Ridge

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>

Inetitute of Miclear Studies it asmmed tte present form.

TARE I

WOOEITED SPECIAL PROGRAM OF INSTRUCTION

BR

TUCLUR SCIENCE JD TECHNOLOGY

roo Ta Bai

course Lact. ab.

Masber Course Nae Meskiy Weekly Boure

suman (6 veers)

Wath. 75 Math, of Modem Science I 9 °

Phys. M10 Atomic Physica 9 °

Puys. 45 Atomic Physics Laboratory 2

9

FIRST SEMESTHR (18 Weeks)

Math. 476 Math, of Modern Science IT 3 °

Phys. 503. Muclear Phys 3 °

Chea. SOL Radiochenistry 2 3

Biol. 501 Health Physice 2 3

WA. B 501 Muclear Reactor Technology 1 3 °

MA. E51. Reactor Inatrunentation

?ant Controle a 3

Te >

SECOND SIMETTIR (16 Veeks)

Mhys. 504 Reactor Physica 3 °

Phys. 506 Muclear & Reactor Phys. Lab. 0

Cem, 02 Com. Processing of Riclear

ues 2 °

Mes B 502 Muclear Reactor Tectmology IT 3

Wi, 512 Reactor Metallurey 2 3

as 552 Oeminer 3 3

crease

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he

TIL Propose Graduate Progres in Nuclear Science ant Tectnology.

: ?he can be ween this progras, which is to lead to a Master's decree ta the Field aomainte of three sessions, coe during the sumer folloved by two wmester seenions Guring the regular acadente year. A total of 41 credit noure of vork are required of viloh 31 are in gratuate level courses and the other 10 are in advanced undergraduate courses, Tbe sumer seveioc 18 frenuly preparatory and vas put in because ve realized that any of the posible cendidates for this course would not have the required training te matbenstice or plysice. During the firet senester the exphasis is on the panic scienees related to resctar operation, ant during the secon? ecnester the epplict science and technology of reactors ts given greater consiierat on, Tt te clear that the main objective of the progran is to give the atudent an adequate conmnd of reactor theory and operation. Yost of the individual courses included are quite standard, and require no further coment, but tt

ta perhaps advisable to state vhat is to be included tn four of them. The

Firat of these te Miclear Reactor Technology I. This is a course inteniet

to tntromice the student to the miclear reactor and its engineering problens. Terainology, types of reactors ant their component parts are to be considered. ?Toverds the latter half, considerwle tie is to be given to the profuction of beet in reactors end its transfer and utilization eleemere,

?Toe next 1s Reactor Instrumentation end Controls. This course, besides

ite Grvious sections incluies ose on the mearurement of quantities iaportant

S fm resctar operation, euch es neutron flux, puma intensity and pover levels.

i Dedfpeers 1 the eeccat courte in Puclear Reactor Technology. Bere we

2A Seeaenor desta cot eperetin. Typical enrtion eres thre, convection tn Dest

Oe ca '

(ot quibacate Lastgn; etrouianing feel ervtany tine Veberior of reactor evetene

preqoes Wo tonjnde coneideretion of the more taportant prohlane related to

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HO Was se eer =

Aaserined 18 Reactor Metallurgy. This course te intended t6 acquaint the stutent vith the metallurgical problens inherent in reactar technology. Bovever, due to the possibility that many of the students may not bave any Previous kmovietge of the field, there will be an intratuctory section on elementary physical metallurgy, Tale vill be folloved by the netalluray of ?the principal rector elenente, such as ureniua, alinimum, rtrconium and others, Besides mechanical properties of these metals and their fabrication probleme, consideration vill also Le given to the dapege vaich my be prolueed by radiation on reactor components

?wo other things need be said sbout the program itself. rirst it te intended for Opaniabt- speaking atulents with « reading moviedge of English. Instruction ts to be in Spanish but the textbooks will be in Boglieh due to the scarcity or total ebsence of aultable material of thie type tn spanish. We, therefore, expect to cet most of our students from Puerto Rico ant lati faerioa. Toe OME thing ts thet, although at the eoapletion of the second senester the muccessful student vill have completed his requiresents and

WALL obtain his degree, he vill nevertheless be advised to take one or another of the intensive sumer prograns given at one of the national laboratories tn

orter to round out his education in this field. It te our intention to

cooperate vith such students by making the a:

yssary arrangements for thes:

wherever possible.

/, Problens Related vith the Establé

ment of this Progran.

at us nov consider the principal problems related vith the establishe

ment of thie graduate progran. The first of them concerns personnel.

Autbough at present ve ave or sho=tly expect to have the personnel necessary

for handling the progrea the first your, ve realise that it will soon be

necessary to expand the studect capacity at the program, This vill require

?more personnel, and it vill be necessary to send some of our professors to

(eon of the Hetional Laboratories or to an American University vith a veil -

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curther

stabLished graduate course in Mucleer Engineering in ordey to 6°

training or experience. In sone cass en intensive wimer wins should Ee

wuffictent, In others tt vill te ©

for to wend thee for ene whaie year.

Preparation for this eventual !i¢ snou?4

eat het wong, apt a faculty

subcoamittee has been appointe? to gens tats prot

The next important pro?.'n 10

Amoratory equipment. Even vite the

stil, quite a protien die t2 the ?Hortatss of the Lime avuiietle betwren

nov snd the date on which the propose proeran 1

petivery pertote

fare sonetines Yong, ont it taies tine aml effort to tnetall st

equipment once it hes a: ratery only onn Leorntory nent be ready con the starting date, an: thst [5 the one. Atonie Phyetzs, for the precistnary

mummes serston, hres 2 ueentation end

4, $e Howith Physi

Controls and Reiicchuriatry must be reaty by

fe atart

the first senester

tovards the end of Aus.

one presents the arecte:

+ OF these, the inst

ers. The second

aifricalty, as tt requires sore ?nstallationa then the

senester laboratories present @ Lesser problen, es more tins te @

Related to the above protieaa is that of securing space and othe:

for the isvoratories. Space bos a

4y been asctgred, but it must be sate

ready for the purpose :t is to serve. Partitions misc be moved or set uPy

seat

ory tavlea must te obteined and installed, ons, wacer end ?

factiities mist de secured, end 60 on, A second Faculty eubsomittce 48

aareniy vorking on these problens. The renaining ex

ative probleme

eonstitate the province of a thind eubcomittee, Tory bave to deal vith auch

mettere aa securing and acreening the candidates, public relations, and otvera-

?Adwinistration of the program {4 hanclet by « alne-nan comittes coapnec) of

?the three eubcomittecs ment

toned, and the Chaimman of which ts Dean P.

ontdies-Mandry.

nie.

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¥. Plans for the Future.

Tp conclusion, let us consider briefly soue of our plane for the future. The first and most important is securing @ critical reactor, a# turing the Firat year of operation nous vill be avaliable, tte efucational functions being substituted by « subcritical assembly and a reactor simletor. Final selection of the type to be obtained kes not been made yet, but st will probably de one of the aaterialsctesting types vhich bave proved useful for ?training purposes. The pover level should be between 10 Ry and 50 Kw, A Yullding vill be required to house tate reactor as vell as the other laboratories of the program, as the space nov aseigavi for the letter ts texporary.

AuAstionnd equipment mst be obtained for al} the laboratories, as the anttiel installations will contain only the minima required, And it is also intended to add a laboratory to the mubject dealing vith Chentcal Processing of Ihclear Fuels. This labore

ry vas not included in the first-year

Anstallettons due to the expense involved.

Another of our plans ie that of expanding factlittes and personne

to accomodate more students, if the demini proves to exceed the proposed

frat year capacity of 15 students per Ieboratory session.

We have also given sce consideration to the posetbility of adding

other types of offerings to our nuclear curriculum, such as an undergraduate

option tn one of the conventicoal engineering fields, in Physics or in

Comtatry. soother possibility {8 a short training course in isotope

techniques simiiar to those proposed for the Rfo Piedres campus, but with

eqpbaste on intustrial us

Finally, we bave been giving oome thought to research possibilities, We

reoogaize that research 14 @ necessary adjunct to graduate instruction,

eepecially if good teachers and students are to be attracted. On the other

hand it bes already been agreed thst basic research in the micloar field 1s

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Bal

to be the previner of =he nfo

Laven ay pites

esearch for tae Mayagicr Faci.ties, 6 ten 1s quote aultente > ce type

of instruction we are to offer a

na be reais y arsced Sy our ney

Engineering Experiment Station.

Meiguel Wiewall, Jr, Dean, Faculty of Setenct

University of Puerto Rico

January 28, 1957

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