ANNUAL REPORT

of the

INTER-AMERICAN INSTITUTE

OF AGRICULTURAL SCIENCES

for the year

1950

Turrialba, Costa Rica
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REPORT OF THE DIRECTOR

FOR THE YEAR 1950

Gentlemen of the Board of Directors:

I have the honor to submit herewith the Annual Report of the Inter-American Institute of Agricultural Sciences for the year 1950. Following the policy initiated last year, this report attempts to maintain a continuous record of technical progress.

The Animal Climatic Laboratory, for which funds were donated by the King Ranch, was completed. A high-altitude sub-station was started on Irazú Volcano. Four hundred and seventy-six plants were added to the economic varieties available for research and distribution. A considerable increase was possible in the collection of back numbers of journals with funds made available by The Rockefeller Foundation. With aid from the same source, periodical subscriptions were increased to 500, and abstract journals were placed in 23 cooperating institutions in the Americas.

At the close of the year the staff included 38 technical members. However, since four were on study leave, there was an actual increase of only one over those reported last year. The staff includes members from nine of the American countries.

Among new projects of particular significance are programs aimed at selecting native dairy animals, classifying land and water resources in cooperation with the Pan American Union, and evaluating rural education and extension methods; an abacá (manila hemp) project in cooperation with the United States Department of Agriculture, and an agricultural chemicals study with funds supplied by the Shell Oil Development Company. The first issue of the Institute journal Turrialba was published.

Activities of note included livestock and grain storage meetings in cooperation with the Food and Agriculture Organization of the United Nations, a survey of the forest resources of Guatemala, a study of animal husbandry and veterinary institutions in Latin America, and a pilot cooperative program with the Inter-American Statistical Institute and the Government of Costa Rica on crop production estimates. Cacao pod meal was shown to be a satisfactory dairy feed. Methods of predicting the onset of cacao disease are being perfected. The Scientific Communications Service was extended to all American countries, with photocopies of scientific articles sent out reaching 500 per month by the end of the year. A farm management text has been turned over to the publishers. A series of food crop varieties was distributed to interested countries. Plans for a portable grain drier were widely distributed. Advances were made in coffee propagation and in the selection of high-producing coffee plants. Courses were perfected for training extension workers.

During the year extensive plans were made for participation in the Technical Cooperation Program initiated by the Inter-American Economic and Social Council at its special session during April 1950.

Respectfully submitted,

Ralph H. Allee
Director

STAFF OF THE INSTITUTE

1950

Ralph H. Allee	Director
José L. Colom	Secretary
Lowell Curtiss	Treasurer
Anna Marie Dye	Administrative Secretary in the Office of the Director
Wilhelmina C. Hayes	Administrative Assistant in the Office of the Secretary

PLANT INDUSTRY DEPARTMENT

Manuel Elgueta	Head
Frederick L. Wellman	Phytopathologist, employed by the United States Department of Agriculture and assigned to the Institute in Turrialba
Pierre G. Sylvain,	Physiologist
Emilio Viale	Entomologist
Florence Thomas	Olericulturist
Kenneth L. Olsen	Physiologist
Lucy Hastings	Assistant Plant Pathologist
Jorge León	Botanist
Humberto Rosado	Geneticist
Ernest H. Casseres*	Olericulturist
Mario Gutiérrez*	Associate Plant Breeder
Hernán Granados	Laboratory Assistant
Moisés Hernández	Laboratory Assistant
José J. Córdoba	Assistant to Botanist
Victor Manuel Matarrita	Assistant to Geneticist
Aída Romero	Secretary

Inter-American Cacao Center

George F. Bowman	Head
J. Harvey McLaughlin	Phytopathologist
Victor Muñóz	Secretary

ANIMAL INDUSTRY

Albert O. Rhoad	Head
Jorge de Alba	Assistant Head
Mills B. Koonce	Superintendent of Livestock
José María Castillo	Superintendent of Creamery

* On study leave in the United States.

AGRICULTURAL ENGINEERING

Norton C. Ives	Head
Gregorio Alfaro	Assistant
Luis Balma	Assistant

AGRICULTURAL ECONOMICS AND RURAL LIFE

Julio O. Morales	Head
Antonio Arce	Assistant in Sociology
Eduardo Arze	Rural Sociologist
Charles P. Loomis	Rural Sociologist and Anthropologist, employed by the United States Department of Agriculture, while on leave from Michigan State College, and assigned to the Institute
Carlos Montañés	Assistant in Sociology
Edwin Murillo	Assistant in Sociology
Ana Teresa Blanco de Sariola*	Home Economist
Sakari Sariola*	Rural Sociologist

EXTENSION EDUCATION SERVICE

D. Spencer Hatch	Head
Fernando del Río	Associate Educationist (also Registrar)
Juvenal Valerio	Professor
Gerardo Luck	Superintendent of Students and Developments
Inés V. Stone	Secretary

SCIENTIFIC COMMUNICATIONS SERVICE

Armando Samper	Head
Alejandro MacLean	Assistant Editor
Helen George	Information Assistant
Iris de Arévalo	Secretary

LIBRARY

Angelina Martínez	Librarian
Catherine Noel James	Assistant Librarian
Emilia de Rodríguez	Clerk

* On study leave in the United States.

RENEWABLE RESOURCES SERVICE

Leslie R. Holdridge	Head
Arthur W. Peterson	Agricultural Economist, employed by the Pan American Union and assigned to the Institute, while on leave from the State College of Washington

BUSINESS OFFICE

George M. Slater	Business Manager
John A. Balenger	Assistant Treasurer

ADMINISTRATIVE COMMITTEE

The Administrative Committee of the Institute, established by the Board of Directors in December 1945 and entrusted with the responsibility for the general plan of development of the organization, met in Turrialba from February 7 through 10, 1950. The activities of the Institute were reviewed and plans for future programs were made during these meetings.

The membership of the Committee during 1950 consisted of the following:

H. Harold Hume (Chairman of the Committee)
Provost, College of Agriculture (now retired)
University of Florida
Gainesville, Florida

Mariano Montealegre, Director,
Instituto de Defensa del Café de Costa Rica
San José, Costa Rica

Knowles A. Ryerson, Dean,
College of Agriculture
University of California
Davis, California

Carlos Madrid, Decano,
Facultad de Agronomía
Universidad Nacional de Colombia
Medellín, Colombia

Ralph H. Allee, Director of the Institute
(member ex-officio)

José L. Colom, Secretary of the Institute
(secretary of the Committee)

PLANT INDUSTRY DEPARTMENT

Manuel Elgueta

1950

INTRODUCTION

The Department work during this year has developed normally even though it has not been possible to increase the personnel as is necessary to carry on the natural growth of the different programs.

The only new program initiated this year was one concerned with herbicides, fungicides, and insecticides sponsored by the Shell Oil Company. As this program was begun near the end of the year, no specific report is included here.

The research work of the Department is carried out by the various staff members; therefore, this report is arranged in sections prepared by the individual specialists.

TRAINING

The following students are working on research projects:

1. Manley Boss, graduate student from the University of Miami, arrived on September 6, 1949. He is working on physiological problems of coffee.

2. Donald Fiester, special student from California State Polytechnic College, formerly a staff member of the "Escuela Agrícola Panamericana", Zamorano, Honduras, arrived on January 3, 1950. He is working on a project on vegetative propagation of coffee.

3. Roger Jean-Baptiste, graduate student from the Escuela de Agricultura, Haiti, arrived on January 4, 1950. He was working on physiological studies of coffee. He left because of illness in April, 1950.

4. Cristóbal Navarrete, graduate student from the Escuela de Agronomía, Medellín, Colombia, arrived on January 4, 1950. His project deals with nutritional studies of coffee.

5. Rodolfo Quesada, graduate student from the Escuela de Agricultura, San José, Costa Rica, arrived in October, 1948. In August, 1950, he obtained his Magistri Agriculturae degree. At present, he is proceeding with his studies at the University of Florida.

6. Rudy Venegas, graduate student from the Escuela de Agronomía, San José, Costa Rica, arrived in May, 1950. He is working on a project of corn breeding.

7. Arthur Leibovit, graduate student from the University of Florida, is a former cacao student of the Cacao Center. Since September, 1950, he has been working under Frederick L. Wellman on a project dealing with a disease problem of cacao.

8. Gonzalo Narváez, from the Escuela de Agricultura, Chinandega, Nicaragua, arrived in October, 1950. He is working on cytological studies.

9. Oliver A. Newton, graduate student from Howard University (Graduate School), arrived on October 21, 1950. He is working on a Shell Oil project dealing with studies on herbicides, fungicides and insecticides.

COOPERATION AND CONSULTATION

In accordance with the cooperative agreement in force between the Colombian Coffee Federation and the Institute, Manuel Elgueta visited Colombia in March, 1950. He spent some time at the Coffee Experiment Station in Chinchiná in order to survey the coffee plantations; he also visited several of the agricultural experiment stations of the Colombian Ministry of Agriculture. On the way back to Costa Rica, he spent a week in Panama visiting the School of Agriculture in Divisa.

In April, 1950, Pierre G. Sylvain and Coaracy M. Franco made an extended trip through some of the Central American countries. They visited Nicaragua, Honduras, El Salvador, and Guatemala in order to survey coffee areas.

In April, 1950, Florence Thomas visited Panama to study some problems dealing with tomato industrialization and production.

Manuel Elgueta attended the conference of the Federación Cafetalera de Centro América y México, held in Tegucigalpa on May 15, 1950.

Frederick L. Wellman and Lucy Hastings attended the conference of Entomologists and Plant Pathologists held in Mexico City from September 26 to October 7, 1950, sponsored by the Rockefeller Foundation. Dr. Wellman presented two papers at this conference: "Certain Factors Limiting Cercospora Disease on Coffee Leaves" and "Effects of Temperature on Vegetative Growth of Five Coffee Disease Fungi". Lucy Hastings also presented a paper: "Cereal Crop Diseases and Pests".

In September, Manuel Elgueta accepted the invitation of the Genetics Society of America to participate in its Golden Jubilee celebration held in Columbus, Ohio. He spoke about the role of genetics in the New World, and presented a commemorative scroll to the President of the Genetics Society.

In October, 1950, Manuel Elgueta, Pierre G. Sylvain, and Emilio Viale attended the technical meeting of coffee workers called by the Federación Cafetalera de Centro América y México. The meeting was held in San Salvador, El Salvador. Manuel Elgueta presented a paper entitled "Programa de Investigación en Café". Pierre G. Sylvain presented a paper entitled "Programa de Fisiología del Cafeto".

In December, 1950, Jorge León went to El Salvador to collect coffee seeds in order to start a project on selection of progenies.

Manuel Elgueta accepted the invitation of University of Florida to participate in the Conference on the Caribbean at Mid-Century. He presented a paper entitled "Fundamental Research in Caribbean Agriculture and the Role of the United States in its Development".

ORGANIZATION AND ADMINISTRATION

Changes in Personnel

On January 12, 1950, Ernest H. Casseres, in charge of the Vegetable Section, left for Cornell University to proceed with his studies for his Ph.D degree. Florence Thomas, Ph.D. in horticulture, from Cornell University, arrived on February 15, 1950 to take charge of Casseres' work.

On March 17, 1950, Emilio Viale, Ph.D in entomology from Kansas University, arrived to initiate studies on main crop pests, especially with regard to coffee pests.

On May 31, 1950, Guillermo Bonilla, Assistant Agronomist to the Department, resigned to accept a position with the Venezuelan Ministry of Agriculture.

Kenneth L. Olsen, Ph.D in plant physiology from the University of California, arrived on November 21, 1950, to work on a new program of studies on herbicides, fungicides, and insecticides, sponsored by the Shell Oil Company.

Visiting Scientists

Dr. Coaracy Franco, plant physiologist from Campinas, Brazil, spent six months (January to June) at the Institute studying shade effect in relation to soil humidity.

Alberto Machado, Head of the Coffee Breeding Program of the Colombian Coffee Federation, Chinchiná, Colombia, spent two months (May to July) at the Institute working on the different projects of the coffee program of the Department.

Arnold Krochmal, from the Botany Department, Cornell University, spent five days (August 20-25) at the Institute collecting tropical fruit plants.

PUBLICATIONS

Crane, J. C. and F. L. Wellman. "Edad del henequen en relación con las características de la fibras." Turrialba. I.I.C.A., Turrialba, Costa Rica. Vol. I. No. 1. Julio, 1950. pags. 74-77.

Elgueta, Manuel. "Algunos resultados de experimentos de podas de cafetales." Suelo Tico. San José, Costa Rica Vol. IV. Nos. 18 y 19. Enero-Febrero y Marzo-Abril de 1950. pags. 36-39.

_____ "Un programa de selección para Coffea arabica." Turrialba. I.I.C.A., Turrialba, Costa Rica. Vol. I, No. 1. Julio, 1950. pags. 37-43.

Hastings, Lucy. "Necesidad de laboratorios de prueba de semillas en los trópicos americanos." Turrialba, I.I.C.A., Turrialba, Costa Rica. Vol. I. No. 1. Julio, 1950. pags. 45-47.

_____ "Estudios sobre la viabilidad de la semilla en Costa Rica." Turrialba, I.I.C.A., Turrialba, Costa Rica. Vol. I. No. 2. Octubre, 1950. pags. 86-88.

_____ "Seed Treatment Studies for Control of Rice Helminthosporium." Proceedings of Primera Asamblea Latinoamericana de Fitoparasitología, September-October, 1950.

_____ "A List of Rice Pathogens Found in Costa Rica." Proceedings of Primera Asamblea Latinoamericana de Fitoparasitología. September-October, 1950.

Quesada, Rodolfo. "Estudios sobre la mancha de la hoja del café producida por el Cercospora en la región de Turrialba, Costa Rica." I.A.I.A.S. Thesis. April, 1950. 90 pp.

Sylvain, Pierre G. "Programa de investigación sobre fisiología del cafeto." Turrialba. I.I.C.A., Turrialba, Costa Rica. Vol. I. No. 2. Octubre, 1950. pags. 88-91.

Viale, Emilio y Humberto Rosado E. "Control of Cornroot Chrysomelids." Turrialba. I.I.C.A., Turrialba, Costa Rica. Vol. I. No. 2. Octubre, 1950. pags. 91-92.

_____ "Chinche de la raíz del maíz (Cyrtomenus sp.)." Turrialba. I.I.C.A.,Turrialba, Costa Rica. Vol. I. No. 2. Octubre, 1950. pags. 93-94 .

Wellman, F. L. "Textos que se sugieren para los estudiantes de agricultura en la América Tropical." Boletín Informativo. Biblioteca, Centro Nacional de Investigaciones de Café, Chinchiná, Colombia. Vol. 6. 1950. pags. 22-26.

_____,J.C. Walker, Allyn Cook and M. Gallegly Jr. "Efectos de temperatura en el crecimiento vegetativo de cinco hongos causando enfermedades en café." Primera Asamblea Latinoamericana de Fitoparasitología. México, D. F., México, Sept. 25 - Oct. 6, 1950.

_____ and Rodolfo Quesada. "Algunos factores limitando la enfermedad causada por Cercospora en hojas de café. Ibid.

_____ "Dissemination of Omphalia, Leaf Spot of Coffee." Turrialba, I.A.I.A.S., Turrialba, Costa Rica. Vol. I. No. 1. Julio, 1950. pags. 17-27.

BOTANY, INTRODUCTIONS, AND MAINTENANCE OF PLANT MATERIAL

Jorge León

Plant Introductions

During the year, 476 plant introductions from various parts of the world have been received. Most important among them, because of their quantities, are Annonaceous fruits from Brazil; high-yielding cinchona clones from Costa Rica; local varieties of beans; varieties and types of coffee from stock collections of Puerto Rico and Central America; different varieties of kenaf; local varieties of cassava; twenty varieties of peanuts, and six varieties of abacá. Most of these plants are commercial types grown in the tropics and introduced here for the purpose of forming a collection of living specimens representing the most important crops of this area. Emphasis is being given to native food plants such as cassava, sweet potatoes, yams, Cucurbitaceae, Araceae, etc. in order to form stock material for future experiments.

Seed Interchange

During the year, 63 shipments of seeds have been sent mainly to the American countries. Each one of them contained one or several kinds of propagating material. In order to start the interchange of plant material grown at the Institute, the following list has been prepared (Not including the varieties grown at the Institute):

Aberia gardnerii
Albizzia (2 sp.)
Allamanda neriifolia
Allamanda cathartica
Amaranthus gangeticus
Antidesmia bunius
Artocarpus integrifolia
Arundinaria amabilis
Arundinaria longiaurita
Arundinaria simoni
Axonopus scoparious

Bambusa textilis
Bambusa tulda
Bambusa tuldoides
Bambusa ventricosa
Bauhinia pauletia
Bauhinia variegata
Boehmeria nivea
Byrsonima crassifolia

Caesalpinia sinchoria
Caesalpinia pulcherrima
Cassia multijuga
Cassia occidentalis
Cassia siamea
Cassia spectabilis
Cassia tora
Centrosema plumieri
Centrosema pubescens

Chaetium bromoides
Chimomobambusa quadrangularis
Chloris gayana
Chrysophyllum cainito
Corchorus capsularis
Corchorus olitorius
Coix Lachryma-Jobi (adlay)
Crotalaria alata
Crotalaria anagyroides
Crotalaria breviflora
Crotalaria guatemalensis
Crotalaria incana
Crotalaria intermedia
Crotalaria juncea
Crotalaria lanceolata
Crotalaria longirrostrata
Crotalaria mysorensis
Crotalaria mucunata
Crotalaria paulina
Crotalaria pumilla
Crotalaria retusa
Crotalaria usaramoensis
Curcuma longa
Cynodon dactylon
Cyphomandra betacea
Cyphomandra costarricensis

Desmodium adcendens
Desmodium canum
Desmodium frutescens
Desmodium infractum
Desmodium leiocarpum
Desmodium nicaraguensis
Desmodium sericophyllum
Desmodium scorpiurus
Desmodium triflorus
Digitaria decumbens
Dioscorea alata
Dioscorea bublifera
Dioscorea trifida
Diospyros discolor
Dolichos hosei
Dolichos lablab
Elaeocarpus serratus
Eriochloa polystachya
Erythrina berteroana
Erythrina cochleata
Erythrina costarricensis
Erythrina poepiggiana
Erythroxylon coca
Eugenia uniflora

Flacourtia indica

Garcia mayana
Gigantochloa apus
Grevillea Banksii
Guilielma utilis

Hibiscus cannabinus 3
Hibiscus sabdariffa
Hyparrhenia rufa

Indigofera endecaphylla
Indigofera hirsuta
Indigofera mucronata
Indigofera suffruticosa
Indigofera subulata
Indigofera sumatrana
Ixophorus Unisetus

Jathropa curcas

Leptochloa virgata
Leucaena glauca

Maranta arundinacea
Melinis minutiflora
Muntingia calabura

Nephelium mutabile

Panicum antidotale
Panicum purpurascens
Panicum maximum 2
Parmentiera cerifera
Paspalum notatum 3
Paspalum dilatatum
Pennisetum clandestinum
Pennisetum purpureum 11
Phaseolus calcaratus
Phyllostachys dulcis
Phyllostachys edulis
Phyllostachys meyeri
Phyllostachys nigra
Phyllostachys sulphurea-viridis

Polytrias praemorsa
Posoqueria latifolia
Psidium cattleianum
Psidium coriaceum
Psidium friedrichstahlianum
Psidium guajava 5
Psidium guineense
Psidium molle
Psidium polycarpus
Pueraria thunbergiana

Ravenala madagascariensis
Rynchosia minima

Solanum hirsitussimum
Solanum quitoense 2
Solanum hyporhodium 2
Spathodea campanulata
Spondias cytherea
Sporolobus indicus
Stenotaphrum secundatum

Tephrosia candida
Tephrosia noctiflora
Tephrosia vogellii
Teramnus uncinatus
Tripsacum laxum

Vigna marina
Vigna repens
Vigna sesquipedalis
Vigna vexillata

Xanthosoma violaceum

Zoysia japonica
Zoysia matrella
Zoysia tenuifolia

Food Crops

Sweet Corn

Two propagation plantings were made with hybrid corn Chirripó-Dulce. In general, the quality is good with reference to size and flavor, but further selection is needed to obtain a more uniform type.

Ayotes (Squash)

The varieties, Peraoro and Clavagorda, developed at the Institute were increased in isolated plots to obtain mass production of seeds. Self-pollination was made to prevent possible contamination.

Cowpeas

During the year, two propagation plantings were made of hybrid cowpeas developed at the Institute -- Garbancito, Azul Grande, Canelo, Chinto, and Chinegra. Various improved lines of Chinto were planted. The two hybrids, Black Mildew resistant and Blue Mildew resistant, need more selection work; a line (27-37) has been propagated from the last one mentioned, which shows good production and resistance. Seven imported varieties have been planted to obtain seeds for distribution.

A yield trial in a latin square design was established with the following varieties: Garbancito, Azul Grande, Canelo, Chinto, Chinegra, and Flue Mildew resistant. The results of this trial will be reported in a subsequent report.

Sorghums

The varieties developed at the Institute by Fennell — Belleza, Ocho, Especial and Enana, were planted twice this year. Belleza variety has reached a high degree of uniformity. Especial needs more selection work.

Peanuts

A mass selection of Bonita, of high uniformity, was planted twice this year. A line of big seed, though of lower yield, was isolated, and the rest of the individual lines were eliminated. A yield trial using Bonita variety and the most promising imported varieties was established to check yields under unfavorable weather conditions. The plots have not been harvested yet. For propagation purposes, twenty-two varieties were planted this year.

Tomatoes

During the year, several lines of the 31-10 original crosses of "Turrialba" and seven lines of back-crosses were planted. One of the back-crosses shows a healthy condition and good-sized fruits.

Grapes

The collection of Vitis sp. was transplanted to an adjoining plot where the 0212 and 0213 hybrids were planted. Most of the plants left for grafting stocks were eliminated.

Beans

The aim of this project is to try different varieties of dry beans grown commercially under wet and hot climatic conditions. The variety "Portugues" shows a marked resistance to diseases and is a good yielder. A yield trial using four varieties (Norteña, Guaria, Chimbolo, and Portugues) was established in a random block design and will be harvested in January, 1951.

Miscellaneous

In order to obtain propagating material, the following plantings were made: 1 variety of Colocasia esculenta, 2 Xanthosoma, No. 0111 sweet potato, yard-long bean (Vigna sesquipedalis), rice bean (Phaseolus calcaratus), adlay (Coix Lachryma-Jobi), etc.

Grasses and Legume Gardens

This is a representative collection of the most important pasture for the lowland tropics. At present, there are thirty species and twelve varieties of grasses, most of which are used for forage. These are established in museum plots of 10 by 20 meters which are cut before flowering. The fresh weights are recorded. The most promising grass in Axonopus scoparius (Imperial or Venezuela) that has maintained a uniform production during a year and a half. There are important differences among the several strains of elephant grass. Two hybrids of this and cuttail millet, Nos. 532 and 533, are the most promising in the elephant grass group, but they show lower resistance to the different cuttings than the Axonopus.

Up to now, the collection has been used only for the purpose of preliminary observations, but its most important aim is to supply propagating material both in Costa Rica and other countries.

The collection of Leguminosae includes forage plants, cover crops, and green manure plants. It comprises fifteen species of Crotalaria, eight of Desmodium, three of Tephrosia, two of Centrosema, six of Indigofera, Vigna, Teramnus, Pueraria, etc. Due to this high number and to the lack of space in the field, only multiplication plots have been established of these plants.

Botanical Collections

Economic Plants

The necessary work has been done during the year in order to maintain this collection. The main problems of this project have been the control of cotting ants, weeds, and grasses. A map of the collection was drawn, and the trees were numbered. Through contracts with some of the Institute laborers, it was possible to keep part of the plots clean. The Institute furnished the land for a year, and the laborers were allowed to plant vegetable and non-perennial crops. Part of this collection was cleared by replacing the avocado with abacá and some trees. The citrus section has to be removed and replaced with new grafted trees.

New Plantings

A tract of land close to the main building was taken to establish an arboretum or botanical garden. This is arranged mostly by systematic groups. The main collection planted up to now is a plot of Leguminosae (trees and shrubs), palms, bamboos, and cacaos. Permanent tags were placed on each tree.

Herbarium

During the year, the collection was arranged systematically. One thousand, five hundred and ten plants were mounted. A total of 2,100 numbers were added mostly from collections made in Costa Rica, Honduras, and Guatemala. As a result of this work, 14 new species were found: 3 from Guatemala, collection of B. L. Lamb and 11 from Costa Rica, collection of J. León.

VEGETABLE CROPS

Florence Thomas

Potatoes

The potato work is carried out mostly in the Cartago potato region on the slopes of the Irazú volcano on samll plots near the Pan American Highway and on the slopes of the Turrialba volcano.

Project No. 39 - Studies with Potatoes (Solanum tuberosum).

Forty-nine potato varieties and introduced breeding lines have been compared for incidence of infection with Phytophthora infestans and tested for yield in several locations of Costa Rica. Harford, DUA_2, CZK_7, and FBY_1 have shown highest yields of the varieties and lines extensively tested. Their yields averaged 8,000 to 18,000 pounds per acre or about 20,000 to 44,000 pounds per hectare. These four selections show a comparatively low incidence of natural infection with Phytophthra, and they are being increased for further distribution. Tubers of high-yielding selections have been distributed in five to ten pound lots to six stations in other American countries and to several farmers in Costa Rica. The varieties and lines already tested and five recently acquired varieties are being tested further in Costa Rica and increased for testing in other countries.

Experiments in Turrialba indicate (1) that cut seed pieces of potatoes yield as well as whole tubers of similar size, and (2) spacing the tubers or pieces six inches apart in the row results in significantly higher yields per acre or hectare than spacing them at twelve inches in the row.

Other Vegetable Crops

Project No. 62 - Standardization of Vegetable Crops Commonly Grown in the Tropics. Location: Institute.

Casseres' selections (A-63, A-64, and A-65) from a native sweet pepper yielded in a replicated trial 3 to 4 times the

number and 2 to 3 times the weight of fruits yielded by the same number of plants of the California Wonder Variety with which they were compared. The fruits of each selection are a little more than one-half the size of California Wonder. A-65 produced a greater weight and number of fruits and larger fruits than the other Institute selections. The selections will be increased for further testing and distribution.

Results of squash trials including Casseres' selections from a native squash and Peraoro, Barbados, and Clavagorda indicate that A-72 produces higher yields than the other selections (A-16, A-17, A-18, A-20, A-45, A-69, A-70 and A-71), and that its yield is about equal to the yield from the same number of plants of Barbados and Peraoro. A-72 is a large globular type with large seed cavity and pale watery flesh. Peraoro and Barbados are straight and crooked necked types with small seed cavities and deep orange flesh. The latter varieties probably are superior in nutritive value to the selections from the local squash. Clavagorda produced few fruits.

Six varieties of hot pepper, five varieties of yuca (cassava), five varieties of sweet potato, two varieties of chayote, and two varieties of plantain are being maintained in the Institute gardens and will be distributed whenever distribution is feasible.

Project No. 63. - Vegetable Variety Trials. Location: Institute.

Several varieties of vegetables may be tentatively recommended for humid tropical regions on the basis of Institute tests at Turrialba, Costa Rica. (At the Turrialba Station, the average annual rainfall is about 119 inches, the average temperature is 72°F., the altitude is 600 meters above sea level, and the soils are old volcanic soils.)

Dry beans: Red-seeded variety, Guaria and black-seeded variety, Chimbolo are satisfactory. Both are Costa Rican varieties.

Snap beans: Green podded varieties Jamaica (Institute strain) and Tendergreen and wax-podded variety, Sure crop wax, have yielded better than others tested.

Cabbage: Steins' Early Flat Dutch produces good heads during some seasons. Other varieties tested do not produce solid heads.

Lettuce: Great Lakes, Imperial 44, Imperial D, and Imperial 17 produce satisfactory heads in some seasons. Other varieties tested do not head well and the four varieties listed do not always produce solid heads

Onion: Crystal wax, Dura de Portugal, and Louisiana Red Creole are satisfactory. Other varieties tested do not produce bulbs.

Carrots: Red Core Chantenay is satisfactory.

Sweet pepper: Institute variety A-65 gives high yields.

Radish: Red Giant is recommended. All varieties tested are satisfactory.

Okra: Emerald or Evergreen are satisfactory.

Tomato: Institute varieties S-41, S-59, S-65, and S-8 yield considerably better than imported varieties. No varieties tested have proved satisfactory during periods of heavy rainfall.

Swiss chard: Fordhook Giant is satisfactory in Turrialba. No other varieties have been tested.

Chinese cabbage: Variety Chihli is satisfactory. No other varieties have been tested.

Table beet: Detroit Dark Red is satisfactory.

Turnip: Purple Top White Globe is recommended.

Cauliflower: Plants of the varieties tested have died before producing heads.

Cucumber: A slicing variety of unknown origin, called "Local" yields well.

The following vegetable varieties are tentatively recommended for cooler and somewhat drier regions on the basis of limited observations at the Institute Vegetable Experiment Station (Altitude 1690 Meters) near Cartago, Costa Rica.

Lettuce: Imperial 44 and White Boston.

Swiss chard: Fordhook Giant.

Cabbage: Stein's Early Flat Dutch.

Carrot: Red Core Chantenay.

Celery: Giant Pascal.

Snap beans: Green-podded varieties Jamaica and Florida Belle; wax podded variety Pencil Pod. Data from a snap bean test near Cartago are presented in Table I.

TABLE I

Yield From Each of Eight Snap Bean Varieties in Pounds per Plot of 60 Sq. Ft. Including Approximately 120 Plants. Test by Victor Morúa

(Planted in 8 Replicates in Cartago, Costa Rica, April 17, 1950)

Variety	Pod Type	Yield in Lbs. per Plot
Sure Crop	Wax pod	69.0
Ranger	Green pod	59.0
Tendergreen	Green pod	56.0
Florida Belle	Green pod	61.0
Longreen	Green pod	60.0
Pencil Pod	Wax pod	73.0
Pure Gold	Wax pod	64.5
Jamaica IAIAS Sel.	Green pod	61.5

Tomatoes

Project No. 80 - Development of Tomato Varieties. Location: Institute.

In a tomato yield test reported by Casseres and Linares in the Institute Journal Turrialba I (1): 7-11, 1950, three Institute varieties S-41, S-59, and S-65 yielded better than the other Institute lines and commercial varieties included in the test. Another test of these three varieties and other varieties, which by observation appeared to have a high yielding ability, was concluded November 18, 1950. In the latter test, S-8, S-41, and S-59 yielded a greater weight of fruits than the other varieties tested. Data from the latter test are shown in Table II. (on page 15)

Native and introduced wild tomatoes and introduced tomato varieties have been tested for resistance to late blight caused by Phytophthora infestans. Types which have appeared most resistant were cross-pollinated with the best Institute varieties and some introduced varieties.

TABLE II

Yield in Weight and Number of Fruits from 48 Plants of Each of 14 Tomato Varieties.
(Planted in 6 Replicates in Turrialba, Costa Rica, July 11, 1950)

Variety	Average Size of Fruits of Each Variety in Pounds	Total Harvested	
		Total Number of Fruits	Total Weight in Pounds
S-56	0.17	76	13.13
S-31	0.13	152	19.19
S-34	0.15	97	14.75
S-41	0.14	154	21.38
S-65	0.16	86	13.50
S-59	0.11	189	21.19
S-8	0.16	148	23.69
S-3	0.14	123	17.88
S-100	0.27	18	4.74
Turrialba	0.19	96	17.88
Master Marglobe	0.18	47	8.31
Selection MM6	0.19	87	16.69
Stokesdale	0.19	47	8.75
Brazil	0.10	119	12.50

CORN

Humberto Rosado

1949 Winter Crop

In the preceding crops' statistical analysis, none of the five characters studied by comparison between ear-to-row progenies and a random sample of the variety had the least significant difference. Therefore, it was considered unnecessary to measure all these characters again, and the comparison was based only on yield and plant height. The result was the same; no significant differences were obtained. To continue the study, we planted fifty rows, and from these selected the best fifty ears to be planted again.

Mass Selection

Two hundred ears from each of the varieties were selected from plants desirable in agronomic characters. In the laboratory, the best hundred of each variety was chosen and shelled together to composite the seed and start a third cycle of mass selection.

Mass Selection with Bi-Parental Control

One hundred and two plots were planted, but due to insect damage five plots were completely destroyed, and five others were discarded for undesirable characters. In the 92 plots remaining, 322 sibs were made. From these, two hundred ears were selected, shelled individually, and planted again for the next cycle of selection.

Top-Crossed Seed of S_1 and S_2 Lines

Seventy-eight S_1 and S_2 lines were grown in detasseling blocks using the I-452 variety as pollinator. Again, due to insect damage, it was possible to harvest only 25, and these lines were used for a yield trial.

Inbred Material

Out of the 258 lines planted in the previous crop, 147 ears were harvested, shelled individually and planted in single-row plots. The corn root bug (Cyrtomenus sp.) caused a total loss of 70 plots in the Institute grounds. On the remaining 77 plots, 213 self-pollinations were secured. All this material was also planted in replicated plots in Barranca where 18 lines showed male sterility and were discarded.

Studies were initiated on the use of chlorinated insecticides for control of soil-inhabiting insects destructive to corn. Four different chemical products were tested including one which had given excellent results in preliminary trials. More detailed tests will be made during the next vegetative cycle.

Introductions

In order to evaluate new material, 29 varieties and single crosses were planted in a randomized block yield trial. At the same time, an agronomic study including silking and tasseling time, height of the plant, height of the ear, stand, vigor, lodging, and resistance to fungus diseases was made.

Fertilizers

In order to test a new method of fertilizing corn, a yield trial in latin square design was planted using seed to which phosphate had been added. The results were not statistically significant.

SUGAR CANE

Jorge León

Project No. 83. Variety and Fertilizer Trials.

During the year, the second crop was harvested with the following results:

Varieties	With Fertilization	Without Fertilization	Total
POJ 2714	4143	3397	7540
POJ 2878	5054	4453	9507
MC. 666	3182	2920	6102
CO. 281	5605	4734	10339
BH 1012	3854	2904	6758
Cristalina	2183	1782	3965
Otaheite	2630	1558	4188
CO. 290	7163	6299	13462
Rayada Criolla	1993	1566	3559
Argentina	7467	6994	14461
Total	43274	36607	79881

Analysis of Variance

	F. Values
Varieties	86.9 xx
Fert. vs. non-fert.	25.7 xx
Varieties x fert.	---

The yields, in general, decreased considerably this year mainly due to thinning because of difficult sprouting in some varieties. CO. 281, CO. 290 and Argentina were the ones which sprouted better and maintained high yields. Variety differences were highly significant, and also fertilization produced a significant increase over all varieties.

Half of the replications were put under a different system of cultivation to make comparisons with the standard methods of the Turrialba area. Fertilizers at the rate of 90 Kg. of nitrogen, 90 P_2O_5 and 90 K_2O were applied to the hectare.

Project No. 70 - Collection of Varieties.

In 1949, the variety collection was established in a new field. This included 66 varieties in individual rows of 20 meters long and 15 varieties of Saccharum spontaneum and S. sinense.

New Variety Trial

This year a new variety trial was established using the new Puerto Rican canes P. R. Nos. 902, 905, and 907 for comparisons with the POJ 2878.

COFFEE

Plantation Management

Manuel Elgueta

Old Plantation Trials

Project No. 37 - Renovation of Old Plantation by Cultural Treatments and Fertilizers.

This is the only trial which has been in progress continuously since 1946, and it has produced four crops already. The last crop will be harvested in January 1951. Results of three years are shown in Table III on page 19.

None of the four different methods of cultivation of the soil gave significant differences. Nitrogen gave a 5% level of significance over non-nitrogen in the years 1947 and 1948, but no significance in 1949. Table IV on page gives the simple effects of fertilizers obtained during these years.

Up to now, the general effect on average yields in the total acreage of this trial is worth recording. There has been a steady increase every year as can be seen from the following data:

1947 - 2057 Kg. to the hectare
1948 - 3796 Kg. to the hectare
1949 - 5239 Kg. to the hectare

Even if these data correspond to cherries, the yield for the last year is high and reaches roughly 1050 Kg. of coffee grain per hectares.

TABLE III

Methods of Cultivation and Fertilization of Coffee Plantation

	N	NP	NPK	NK	P	PK	K	T	Total Cult.
1947									
Superficial shoveling	46.8	104.0	90.5	39.5	56.5	85.0	45.8	47.9	516.0
Deep shoveling	92.3	97.0	54.0	69.8	33.8	89.3	57.0	63.6	556.8
Cover crop	114.9	58.7	94.7	111.6	114.3	66.5	59.8	92.2	712.7
Chopping	96.3	61.3	74.9	109.4	129.2	91.4	63.7	56.9	683.1
Total Effect of Fertilization	350.3	321.0	314.1	330.3	333.8	332.2	226.3	220.6	
1948									
Superficial shoveling	193.2	184.6	237.9	149.8	103.0	123.5	71.8	35.7	1099.5
Deep shoveling	153.5	154.3	110.4	133.8	70.8	109.0	104.4	126.9	963.1
Cover crop	195.0	216.9	144.1	201.0	162.2	96.3	146.1	203.1	1364.7
Chopping	181.7	133.5	166.8	154.0	138.5	114.4	127.6	111.8	1128.3
Total Effect of Fertilization	723.4	689.3	659.2	638.6	474.5	443.2	449.9	477.5	
1949									
Superficial shoveling	243.5	188.7	276.9	183.5	180.6	170.9	236.7	123.1	1603.9
Deep shoveling	269.6	276.9	184.6	163.7	281.8	232.5	258.9	204.4	1872.4
Cover crop	169.6	147.9	159.2	130.9	195.0	82.1	181.5	206.7	1272.9
Chopping	183.8	212.0	198.1	192.4	246.8	187.2	150.7	167.0	1538.0
Total Effect of Fertilization	866.5	825.5	818.8	670.5	904.2	672.7	827.8	701.2	

TABLE IV

Simple Effects of Fertilizers

	1947	1948	1949
N_o	1112.9	1845.1	3105.9
N_1	1315.7	2710.5	3181.3
P_o	1127.5	2289.4	3066.0
P_1	1301.1	2266.2	3721.2
K_o	1225.7	2364.7	3297.4
K_1	1202.9	2190.9	2989.8

Project No. 87 - Shade, Pruning and Fertilization Effect on Old Plantation.

There are already three crops on this trial, but the last one will be reported in 1951. Results of the years 1948 and 1949 are given in Table V on page 21.

Results from the table can be summarized as follows:

1. Both years the main effect was produced by coffee pruning. Increases of more than 50% in 1948 and of about 60% in 1949 were obtained in the non-pruned plots over the pruned ones, and the difference reached a level of significance of 1%.

2. The effect of shade on coffee production was also noticeable. In both years, the major plots under normal shade gave the best results which reached a significant level of 5% in 1949. In 1948, the differences did not reach a significant level when analyzed together, but when the comparison of shade vs. non-shade was made, the F. value obtained was 8.4 which is significant at the 5% level. In both years then, the main effect was produced by the elimination of shade.

3. Fertilization with NPK and NPKCa produced a significant effect only in 1949. In 1948, however, the interaction between coffee pruning and fertilization reached the 5% level of significance. Looking at the figures of Table V, it can be seen that this is due to the fact that the fertilizers acted only on the non-pruned coffee in which the yield of the check plots is much lower than the yields of the plots with NPK. In the plots under pruned

TABLE V

Effect of Shade, Pruning and Fertilization of Coffee, 1948 and 1949 Crops

ffee uning	Fertili-zation	Shade Treatments: Without Pruning 1948	Without Pruning 1949	Normal 1948	Normal 1949	Heavy Pruning 1948	Heavy Pruning 1949	Without Shade 1948	Without Shade 1949	Total Pruning and Fertilization 1948	Total Pruning and Fertilization 1949
uning	NPK	21.35	75.47	20.86	111.61	15.19	39.81	17.17	23.89	74.57	250.78
	NPKCa	20.74	67.60	24.22	100.21	29.83	103.83	7.69	18.31	82.48	289.64
	Check	27.55	84.30	31.32	81.67	18.92	51.20	9.48	19.14	87.27	236.31
thout runing	NPK	41.32	132.59	55.02	148.41	40.99	146.02	24.27	75.42	161.60	502.44
	NPKCa	28.02	112.76	31.20	124.88	26.00	126.55	30.41	62.11	115.63	426.30
	Check	33.91	79.00	30.46	89.41	16.29	71.41	18.41	49.96	99.07	289.78
tal hade Treatment		172.89	551.72	192.88	656.19	167.22	538.51	107.43	248.83		

Effects of Fertilization

	1948	1949
K	298.78	753.22
KCa	214.41	715.94
eck	236.63	526.09

Effects of Coffee Pruning

	1948	1949
thout Pruning	244.32	776.73
uned	376.30	1218.52

Analysis of Variance

	F. Values 1948	F. Values 1949
Total Shade Treatment	2.06	3.06
Shade vs No Shade	4.58	8.4 x
Coffee Pruning	14.45 xx	14.4 xx
Fertilization	1.67	3.44 x
Coffee Pruning x Fertilization	3.76 x	2.27

coffee instead, there are no differences between check plots and fertilized ones. This trial has been giving very consistent results in these two years, and with the still incompleted data of the harvest of 1950, it seems that there will also be close agreement as to the trends of the results.

This trial will have to be discontinued after the crop of 1951 because of the damaging effect of the lack of shade which is killing many trees.

Project No. 99 - Fertilization Trials.

A factorial of N, P, K, and Ca. begun in 1947 has not yielded significant differences in any of the three crops because of the poor condition of the old plantation in which the trial was located. A complementary trial on the effect of compost has not given differences due to the same reason.

New Plantation Trials

During the year, several new trials were begun based on the experience of the old plantation trials. Most of them were planted on factorial designs to take advantage of the increase in accuracy that they give specially for simple comparisons.

1. Factorial Fertilization Trial

The elements N, P, K, and Ca. are tried in three different levels of application 0, 1, and 2. Levels 1 and 2 correspond to 90 Kg. per hectare each of NPK and 700 Kg. per hectare of $CaCO_3$. Level 2 is twice the former amounts.

The trees were planted in October, 1949, but replanting has been necessary to insure an even plantation. This has delayed the application of the fertilizers which will be applied when the whole trial is in order.

Plots are of nine trees each in squares of 3 x 3. Total number of parcels are 81, which are arranged in a latice of 9 x 9 with 2 replications.

2. Variety Trial

Planted from April 14 to July 12. Varieties typica, bourbon, and nacional from El Salvador and Montecristo are being compared in a randomized block design with five replications. The Montecristo variety has all the characteristics of the nacional from El Salvador, but had originated in the finca Montecristo near the little town of San Isidro of Alajuela.

3. Planting Distance and Pruning

Planted in August, 1950. Distances tried are 1.50, 2.00, 2.50, 3.00, and 3.50 meters in squares between plants. Each distance is tried in two types of plant formation, free growth and Costa Rican pruning with five replications. This is a factorial with a combination of two factors. The simple comparisons will get the advantage of ten replications for the distance and 25 for types of plant formation.

Several answers are expected of the trial such as production delay produced by top pruning in order to get branching of the trees, later effect of top pruning and free growth, age of interference of the plants at different distances and in the two types of plant formation. The last answer can lead to a practical type of crowded planting to get the benefit of an early high yield per hectare with a thinning of the plants to proper distances for a later period of adult high production. If the Costa Rican method of top pruning proves good for the production of the adult plant and free growth for an early production, a combination of both systems could be applied during the earlier years, pruning only one tree in four to attain a well-pruned tree for adult production.

4. Methods of Soil Cultivation

Planted in December, 1949. Most systems of soil management in cafetales are founded only on tradition. Besides, expenses of some of them run very high. Consideration must be given also to erosion in coffee plantings on slopy soils. Trials made abroad seem to indicate that what the plants need is good care with any type of soil management. Project No. 37 in four years is not yet giving any indication of differences. In this trial, 8 different soil types of cultivation are tested as follows:

a. Holes between trees for the accumulation of organic debris.

b. Hilling or piling up of soil to the trunks of the plants and clear cultivation of the inter-rows.

c. Mulch in the form of banana leaves or dried grass.

d. Horse cultivation of inter-rows.

e. Legume cover crop.

f. Chopping of weeds.

g. Superficial shoveling, just to cut off the weeds.

h. Deep shoveling leaving the weeds covered

Costs of the different methods will be taken, because this fact will perhaps be the deciding one in the selection of the best method.

Breeding Work

Individual Tree Performance

Data of the plot of 100 trees were continued this year. Variability found agrees very closely with data taken in Colombia, Brazil, and the Belgian Congo. These data are going to be used in relation to studies of experimental plot size in combination with others from Colombia that are being analyzed on a cooperative basis. An article is in preparation and will appear in one of Turrialba's future issues.

Progeny Selections

This program was initiated in 1949. The 158 selections made at the finca La Dominica were planted in the nursery. The first selection for uniformity was made in July, 1950, and only 43 progenies were planted in the field in squares of 4 x 4 trees each. The first one hundred numbers of this first selection correspond to the 100-tree plot that is being individually controlled for production. A correlation study will be possible later between mother trees and progeny performance.

In February, 1950, another selection was made in several coffee fincas of the central plateau of Costa Rica. Seven hundred progenies were selected and planted in the nursery in May. Weekly fumigations with Fermate have been made to maintain them free of banal nursery infections which later will badly damage the plants when transplanted to the field.

Growth has been very good, and the progenies show remarkable differences among themselves. On the basis of uniformity alone, a selection has been made of about 200 up to now. It is expected that not more than 200 will be transplanted to the field next May.

In December, Jorge León went to El Salvador to select progenies from the coffee fields from which the "nacional" type is being produced. The purpose of this selection is to enlarge the basis of the geographical area from which trees are taken and to have a good sample of the possible different types which exist in the coffee from El Salvador. Enough seed was brought from each selected tree to have enough seedlings for the Institute project and for another project from the Ministry of Agriculture of Costa Rica which contributed to the expenses of León's trip.

There was still enough remaining to supply the Chinchiná Experiment Station of Colombia with seed from most of these progenies. A similar project will be conducted at the Colombia Station. Also, the Centro Nacional de Agronomía from El Salvador which previously contributed facilities and time of its workers for the collection work, collected seed from the same trees. This selection will then be conducted at different places and will provide a very good opportunity to study the possibilities of adaptation of this material which lately has been widely recommended for new plantings in several countries.

Collection of Species and Varieties.

The material of different species that were grown in the nursery was transplanted to the field in October. The species and varieties that now have a permanent location are the following:

Coffea liberica Bull.
Coffea excelsa Chev.
Coffea canephora Pierre
Coffea canephora var. typica
Coffea canephora var. laurentii (robusta)
Coffea canephora var. ugandae
Coffea stenophylla G. Don
Coffea abeokutae Cramer

Coffea arabica var. typica Cramer
Philippinean
Sumatra
Chocolá
Salvadoreño
Moca
Guadaloupe
Ceylon
Preanger
Padang
Blue Mountain

Coffea arabica var. bourbon Choussy
Coffea arabica var. maragogipe Froehn.
Coffea arabica var. san ramón McClelland
Coffea arabica var. purpurascens Cramer
Coffea arabica var. bullata Cramer
Coffea arabica var. erecta Ottolander
Coffea arabica var. murta Cramer

Most of the items were planted in squares of 8 x 8 trees to insure good observations of the plants and the possibility of collecting uncontaminated seed from the central trees.

Physiological Studies

Pierre G. Sylvain

Three granduate students, Manley Boss, Cristobal Navarrete, and Donald Fiester have assisted in these studies.

A visiting scientist from the Institute of Campinas, São Paulo, Brazil, Mr. Coaracy Franco, carried investigations on the available water of coffee plantations in Costa Rica and El Salvador. He used the laboratory and library facilities of the Institute during his stay at Turrialba.

A new plant physiologist, Dr. Kenneth L. Olsen, arrived at the end of the year to be in charge of the Shell project. He will be helped by a graduate assistant, Mr. Oliver A. Newton, and both of them will devote a large part of their time to investigations on coffee.

In order to centralize the plant physiology research at the Institute, the main laboratory room has been reserved for specialists in this field without consideration of the crop they may be working on. Better laboratory facilities have been provided by the construction of several new tables fitted for chemical work.

The following investigations have been carried out during the year:

Project No. 154 - Some Internal and External Factors Affecting the Vegetative Growth of Coffee.

The graduate assistant, Manley Boss, is leader of this project. Data for the whole year have been obtained now, and only statistical analysis and interpretation of the results are left to be done. The growth curve of bearing trees followed last year's curve except for minor variations. The growth cycle of young non-bearing trees and of defruited trees followed in general the cycle of bearing trees, which seems to indicate that fruit production does not alter this cycle. The application of nitrate fertilizers once or three times during the season did not seem to alter the cycle either.

The total nitrogen of the soil remained fairly constant throughout the season in each position sampled. Soil nitrates, although fluctuating markedly throughout the year, did not seem to be a limiting factor for growth at any time. Soil moisture also fluctuated with the lowest percentage in April, 1950 and the highest in December, 1949 and August, 1950.

Foliar analyses seemed to indicate that the nitrogen factions are at a minimum during the period of dormancy and at a maximum at the vegetative growth peak.

Project No. 153 - Effect of Shade upon Growth and Differentiation of Coffee Seedlings as Expressed by Physical Measurements and Chemical Composition.

On March 15, 1950, 64 potted coffee plants in four groups of sixteen were put under artificial shade in the small lath house, and the same number in full sun for later examination, measurements, and chemical analyses.

Unfortunately, a disease infestation was so great that by May 23, 1950, the experiment had to be temporarily abandoned. Miss Lucy Hastings, plant pathologist, identified the disease as caused by Cercospora coffeicola. The plants in shade had an average of 80.5 spots by replication of sixteen plants, and those in sun, an average of 431 spots by replication.

It is hoped to repeat this experiment as soon as better information has been obtained on the control of nursery diseases from the experiments now being carried out by the pathologists.

Project No. 157 - Annual Variations in Individual Yield of Coffee Trees Growing under Different Conditions.

Record was taken of individual yield of the same coffee trees as of last year. The harvesting season went from September 9, 1950 to December 29, 1950, and the crop was picked seven times.

By compiling data for two years, the accumulated yield went from 14 grams to 13,895 grams of cherries per tree in the shaded plots as compared to 71 grams to 20,876 grams in the non-shaded plots. Two trees in the shade and 9 trees in full sun bore over 10,000 grams of cherries.

Project No. 149 - Carbohydrates and Nitrogen Constituents of Branches of Bearing and Non-Bearing Coffee Trees throughout the Season.

Samples for chemical analyses were collected 6 times throughout the season. Carbohydrates determinations have been run for 2 series of samples and nitrogen determinations for 5 series.

Results obtained so far seem to indicate a direct correlation between vegetative growth and total nitrogen concentration in the branches.

Project No. 171 - Total Ash and Some Carbohydrates and Nitrogen Constituents of Roots of Bearing and Non-Bearing Coffee Trees throughout the Season.

This new project, under the leadership of Cristobal Navarrete, was planned as a complement to Project No. 149 to give more informa-

tion of the carbohydrates and nitrogen cycle throughout the plant. It is hoped that it may also help to interpret the results from the study on the vegetative growth cycle.

Four blocks of 12 trees were defruited throughout the season, and the same number of trees went without treatment as controls. Each block was divided in 2 series of 6 trees each from which root samples were collected approximately every four months in order that samples may be obtained from each block every two months.

Five collections have already been made, and the various analyses completed for 4 of them. The greatest variation found so far is in the starch and dextrins fractions.

Project No. - Studies on Die-Back.

Die-back of coffee has been attributed to pathological organisms as well as to various physiological causes. In order to better study the symptoms of this complex, attempts were made to induce it experimentally by the use of different treatments apt to result in food starvation. By simply defoliating 44 coffee branches in May, it was found that symptoms of the die-back appeared in 2 branches after 7 weeks, in 20% of the branches after 13 weeks, and in 88% after 23 weeks.

By defoliating and ringing 23 bearing coffee branches, the first symptoms appeared in 20% of the branches after 12 days; the actual death of the terminal bud had occurred in 19 branches after 32 days.

When branches were ringed without defoliation, no symptoms of die-back were found.

It has been possible to establish the typical sequence of symptoms as follows:

1. Darkening of stipules (not in all cases followed by die-back).

2. Darkening of the nodes, starting usually 2 or 3 nodes from the tip.

3. Darkening of the inter-nodes.

4. Death of the terminal bud usually starting a little below the bud and progressing upwards.

Project No.169- Some Aspects of Propagation of Coffea arabica by Cuttings.

This project is under the leadership of Donald Fiester. Although the project was undertaken primarily to find out the best practical method of assexual propagation of coffee, so great emphasis has been given to the physiological factors involved that it should be considered as a physiological as well as a horticultural investigation.

In spite of the fact that coffee has been propagated by cuttings for some time, this work has generally been done by using cuttings of relatively large size. Considering the relative scarcity of material in valuable clones, emphasis has been placed in this project on the use of the smallest practicable propagating units. The possibility of using one leaf bud and node cutting has been investigated.

The propagating bins in the main greenhouse have been altered to permit their filling with water maintained at a constant level of 5 cms. below the bottom of the propagating box. This is done in order to provide at all times a high atmospheric humidity within the box.

The large number of experiments on cuttings have included comparison of the value of different media (vermiculite of commercial grade, river sand, and soil); the rooting ability of one node cutting according to their position along the orthotropic stem; study of the effect upon rooting of five growth substances used at various concentrations; the effect upon rooting of treatment with potassium permanganate, sucrose, and a mixture of sucrose and hormodin N°2, used at various concentrations.

The environmental conditions used for rooting and the use of growth substances apparently favored greatly disease infestation so that it was necessary to study with a plant pathologist the best methods of control. Spraying the mother plants with Fermate resulted in satisfactory control of Colletotrichum coffeianum, which caused most of the damage.

Results from the experiment on the rooting ability of various nodes according to their position showed that one node cutting obtained from the 3 superior nodes had highly significant superior rooting ability as compared to cuttings from the 3 lower nodes. No roots were produced after three months from cuttings obtained from the sixth lower node.

Project No. 170- Some Aspects of Assexual Propagation of Coffea arabica by Budding and Grafting.

Donald Fiester is also leading this project. Fundamental to the use of budding and grafting as a means of propagation is

a better knowledge of the various techniques which may be used to this end and of compatibility between Coffea arabica L. var. typica and various rootstocks which might be tried.

Two thousand, four hundred and seventeen coffee plants of 7 different species and varieties have been put in pots and nursery beds to be used as stock to experiment various types of budding and grafting.

Pathological Studies

Frederick L. Wellman

Project No. 128 - Coffee Tree Production Study to Select Most Fruitful Mother Trees from Which Will be Developed High-Producing Varieties for Coffee Improvement in Costa Rica.

A simple 100-tree plot study has been in progress for a few years and has been carried on in a neighboring finca, La Dominica. It was started by Frederick L. Wellman, but is now under the direction of Pierre G. Sylvain and his assistants. The purpose of this plot is to select under an individual tree production basis, the highest-producing group. This will probably be composed of 10 to 15 trees. The seeds from this group will be used in a study of the methods of coffee improvement. It may well be that some of these will prove to be of high quality or other spectacular characteristics in which case, they will be used in a more careful genetic study.

Project No. 88 - Spraying for Control of Disease in Coffee Nurseries.

This project is being carried on by Miss Lucy Hastings and Donald Fiester. Preliminary studies were made with regard to spraying for control of serious leaf and branch die-back in the coffee nursery. Experiments have been run since May, 1950, with the fungicides Bordeaux and Fermate. Fermate has been shown of benefit. Further work includes similar comparisons with Fermate, Parzate, Zerlate, Copper A, Dithane, and Tri-basic Copper. After a few more months of work, it is believed results will be ready to be evaluated as to the next step. It is considered that nursery spraying will be of the most importance in certain special instances. In such cases, it would be those in which the nursery stocks were to be used in the selection program, for example, or for physiological studies or horticultural manipulation without the presence of disease. It still remains questionable whether spraying can be used in general nursery practice in coffee.

Project No. 117 - Studies on Field Control of Omphalia Leaf Spot of Coffee.

This project was started early in 1948. Data are in hand now and give the following results. Briefly, the best method of control was by defoliation. The most satisfactory time for defoliation will probably be found to occur shortly after the close of the dry season. Studies are being made on this point as will be indicated in the project discussed below. The defoliation method has been found to destroy the current year's crop, but the crop that is developed next year is so much increased as to more than pay for the loss. Data are presented in Table VI with regard to effects from defoliation treatment.

TABLE VI

Effects of Defoliation Treatment to Control the Omphalia Leaf spot of Coffee Under the Very Severe Conditions of Areas that Were Semi-Abandoned Because of the Disease in the Region of Turrialba, Costa Rica.

Area and treatment	Months after treatment	Tree Condition During Study: Start Vigor	Start Disease	End Vigor	End Disease	Comparative Increase (percentage) in production: Nodes	Fruits	Growth
1A None			Healthy	Good	Healthy	132	609	242
1B None			Diseased	Medium	Serious			
2A Treated (P)	12	Fair	Severe	Good	Healthy	30	297	
2B Treated	13	Fair	Severe	Good	Healthy	49	294	
2C None	13	Fair	Severe	Poor	Severe			
3A Treated (P)	12	Poor	Severe	Medium	Healthy	(-10)	285	150
3B None	12	Weak	Severe	Weak	Severe			
4A Treated	13	Weak	Severe	Good	Healthy	198	1131	269
4B None	13	Weak	Severe	Poor	Severe			
5A Treated	12	Medium	Serious	Good	Healthy	11	126	
5B None	12	Medium	Serious	Fair	Serious			
6A Treated (P)	18	Medium	Serious	Good	Healthy			
6B None	18	Medium	Serious	Fair	Severe			
7A Treated	30	Weak	Severe	Good	Healthy	46	403	136
7B None	30	Weak	Severe	Poor	Severe			

(P) Indicates pruning included with defoliation treatment.

Project No. 131 - Effects on Coffee Trees of Defoliating and Pruning to Control Omphalia Leaf Spot.

This project has consisted of pruning and defoliation in small replicated plots. These plots are contiguous, and because of experimental design, have been treated without regard to the presence of disease in trees in the next row. Unfortunately, because of the experimental condition, this study has not yielded perfectly satisfactory results due to reinfections in plots. Enough, however, has been learned so that it is clear that defoliation can be relied upon as a practical control method. This project was, after all, a beginning program using knowledge gained during the last three and one-half years. The project is to be redesigned.

Project No. - Determination of Method of Infection of Omphalia Flavida on Coffee by Histological and Cytological Studies.

This work is a cooperative study with Sr. Gonzales Narváez, special student. He has developed special techniques for killing and staining of coffee materials, and studies are in progress with regard to host-parasite relations in Omphalia coffee leaf spot. Mechanisms of epidermal penetration in tissues and the mesophyll have been determined. Relationships of the parasitizing of the fungus hyphae have been followed in all of the different leaf tissues. Work is far from being complete, but will be carried further to fruitful results within the next few months.

Project No. 91 - Life History Studies on Coffee Disease Fungi I - Omphalia Flavida Attacking Foliage and Fruit.

This study has been brought to a fair degree of completion with this year's work. The purpose has been to gain the practical knowledge necessary to help with the understanding of application of control measures. This project has been carried on with the help of Miss Lucy Hastings and student assistants. In connection with such work, the student assistants have been given a chance to study fundamentals of pathology.

Project No. 92 - Life History Studies on Coffee Diseases Fungi II - Pellicularia (Corticium) Koleroga Attacking Foliage and Fruits.

(In abeyance at present)

During this past year, further observations have been made with regard to the methods of attack of the organism. Observations have also been made indicating that excessive rains are distinctly deleterious with regard to progress of koleroga. This project will be started again in the coming year especially in connection with host-parasite relationships and environmental factors. With regard to control, some observations are in progress on spraying that may be futher enlarged.

Project No. 118 - Life History Studies on Coffee Disease Fungi III-Rosellinia sp. Causing the Root Rot and Collapse of Coffee Trees.

This project was started over two years ago, and while it has been carried on in a minor way during the past year, it has increased knowledge sufficiently so that it will be possible to base soil treatment studies upon sounder thinking with regard to field applications.

Project No. 151 - Life History Studies on Coffee Disease Fungi IV-Cercospora coffeicola. (With Rodolfo Quesada).

A thesis on the Cercospora leaf spot of coffee has been completed. A summary of important points is as follows:

1. A comprehensive literature review of the subject.

2. Mycological analyses of the organism including shape, size, size distribution, and attachment.

3. Spore germination found as good in light as in dark.

4. Temperature relations, optimum 30°C., but good at 25 and 35, inhibited at 40 and killed at 45 degrees.

5. Acidity and alkalinity relations, best at pH of 5, medium at 4 or 6 and 7, while 3 and 8 were poor.

6. Culture characteristics on several different media; sugars, starches, nitrogenous compounds (peptones) not good alone, required balance of nutrients.

7. Infection studies on light and tissue age effects; young (early flush stage) sun-exposed leaves were attacked without injuring epidermis, well-shaded leaves of any age appeared to have some resistant character, injured leaves on plants in sun produced 94 percent of infection, in shade 35; when sprayed with spore suspension on new flush leaves those in sun were all attacked, those in shade uninfected.

8. Fruit infection studies: six paired lots gathered from sun and shade exposed trees gave following percentages of Cercospora infection for shade trees, 6, 1, 1, 8, 0, 0; for sun trees, 18, 28, 41, 19, 27, 19.

In addition, further studies have progressed in connection with environmental relations regarding the limiting factors for disease production.

Project No. 150 - Consultative Visits to Various Areas and Countries to Assist in Determining Causes of Crop Losses Due to Disease.

These visits are largely the result of request of the Office of Foreign Agricultural Relations in Washington, D. C. During the past year, considerable time has, as usual, been used in consultative and assistance activities with the Costa Rican National Department of Agriculture. More than the usual amount of time has been spent in the Meseta Central of the country. Work was also done in consultative capacity in Peru and Florida, U. S. A. attendance at the meeting of the first gathering of the Plant Parasitologists in Mexico added considerably to inter-area relations.

Entomological Studies

Emilio Viale

This work was begun in March, 1950. The program of entomological studies in coffee involves the following:

Coffee Pests

A. Studies on the biology and control of the Coffee Root Mealybugs and their possible relationship to diseases.

Severe damages were observed in coffee plantations of the central Costa Rica plateau. Several other coffee producing countries have reported serious damages. The main objectives are:

1. To study the economic importance of the pest, its taxonomy, life cycle, distribution, and its possible relation to some diseases.

2. To study means for its economic control.

The experimental biological studies are in progress involving two series of experiments with three groups each. Mealybugs from "healthy" and "diseased" plants with and without their attendant ants are included. Chemical analysis of roots and foliage from infested and uninfested coffee plants have been conducted. They covered total nitrogen, total and reducing sugars, and total ash contents. Results of preliminary experiments indicate that chemical differences may exist between infested and noninfested roots.

The economic control studies are being conducted in a heavily infested area. Three highly effective and residual ant killer insecticides with two and three different ways of application are under experimental study:

1. Aldrin (compound 118)

   a. Group treated by careful removal of soil at base of coffee plant, down to primary roots. The insecticide was applied to the soil being shoveled back to its original place.

   b. Same as "a" plus hilling the plant with treated soil, (to promote development of coffee roots at a higher level into treated soil).

2. Dieldrin (compound 497)

   a. Same procedure as "1-a".

   b. Same procedure as "1-b".

   c. Pouring insecticidal suspension around the base of plant. No soil removed.

3. Chlordane

   a. Same procedure as "2-a".

   b. Same procedure as "2-b".

   c. Same procedure as "2-c".

Each treatment includes four coffee trees; two treated and two checks. Three replications in three different localities are considered. The first two observations, covering the first 30 and 60 days after the treatment, have shown no significant differences for the Aldrin and Chlordane treatments, but significant differences have been observed for the Dieldrin in so far as groups "a" and "b" are concerned. Further observations are to be made. A special sampling and infestation grading technique is being followed for these observations. A field experiment to study resistance to root mealybugs by different species and varieties of coffee has been lined up in the same area.

Taxonomical and distributional aspects have been carried out simultaneously. The two most frequently found species of mealybugs in the highly damaged areas of Costa Rica are Neorhizoecus coffeae (Laing) and Geococcus coffeae Green.

B. Studies of the coffee bean borer Hypothenemus hampei (Ferr.) with special emphasis on surveying its later progress and the possible invasion of uninfested coffee regions in the Americas.

The first step on this important project has been to prepare a list of bibliographical references on the subject, and to contact Brazilian and Colombian technicians working on the pest.

C. Comprehensive study of useful and injurious insects to coffee.

This includes studies for general measures of control for the most economically important pests. In this respect emphasis has been placed upon:

1. Testing of new insecticides.

2. Methods of application adapted to the peculiar conditions of coffee plantations.

3. Study of economical adherents to prolong the residual effect of the insecticide under tropical conditions.

Compilations and revisions of the bibliographical material and its distribution to other centers of research constitute an important part of this program. Permanent contact with other coffee research centers is being attempted with the following objectives:

1. Coordination of research projects.

2. Interchange of entomological material.

3. Construction of practical keys for pest identification, with general indications about control.

4. Orientation of quarantine and educational propaganda.

GENERAL PLANT PATHOLOGY

Frederick L. Wellman

Project No. 186 - A Seedbed Colletotrichum Anthracnose of Cacao.

The work on this project has been carried on by a United States student from Florida, Mr. Arthur B. Leibovit. He has made important contributions to the anthracnose problem in general, as well as specifically to cacao research. In cooperative studies with Sr. Gonzales Narváez, a special student from Nicaragua, methods of penetration of the organism and its attack on the internal tissues have been determined. All these studies have been designed to assist in the final development of control measures for the disease.

Results of these studies may be in part listed briefly as follows:

1. A thorough literature review was accomplished.

2. Germination of spores of the fungus was found to be extremely variable for causes still unknown.

3. Spores placed on upper surfaces of mature leaves show little or no germination and no entrance.

4. Spores on lower surfaces of mature leaves germinate sparingly and cause no infections.

5. Spores on upper surface of tender new flush leaves germinate readily and penetrate by infection peg that comes from appressorium developing from germ tubes of spores.

6. Spores on under surfaces of tender leaves are capable of infecting through stomata and as well by direct infection by means of appressorium development and its infecting peg.

7. Infection of tissues may be of a latent nature that is dependent on physiological conditions.

8. Dissemination studies have shown that the organism is largely water-carried.

9. Sources of inoculum in the seed bed are, surrounding cacao trees, the fruits from which the seeds come, and soil debris.

10. Details of study on symptoms showed the close correlation between modes of dissemination and infection and its occurrence in the seed bed.

11. Control measures to be successful will have to include seed treatment as a primary consideration.

12. The cacao strain of Colletotrichum is capable of attacking coffee, and probably some other hosts. These results are being prepared in the form of a thesis and will be used for other publication as well.

Killing of Abacá Plants with Herbicides.

This project was carried on with the Philippine student, Romero Martínez. On request from Washington, D. C., herbicidal applications were studied for eradicating abacá plants. This is for use in the Philippines and other Oriental countries to assist in control of virus diseases of abacá. A heart injection method was devised which appeared satisfactory in application of the herbicides to the abacá plant. A total of 45 different treatments were studied. Briefly, the most successful kill was from a heart injection consisting of a 2,4-D ammonium salt (1 gm. /200 cc. water) in which it was necessary to use only 50 cc. of the solution infected into the base of the plant. The herbicide was transferred through corm tissue connections from the treated plant to the mother plant from which it arose originally, and killed not only these, but the young half-grown follower of shoot

from the treated corm. It also killed the very young shoot or peeper that came from the corm of the follower. This work is being continued.

Incidently, it is to be noted that Mr. Martínez prepared an inclusive report on abacá production in both hemispheres. His work while here at the Institute was carried on as a United Nations scholar.

Plant Disease Collections.

Plant disease specimens are being gathered together for identification of causation. These come largely at present, from the local area, Turrialba, but extend to other regions and even other countries. Sets of these preserved specimens are being sent to Mr. John A. Stevenson, Head Mycologist, United States Department of Agriculture. His work in connection with Latin American mycology is being drawn upon. From this cooperative effort, it is expected that eventually there will develop at least a host list that will be of importance to the Turrialba region. It is hoped that it will be for wider usability when finally completed.

Coffee Group Meeting

During most of the year, a group has met at two-week intervals to study coffee program problems. Studies are considered from all parts of the coffee-growing world. These are related to our own problems. It has been attempted to keep this out of the type of presentation that might be labeled "seminar." In all cases, discussions have been very informal. Membership of the group has been a little less than twenty most of the time. Reports and discussions have been heard from workers in many countries such as Brazil, Haiti, Costa Rica, the United States, Colombia, the Philippines, Puerto Rico, Peru and Chile.

A new laboratory space has been prepared, and plant pathological work has been moved into its new location. Present plans indicate that eight or nine people will work in the new laboratory.

Seed-Borne Diseases

Lucy Hastings

This work was begun in September, 1947. Lists have been accumulated of fungous and bacterial organisms found on such seeds as beans, cabbage, cacao, coffee, corn, cowpeas, kenaf, onions, peanuts, pepper, rice, sorghums, tomatoes, watermelon, and those organisms of importance as seed and seedling pathogens have been given further investigation.

Project No. 96 - Seed Treatment Studies of Major Crops Grown in the Region of Turrialba.

This work was begun in 1947. Results conclusively showed seed treatment to be very generally valuable in increased plant stand and protection. A complete reporting of these investigations has been made, and work of the year 1950 in this connection has been almost exclusively on rice.

A brief summary on this project is as follows:

Beans: A progress report for this project was submitted in March, 1948 at which time 37 genera of fungi were listed on beans with 14 genera of fungi and a bacterium as seed-borne. Seed treatment was shown of benefit when seeds underwent any storage period before planting. Arasan was the best of the seed disinfectants used. Some additional work was later done on cowpeas showing, as did the bean tests, that when this seed was well cleaned and dried and planted immediately, very little advantage was seen in seed treatment under our conditions, but that under any storage period there was a real advantage which became progressively greater with lengthening of the storage interval. No further work was done except in helping to plan work for a student in bean seed treatments in the early part of 1949.

Corn: This project was reported in March, 1948. A later field test was reported in July, 1949. Of the chemicals used as seed treatments, Arasan was the best, giving a 16.9% increase in stand over the untreated controls.

Sorghum: This project was reported in June, 1948. A field test was reported in July, 1949, in which Arasan, the best treatment, gave a 72% increase in stand. Both in plant stand and in growth measurements this treatment was shown to be of real value in laboratory, greenhouse, and field testing.

Peanuts: This project was reported in March, 1948 and July, 1949. Seed treatment increased stand from 17 to 33% and yield 21 to 45%.

Tomatoes: A seedling disease problem was observed in tomatoes in the vegetable garden in January, 1948, caused by the fungus, Rizoctonia. A seed treatment test was carried out in the greenhouse with the Rutgers variety, the variety in the garden where the problem appeared. Arasan dust treatment allowed a 50% increase in stand.

Project No. 173-Seed Storage Problems in Relation to Disease

This work was begun in 1948 with special emphasis on corn seed viability, which has recently been reported briefly in the

Turrialba Journal. Current work is on rice in a study on the rate of decrease in germination and factors involved. This work covers periodic laboratory germination and seed-borne pathogen analysis for 4 varieties at 4 moisture levels of seed storage, and with 5 seed treatments. This test was begun in November, 1950.

Project No. Manual of Methods in Evaluating Losses and Studying Control Methods for Seed-Borne Plant Diseases

This writing has been under way and is progressing slowly, largely outside of office hours, with helpful criticisms and suggestions for the various drafts from Dr. Wellman and others.

Rice Diseases

Project No. 174-Rice Diseases in the American Tropics

This work was begun in 1948. The first work was largely with seedling losses due to seed-borne disease organisms. A list of some 28 organisms of interest as parasitic to varying degree has been accumulated from seed studies. Investigations stimulated a wider collection and study of rice diseases and a careful study of all available rice disease literature. To date the general list includes about 60 organisms, most of which are associated with rice disease symptoms. Most important of these, from disease surveys and from various types of infection tests are: Helminthosporium oryzae Van Breda de Haan, Pellicularia oryzae Br. & Cav., Curvularia spp., Sclerotium oryzae Cat., Fusarium spp., Cladosporium spp. Comparatively low rice yields in Central America, and in Costa Rica especially, have been found very closely associated with high incidence of Helminthosporium and Pellicularia.

Project No. 175 - Helminthosporium oryzae Studies

A large number of isolates of Helminthosporium oryzae have been collected. Nineteen of these, compared in infection tests for possible differences in pathogenicity, have shown some variation. Spread and development of the stages of the disease later in the life of the plant have been under investigation, and a weed problem has been found at least in a part of the Guanacaste region of Costa Rica to be involved in spread of the disease, since two common grass weeds are carriers of the Helminthosporium. Investigations of possible methods of control other than seed treatment and cultural practices to reduce susceptibility are under investigation.

Project No. 175-A - Helminthosporium oryzae Studies: Varietal Testing

Begun in August, 1950, this work has covered greenhouse inoculations of spore suspensions from mixed isolates of

Helminthosporium. Varietal response has been evaluated in several ways in order to work out practical and reliable methods of differentiation for later more extensive testing.

1. The first method, which might be called a measure of severity and response was to obtain the percent of a hundred plants selected at random among each variety which had leaves so badly infected as to have been killed for a distance of 5 cm. or more from the leaf tips.

2. The second method of evaluation was a grading of the leaf infections for severity as commonly used in cereal rust studies.

3. A comparison was made of the length of infected lesions.

4. A further method of evaluation of response to the disease was that of green plant weight.

The several methods used in preliminary evaluations of differences in response of 12 varieties to seedling inoculations of Helminthosporium oryzae were in agreement in pointing to Berlin as a variety with some degree of resistance to at least the early phases of the disease. If investigations show that results from these rapid and relatively easy greenhouse evaluations are valid for the general life of the rice plant, which appears true from disease surveys in the fields, then this can be a very excellent means of large-scale varietal comparisons of resistance and susceptibility.

Project No. 176 - Seed Treatment Studies in Rice

Rice seed of a number of the most commonly grown varieties in Costa Rica was studied to determine the presence and importance of Helminthosporium oryzae and other possible limiting seed-borne organisms. Laboratory tests showed high percentages of this fungus carried internally as well as on the surface of the seeds and glumes of all varieties tested. In germination tests, greenhouse tests, and tests using seed under various storage conditions it was found that at least the seedling phase of this disease could be consistantly controlled by treatment with the disinfectant Granosan (ethyl mercury phosphate) while other treatments failed. A first field test with El Salvador and Costa Rica sources of Fortuna variety seed showed a highly significant increase in stand for Granosan-treated seed. Two other field tests concluded in December, 1950 in the Turrialba region and in the larger rice region of western Costa Rica showed highly significant increases in stand for Granosan, Granosan M. Arasan, Spergon, and Phygon. The best treatments were the mercurials.

These experiments were of 60 X 64 M, 6 varieties, 16 treatments; split-plot design. Yield data showed significant increases for seed treatment in the test in western Costa Rica, were inconclusive in the Turrialba test. Averages for the 6

varieties of the former test showed 19 percent increase in yield for best treatment over untreated, while the latter gave 6 percent increase. There was high incidence of Helminthosporium leaf and head blight for both regions and also Piricularia for the Turrialba region, indicating that seed treatment is of only partial benefit in the complete story of the disease loss.

Project No.177 - Pellicularia oryzae Studies

Diseased specimens have been collected, symptoms studied, surveys made which showed it to be a very serious disease and found this year chiefly in the Magnolia variety in the Turrialba region. Several isolations have been made, and infection tests have proven the pathogenicity of these. A number of single spore isolations have also been made. Conditions necessary for spore production and germination have been determined and these follow closely reports of other investigators. Seedling inoculations under optimum disease conditions and evaluation of susceptibility of commonly used varieties in the American tropics have been begun.

GENERAL ENTOMOLOGICAL STUDIES

Emilio Viale

Corn Pests

Study of the Life Cycle and Control of the Corn Root Insects

The corn plant in the tropics is infested and severely damaged by various root insect pests. The yield of each corn crop is reduced, and rapid succession of crops often in impossible because of the seasonal outbreaks of root insects in the soil. Studies are under way on its: (1) economic importance, (2) taxonomy, (3) life history, (4) distribution, and (5) economical control methods of reducing root insect damage that will increase corn yields per crop and restore the possibility of two crops a year in some tropical regions.

Corn Root Bug (Cyrtomenus sp.)

Important aspects of the life cycle, ways of distribution, and habits of this new corn pest have been studied since April, 1950, under field and greenhouse conditions. While these biological studies were in progress, some of the new organic insecticides were tested at different concentrations and formulations. Under laboratory tests, Parathion showed higher effectivity than Aldrin (compound 118), Dieldrin (compound 497), and Chlordane in the given order. Field tests, however, conducted

in cooperation with the corn breeding technicians, in three different series of control experiments, placed Aldrin at the top with a very high degree of control. Parathion, on the other hand, gave an extremely low field control of this pest. One single application of Aldrin, at the rate of one and one-half to two pounds of actual insecticide per hectare, applied either on the planted row at the pre-emergence stage or around the base of the young plant when 15 to 20 days old, gave excellent results.

Control of Corn Root Chrysomelids

The corn rootworms (Diabrotica spp. Chrysomelidae) are considered among the most serious enemies of corn in the Americas. Work being conducted on these "worms" and other root insect pests has led to a chemical control method that seems to be very effective and practical.

Results from comparative studies of four synthetic organic insecticides using various formulations, types, and time of application, have shown, up to the present, that the insecticide Aldrin (compound 118) has given the best practical control for the corn rootworms. In connection with these control studies, counts were made of the mortality of chrysomelid larvae as well as of the attendant ants of the corn root aphids, the corn root bug, and some other soil insect pests. Diabrotica larvae reached a mortality of 92 percent. A count of lodged hills made in plots of two-month-old corn plants in 10 untreated plots showed 60 percent lodged hills. There was a minimum of 33 per cent and a maximum of 80 per cent for these 10 untreated plots in comparison with none lodged in 10 treated plots.

The concentration found economically effective, using Aldrin wetable powder, was 0.15 per cent at the rate of one and one-half pounds of actual insecticide per 10,000 hills of corn. It can be applied in spray form directly to the soil surface at the base of young corn plants when they are 15 to 20 days old. It may also be used on the corn row immediately following planting. In the work reported here, single applications were made.

Studies on corn root pests, including their economic control, are still in progress.

Sweet Potato Weevil

In September, 1950, a project was started to investigate the extremely serious problem of the sweet potato weevil. The high percentage of tubers destroyed by this curculio discouraged many growers from continuing to expend time and money in obtaining a crop that insects make unmarketable.

A thirty-plot experiment covering an area of 900 square meters is being used for comparative studies of four synthetic organic insecticides with different times of application. This project is carried out with the cooperation of the Horticulture Section and involves the following insecticides: Lindane (ninety-nine per cent Gamma Isomer Benzene Hexachloride), Chlordane, Dieldrin (compound 497), and Aldrin (compound 118). Observations are made at 90 days and at harvesting time. A bioassay will be conducted to investigate the possibility of insecticide fixation by the sweet potato tubers at harvesting time.

Control of the Bean Chrysomelids

For many years, farmers and plant breeders dealing with beans have suffered heavy losses in yield and genetic material as a consequence of foliage and root damage by chrysomelid beetles. Up to now, insecticides had shown but little efficiency to solve this problem. A new attempt has been started to test some of the newest insecticides in cooperation with the Horticulture Section.

Seven blocks with an area not less than 120 square meters each and well distributed over the horticulture garden were used. Each block had a minimum of two and a maximum of three well separated plots of ten 5-meter-long rows each. The bean variety under this experiment was "Portugues". Three and four replications were considered. Insecticides used were: Isotox, Chlordane, and Aldrin on foliage applied at ten-day intervals up to the time fruits were formed, (3 applications in total). Dieldrin was also used on soil at the base of the young plants in a single application. Counts were made on a number of chrysomelids present, and foliage damages, and green bean yields were recorded. A late infection by a leaf blight fungus prevented following the experiment any further. As far as the insect present and foliage damages are concerned, the order of insecticides efficiency was as follows: (1) Isotox, (2) Aldrin, (3) Chlordane, (4) Dieldrin, and (5) Check. However, the average yield per plot did not correspond to such an order. In this particular experiment, they were Aldrin with 10 pounds as the highest, and the Check with 7.6 pounds, as the lowest. The second in yield was Dieldrin with 9.46 pounds. Other series of tests in this project are still in progress.

Pest Control and New Insecticide Trials

This project was set to provide up-to-date information particularly on the newest synthetic organic insecticides and their applicability to the control of the more important tropical insect pests. Tropical agriculture, cattle and household pests have been included. Insecticides such as Aldrin, Chlordane, DDT, DDD, Dieldrin, Benzene Hexachloride in its different forms, Methoxychlor, Toxaphene HETP, Parathion, and E 605 have been tested. A 24-page mimeographed handbook with practical information on these insecticidal compounds was issued in July, 1950. Particular emphasis was placed on precautions to be taken when using and handling them.

Different types of apparatus, from the hand duster and sprayer to the mist sprayer and fogging types of machines, are in use in insecticide experiments at this Institute.

INTER-AMERICAN CACAO CENTER

J. Harvey McLaughlin 1/

Introduction

From January 1 to June 30 of 1950, the emphasis of the Cacao Center program was on the training of students. We had developed a comprehensive study program to prepare students for cacao research work. The study program was designed as a practicum for cacao culture and investigation and consisted of a number of field exercises and field trips which the students were to complete within a period of 4 to 6 months. The exercises were designed to cover the subject matter on a broad basis and each posed a specific problem to challenge the student's interest. This comprehensive study outline proved to be very satisfactory in scope and was favorably received by the students.

Beginning on July 1, we were directed to revise our program with major emphasis to be placed on research conducted by staff members. The training of the students in attendance was to be completed as rapidly as possible. Student fellowships supported by American Cocoa Research Institute funds were to be discontinued. Future trainees in the Cacao Center were to be men sent here by their employers, and at their expense, to learn the more practical aspects of cacao growing, rehabilitation, propagation, and disease control. These men are to assist staff members in their research programs. No formal course work will be required, and no degrees or diplomas will be offered.

A number of new research projects have been initiated; the number and scope of research projects will be increased as the staff increases or as the lines of investigation necessary become clarified. Our staff will be increased early in 1951 by the arrival of Dr. Paulo T. Alvim of Brazil as plant physiologist, and by the appointment of Luis Siller as assistant in plant pathology. We hope to add an assistant in horticulture in the near future.

The lines of investigation considered most urgent and toward which we are directing our research are:

1. Methods for increasing yield of old plantations, by cultural practices, disease control, rehabilitation by top-working, etc.

2. Selection and testing of high-yielding vigorous clones for new plantings.

3. Cultural methods of disease control with special emphasis on Phytophthora palmivora Butl.

1/ This report was prepared by Dr. McLaughlin, as Mr. George F. Bowman, Head of the Center, was absent from Turrialba making a survey of the possibilities of producing cacao commercially in the Trust Territory of the Pacific Islands at the re-

4. Selection, testing, and application of fungicides to reduce costs of direct control of disease.

5. Selection of disease-resistant clones and study of the nature of resistance.

6. Simplification of propagation methods and more economical planting of new farms.

7. Development and adaptation of equipment for propagation, planting, disease control, harvesting, transportation, breaking, fermentation, and drying.

In addition to our revised training and research program, we will continue our efforts to disseminate the information gained, to advise and encourage cacao growers in every way possible, and to promote the establishment of demonstration farms wherever possible.

Although our program in the Cacao Center has undergone marked changes, the primary objective remains the same: to learn how to produce more and better cacao so much more effectively that users of these improved methods can produce cacao beans at a lower price than those producers who exploit natural and human resources, and to demonstrate these methods so effectively that, not only will they be adopted quickly by the best of the present producers, but new capital will be attracted to the cacao industry.

We believe that we are advancing in the fulfillment of this objective. This annual report presents some of the reasons for our belief.

Training

The following is a summary of the training activities of the Cacao Center for the calendar year 1950 indicating the names of the students, their home countries, period of time as students, fields of study, titles of theses presented, the salient results of theses, and degrees and/or titles received.

Bartolomé, Rafael. Philippine Islands. October 1949 - October 1950. Physiology of cacao. Thesis: "A study on the effect of fertilizer application on the incidence of cherelle wilt on cacao." No measurable effects of fertilizer applications to cacao in relation to incidence of cherelle wilt were observed. Advanced the hypothesis, based on exploratory experiments, that cherelle wilt in La Lola farm was mainly due to leaf hoppers and fungus infections. Degree and title: Magistri Agriculturae and Especialista en Cacao.

Calderón M., Zenaido. Mexico. October 1949-October 1950. Propagation of cacao. Thesis: "Comparación de dos tipos de injerto en cacao." Best results were obtained using 'Inverted U' method of budding wrapped with rubber bands. Recommended that budding not be done in the late afternoon or during a rain. Title: Especialista en Cacao.

Castro, Homero. Ecuador. October 1950- . General cacao production. Six months' student.

Dadaille, Bertin. Haiti. January 1949-August 1950. Propagation of cacao. Thesis: "Post budding treatment of cacao seedlings." The 'Inverted U' method of budding was satisfactory on seedlings as well as on chupons. Cutting back the stock 14 days after budding or half cutting and bending the stock immediately after budding were preferable to cutting back the stock immediately after budding. Budding was satisfactory on seedling stocks varying from 1.0 to 3.5 cm. in diameter. Degree and title: Magistri Agriculturae and Especialista en Cacao.

Da Rocha Barbosa Manoel. Brasil. April 1950-June 1950. General cacao production. Three months' student.

García R., Francisco. Colombia. September 1949-September 1950. Selection of cacao. Thesis: "Estudio de relaciones entre características estimables y producción en árboles de cacao." Correlated height of tree, height of trunk, diameter of crown, diameter of trunk, vigor of main branches, number of basal chupons, number of trunk chupons, size of flower cushion, number of flowers per cushion, number of cushions per foot of trunk, and thickness of the bark of the trunk with both high production and low production. Production definitely correlated with vigor but no one character studied was definitive for selection. Title: Especialista en Cacao.

Gavinet, Andrés. Nicaragua. April 1950-October 1950. General cacao production. Six months' student.

Gilbert, Abel. Ecuador. August 1950- . General cacao production. Six months' student.

González R., Arturo. Mexico. January 1950-December 1950. Pathology of cacao. Thesis: "Efecto de algunos hongos sobre el marchitamiento de los frutos jóvenes de cacao." Inoculated pedicels of cherelles with isolates of Phytophthora, Diplodia, Colletotrichum, Fusarium, Pellicularia, and Pythium. Only Phytophthora palmivora Butl. caused losses greater than those experienced in non-inoculated cherelles. Title: Especialista en Cacao.

Guerra, Oswaldo. Ecuador. March 1950- . Propagation of cacao. One year student.

Leibovit, Arthur. United States. September 1949-September 1950. General cacao production. One year student.

Leroy, Hiram. Haiti. January 1950-March 1950. Resigned because of poor health.

López R., Gustavo. Ecuador. August 1949-October 1950. Pruning of cacao. Thesis: "Comportamiento de los brotes en el árbol de cacao después de la poda." Branches of trees pruned to 3, 6, and 10 cm. in diameter. Branches pruned to 3 cm. in diameter produced mostly fan wood flushes, whereas those pruned to 6 and 10 cm. produced mostly chupon wood flushes. Flushes on branches pruned to 3 cm. developed more rapidly than the others for 6 months but were less well developed at 11 to 13 months. Title: Especialista en Cacao.

Matutue, José. Honduras. October 1950- . General cacao production. Six months' student.

Mejía L., Enrique. Colombia. September 1949-October 1950. Fermentation of cacao. Thesis: "El efecto de las revolturas sobre la variación de la temperatura y del pH durante la fermentación del cacao." Cacao beans were fermented in double-wall boxes. One treatment consisted of turning or mixing the beans thoroughly (1) every 6 hours, (2) every 12 hours, (3) every 24 hours, and (4) the check with no mixing. The treatments were ranked 2, 1, 3, and 4 for quality in the final product. The highest temperatures were measured in treatment 1; the lowest in treatment 3. No significant differences were obtained in relation to pH of the pulp in the different treatments. Title: Especialista en Cacao.

Murga, Lionel. Guatemala. January 1949-January 1950. Pruning of cacao. Thesis: "La reacción del árbol de cacao a la poda." Pruning trees resulted in the production of new flushes of leaves irrespective of the normal time of flushing, and the pruned trees flushed again when there was a general flushing of non-pruned trees. Branches pruned to 2.5 cm. produced mostly fan wood flushes; those pruned to 5.0 or 10.0 cm. produced mostly chupon wood flushes. New growth on the branches pruned to 2.5 cm. was dispersed along the branches; on the 5.0 and 10.0 cm. prunings, the new growths tended to develop near the cut ends. Title: Especialista en Cacao.

Oechsli, L. Paul. United States. October 1948-February 1950. General cacao production.

Pachecho C., Rosendo. Ecuador. October 1949-October 1950. Propagation of cacao. Thesis: "Tratamientos posteriores al injerto de cacao en chupones basales." Chupon stocks were: (1) cut off immediately after budding at (a) 5 cm., (b) 10 cm., and (c) 15 cm. above the bud; and (2) cut off 14 days after budding at (a) 5 cm., (b) 10 cm., and (c) 15 cm. above the bud. The percentage of bud 'takes' and subsequent growth of the shoots for a period of 168 days were approximately equal for all of the treatments. Title: Especialista en cacao.

Siller F., Luis R. México. February 1949- . Pathology of cacao. Student assistant during 1950. Will complete studies in February 1951.

Smit, Anton G. Surinam. January 1949-March 1950. Pollination of cacao. Thesis: "The pollination of cacao in Costa Rica." Cacao pollen is viable up to 48 hours after dehiscence of the anthers. Ants and aphids probably do not play an important part as pollinators in Costa Rica; wind and water likewise were considered unimportant. Both thrips and a flying insect play an important role in the pollination of cacao in Costa Rica. Degree and title: Magistri Agriculturae and Especialista en Cacao.

Spinola, Fernando. Brazil. April 1950-October 1950. General cacao production. Six months' student.

Torres S., David. México. January 1950-December 1950. Entomology of cacao. Thesis: "Investigación de los efectos de un insecto sobre el marchitamiento de los frutos jóvenes del cacao, y estudio del ciclo biológico del mismo." An insect of the family, Membracidae, was shown to be one of the causes of the wilting of cherelles. Both adult and nymphal stages of the insects caused wilting; the losses caused by the adult were slightly greater (not significantly so) than the losses by the nymphs. Small pods surviving the insect attacks grew more slowly than non-attacked pods. Title: Especialista en Cacao.

Vásquez M., José. México. February 1949-July 1950. Propagation of cacao. Thesis: "La producción de chupones basales on Theobroma cacao L." The treatments employed to force the production of basal chupons and the percentage success for each were: (1) trees cut off 30 cm. above the soil - 80%; (2) trees cut off 90 cm. above the soil - 100%; (3) trees partially cut and bent over - 75%; (4) trees ringed 30 cm. above the soil - 45%; (5) trees half-ringed - 70%; and (6) trees pushed or pulled over onto the soil - 70%. The chupons produced on the trees pushed over onto the soil were more vigorous than the chupons of the other treatments. There were no statistically significant differences between the 5 treatments producing 70% or more chupons. Degree and title: Magistri Agriculturae and Especialista en Cacao.

Velásquez, Rosendo. Guatemala. January 1949-January 1950. Propagation of cacao. Thesis: "Influencia del tiempo de decapitación en el injerto de chupones con yema." The treatments were: (1) cutting off the chupon 10 cm. above the budding point one week before budding; (2) cutting off the chupon 10 cm. above the bud at the time of budding; and (3) cutting off the chupon 10 cm. above the bud one week after the budding. Cutting off the chupon at the time of budding gave the best results. Budding was most successful on chupons varying from 1.5 to 3.5 cm. in diameter in the budded region. Title: Especialista en Cacao.

Vivero, José E. Ecuador. January 1949-March 1950. Pathology of cacao. Thesis: "Estudio sobre la marchitez y caída de las hojas en almacigales de cacao". Seedling plants in nursery beds were losing all of the leaves from the growing tips, thus presenting an elongated central stem devoid of leaves. The results of experiments indicated that the abnormality was produced by a fungus or fungi, probably Phytophthora palmivora Butl., and could be controlled by the application of 5-5-50 Bordeaux mixture at 7 or 14 day intervals. Title: Especialista en Cacao.

Research Projects

Project No. 125-11-A. Selection of Cacao Trees for Clonal Multiplication. Geo. F. Bowman and J. Harvey McLaughlin.

Individual records of production and pod susceptibility to Phytophthora palmivora Butl. are being obtained from 1082 trees in the rehabilitation experiment and from 1571 trees in the fungicide comparison plots. Such data have been obtained for 18 months in the first case and for 4 months in the latter. Ninety of the highest-yielding trees in the rehabilitation experiment have been observed closely, and 12 of these have been given clonal selection numbers. A statistical study of the pod yields for the 1082 trees indicated a mean-yield per tree of 30.12± .68 pods, a standard deviation of 22.37± .48, and a coefficient of variation of 74.26± .2.31%. This cv. is high and reflects the extreme variation observed from tree to tree in La Lola. The range in production per tree varied from 0 to 176 pods. A curve plotted with the data showed a skewness of 0.7.

Project No. 125-11-A-2. Clonal Comparisons. Geo. F. Bowman and J. Harvey McLaughlin.

Approximately 4 hectares of former pasture land in La Lola have been planted with bananas at 4.25 x 4.25 meters spacing. The bananas were set back in growth first by drought, then by excessive water. They are now growing fairly well; the area should be ready for planting the clonal selections in April or May.

Project No. 125-III-B-1. Trials of Budding Methods in Cacao. Geo. F. Bowman and J. Harvey McLaughlin.

Much of the work under this project has been done under student sub-projects (see sec. II under student theses). The most satisfactory method of budding cacao at present is the 'inverted U'; it is equally satisfactory on chupons and seedlings. Chupons should be decapitated immediately after budding, whereas, seedlings should be cut off 14 days after budding. Wrapping the buds with rubber bands has been as satisfactory as wrapping with strips of muslin dipped in a 1:1 mixture of paraffin and beeswax.

Project No. 125-III-C. Propagation of Cacao by Softwood Cuttings. Geo. F. Bowman and J. Harvey McLaughlin.

This is a line project and is reported through sub-projects.

Project No. 125-III-C-1. Turrialba Continuous Spray Propagator for cacao Cuttings. Geo. F. Bowman and J. Harvey McLaughlin.

Preliminary experiments have been conducted and complete plans drawn up for the Turrialba continuous spray propagator. Construction has been delayed because of difficulties in obtaining materials.

Project No. 125-V-D-1b. Rehabilitation of Cacao by Budding of Basal Chupons: Field Demonstration. Geo F. Bowman and J. Harvey McLaughlin.

Section 5 of La Lola farm covering 1.58 ha. of 34-year-old cacao trees in poor condition has been mapped for tree location and has had 3 applications of 4-4-50 Bordeaux mixture applied at approximately 30-day intervals to bring Phytophthora palmivora Butl. under control. The trees have not yet been pushed or pulled over because of demands for the use of the tractor for other work on the farm.

Project No. 125-VII. Studies in Pathology of Cacao. J. Harvey McLaughlin and Geo. F. Bowman.

This is a line project and is reported through sub-projects.

Project No. 125-VII-A. Life History and Control Studies of "Phytophthora palmivora" Butl. J. Harvey McLaughlin, Geo F. Bowman, and Luis Siller.

This is a line project and is reported through sub-projects. (See also in section on Training under student research).

Project No. 125-VII-A-1(1). Etiological Studies of "Phytophthora palmivora" Butl. J. Harvey McLaughlin and Geo. F. Bowman.

It has been demonstrated that, in addition to the well known pod rot and chupon blight of cacao, P. palmivora causes: (1) premature ripening of pods through cushion infection, (2) both a leaf and tip blighting including the abscission of mature leaves through petiole infection, (3) a wilting of cherelles through pedicel infection, and (4) a seedling blight. A paper has been prepared on the symptomatology of the Phytophthora disease complex. Experiments are under way to determine the length of time that diseased pods serve as a source of inoculum for infecting other pods.

Project No. 125-VII-A-2(1). Studies of the Inter-relationships Existing between Precipitation, Temperature, and the Incidence of Phytophthora Infection. J. Harvey McLaughlin, Geo. F. Bowman, and Luis Siller.

Regression analyses of rainfall data and the incidence of pod infection by P. palmivora has indicated that there is little relationship between the total rainfall for a period of 2 or 3 weeks preceding harvest and the incidence of infection or between the number of rainy days for a period of 2 or 3 weeks preceding harvest and disease incidence. However, the analyses applied to the number of days with 0.25 inch or more rain per day for a period of either 2 or 3 weeks preceding harvest indicated highly significant relationships with incidence of infection; date 4 weeks preceding harvest were not significant. Studies of temperature data (number of days with the difference between the maximum and minimum temperatures below the mean annual difference between the mean maximum and mean minimum temperatures) indicated similar relationships but were not so well marked. Thus the incidence of Phytophthora infection of pods may be predicted as much as 3 weeks in advance; however, more accurate environmental data are necessary in order to increase the accuracy of prediction. Equipment is on order to fulfill this need.

Project No. 125-VII-A-3b(1). Evaluation of Fungicides as Protectants against "Phytophthora palmivora" Butl. on Cacao. Luis Siller, and J. Harvey McLaughlin.

Tribasic copper sulfate, Bioquin 1, Crag 658, Crag 341-C, Crag 531, SR 406, Puratized Agricultural Spray, Dithane, Phygon, Karbam black, Zerlate, Yellow Cuprocide, Fermate, and Copper A have been compared with 5-5-50 Bordeaux mixture for efficacy in the control of P. palmivora on cacao seedlings. None of these fungicides has demonstrated equivalent or superior control to the Bordeaux mixture. Some of the fungicides have given satisfactory control for 7 to 10 days but failed thereafter. Efforts are now being directed to the study of "stickers" with these

fungicides. A paper covering some of the work of this project was prepared and presented to the meeting of plant parasitologists in Mexico.

Project No. 125-VII-A-3b(2). Field Control of "Phytophthora palmivora" Butl. with Fungicides. J. Harvey McLaughlin and Geo. F. Bowman.

The experimental design was laid down in the field and the first applications of fungicides applied during the first week of September, 1950. The plots have been sprayed on a 30-day cycle since that time. Yield data and diseased pod data are obtained every 14 days. The treatments included in the experiment at this time are: (1) non-treated checks, (2) 4-4-50 Bordeaux mixture, (3) SR 406, (4) Dithane, and (5) 4-4-50 Bordeaux mixture. The No. 5 treatment of Bordeaux mixture will be applied on a 60-day cycle beginning in January 1951. No results can be reported reliably at this time. Observations indicate that the Bordeaux mixture and SR 406 are superior to the Dithane.

Project No. 125-VII-A-3b (3). Field Demonstration of the Control of "Phytophthora palmivora". Butl. J. Harvey McLaughlin and Geo. F. Bowman.

Approximately 20 hectares of cacao in sections 1,2,3,4, and 5 have been aprayed with 4-4-50 Bordeaux mixture 3 times on a 30-day cycle with the portable spray machine. Sections 6 and 7, approximately 5 hectares have been sprayed twice. Approximately 32 ha. have been sprayed once through 3/4 inch galvanized pipe. Pipe is being laid in 13 additional hectares so that approximately 45 hectares cacao (sections 6,7,8,9,10,11,12,13,14, and 15) will be sprayed by means of the pipe system. Thus 20 hectares of cacao will be sprayed with the portable rig pulled by the tractor, 45 hectares will be sprayed through pipe; and 18 hectares distributed in sections 1,2,3,16,31, and 32 will not be sprayed.

Project No. 125-VII-E(1). Studies on Soil-borne Pathogens of Cacao Seedlings. Luis Siller, J. Harvey McLaughlin, and Geo. F. Bowman.

Work under this project has been confined to control. Solar heat was found to be ineffective as a control measure under our experimental conditions; also, treating the soil with such fungicides as Bordeaux mixture, Phygon, Fermate, SR 406, Yellow Cuprocide, Karbam black, and Copper A proved ineffective. In an experiment comparing decomposed cacao pods and ordinary sawdust as germination media for cacao seeds, it was found that seed planted in a layer of sawdust 4 inches thick on the nursery beds germinated satisfactorily and the seedlings thrived. All of the nursery beds are utilized in this way at present.

List of Other Projects of the Cacao Center:

125-II-A. Selection of cacao trees for clonal multiplication.

125-II-A-2a. Clonal comparison.

125-III-B-1. Trials of budding methods in cacao.

125-III-C. Propagation of cacao by softwood cuttings.

125-III-C-1. Turrialba continuous spray propagator for cacao cuttings.

125-V-D-1b. Rehabilitation of cacao by budding of basal chupons.

125-VII. Studies in pathology of cacao.

125-VII-A. Life history and control studies of "Phytophthora palmivora" Butl.

125-VII-A-1(1). Etiological studies of "Phytophthora palmivora" Butl.

125-VII-A-2(1). Studies of the inter-relationships existing between precipitation, temperatures, and the incidence of Phytophthora infection.

125-VII-A-3b(1). Evaluation of fungicides as protectants against "Phytophthora palmivora" Butl. on cacao.

125-VII-A-3b(2). Field control of "Phytophthora palmivora" Butl. with fungicides.

125-VII-A-3b (3). Field demonstration of the control of "Phytophthora palmivora" Butl.

125-VII-E(1). Studies on soil-borne pathogens of cacao seedlings.

Cooperation and Consultation

In March and April, Dr. McLaughlin made a trip of some six weeks duration to Colombia, Ecuador, and Peru. The purpose of the trip was observation of cacao and consultation with growers and investigators in the various regions visited. In Colombia, the areas visited were Medellín and Palmira. Pichilingue, Clementina, La Julia, La Vinces, Tenguel, and intermediate points in Ecuador were visited. The experimental station at

Tingo María, Peru was visited and cacao discussed with various members of the Peruvian Ministry of Agriculture. Reports covering this trip have been published in the Cacao Information Bulletin.

McLaughlin also attended, by invitation, the First Latin American Assembly of Phytoparasitologists in Mexico City from September 25 to October 7. Two papers entitled: "Some symptoms of Phytophthora palmivora Butl. Infection on Theobroma cacao L. in Costa Rica" and "A Method of Evaluating Fungicides for the Control of Phytophthora palmivora Butl; on Theobroma cacao L." were presented. On the return trip from Mexico City, cacao was observed and discussed with growers and investigators in the vicinities of Tapachula, and Rioja, Mexico and on the Pacific lowland side of Guatemala. Cacao growing and investigational programs were discussed extensively with Hector Sierra, Director General of Agriculture in Guatemala.

We had the pleasure of entertaining numerous guests interested in cacao at La Lola farm during 1950. Some of these were: Dr. Arne Muntzing, Professor of Genetics, University of Lund, Sweden, who is adviser to Hacienda Clementina in Ecuador; Dr. S. de Blank of the United Africa Company, Limited; Mr. Leonard Schwarz of the American Cocoa Research Institute; Mr. H. Russell Burbank of Rockwood and Company; Mr. James L. Clevenger Jr. of the Hershey Chocolate Corporation; Mr. Bernhard S. Blumenthal of Blumenthal Bros.; Sr. João Ferreira da Cunha, Professor of Tropical Fruits of the Instituto Agronómico of Campinas, Brazil; and others.

The Animal Industry Department of the Institute obtained through the Cacao Center quantities of a feed for dairy cattle developed by the United Fruit Company in Panama. This dairy feed is composed in part of dried, ground cacao pods. Results, still unpublished, indicate that palatability and digestibility are good enough to allow the meal to replace a considerable part of the corn fed to cows and pigs.

Interests in La Lola farm has become quite keen among our neighbors during the past few weeks. We have fruit and they do not, which makes our methods of interest and brings us visitors. There is an increased interest also in vegetative propagation, and we have supplied 50 budded plants to a small producer whose 40-acre farm adjoins our farm. He expects to build a small propagator soon for the rooting of cuttings. Sr. Jorge Alvarado, a former cacao student, who is now extension agent for cacao in the Limón area, reports that many of his cooperators are interested in clonal cuttings, and he is assembling orders now for plants from those who wish to buy plants from us. We expect to charge $0.45 per plant, which we estimate will leave enough profit to induce some independent producer to compete with us. According to Alvarado, the farmers in his area

are accepting, with alacrity, the cultivation methods he learned from us as a student.

Arrangements were completed in November to send clones from all the Latin American countries and the British West Indies to the Mayaguez station in Puerto Rico. Using this station as a germ plasm bank and quarantine station, we shall be able to bring all good selections to any country without fear of introducing disease.

Cooperative work in the United Fruit Company propagation center at Zent has demonstrated that the continuous spray method of rooting cuttings increases the percentage of rooting very considerably while at the same time reducing labor costs. A small trial of transplanting methods showed excellent results for the placement of all roots in a vertical position when plants are placed in the nursery. This small change promises to reduce field losses very considerably. The frequent spraying of nurseries with Bordeaux mixture, on our advice, almost completely eliminated leaf fall and allowed the gradual reduction of shade until the young plants were growing vigorously in full sunshine before being transplanted to field locations. These plants were sturdier and more resistant to damage than those grown under shade.

Numerous individuals have consulted with us in Turrialba on the growing of cacao and other crops. Bowman has been consulted frequently on questions related to the production of bananas and abacá. A voluminous file of answers to written requests for information has been accumulated in our office.

The third meeting of the Inter-American Technical Cacao Committee was held in Trinidad from November 20 through 25, under the auspices of the Institute. The meeting was limited to discussion of technical problems and the inspection of experimental and commercial plantings. Of particular value to visitors from the Latin American countries were the practical demonstrations of increased yields gained from clonal plantings. Replanted fields were seen that yielded an average of 1200 lbs. of cacao beans per acre in the fourth year after planting; more than 4 times the expected yield of the best seedling fields.

The publication of the Cacao Information Bulletin has been maintained on a monthly basis in both Spanish and English. Its circulation has been increased to approximately 2,000 copies per month. The Scientific Communications Service of the Institute has taken over the editing and printing of the bulletin. It has been renamed Cacao and the format changed slightly to improve its appearance. A survey of reader reaction indicated that the journal was of considerable interest to a large range of cacao workers, from academic scientists to small farm producers. The popular articles have been received by the readers with considerable interest.

Organization and Administration

Geo. F. Bowman and J. Harvey McLaughlin continued throughout this year as Head and Horticulturist, and Plant Pathologist respectively, of the Cacao Center. Leslie R. Holdridge terminated his services with the Cacao Center at the end of January in order to take up his present duties with the Institute. Luis R. Siller F., a cacao student from February, 1949, was advanced to student assistant in February, 1950, and continued his studies toward the degree of Magistri Agriculturae. Carmen Donnelly, secretary, resigned in April, 1950. Marta Urribe was appointed secretary in May and resigned in August. Victor Muñóz was employed as administrative assistant and secretary in July, and Dr. McLaughlin was advanced to assistant chief of the Cacao Center. León La Prade was appointed horticultural aide in September, and stationed permanently at La Lola farm. James Kermack, overseer of La Lola farm, resigned at the end of November because of his wife's poor health. La Prade has taken over the former duties of Kermack satisfactorily.

Publications

Bowman, Geo. F. 1950. "Quality in cacao". Cacao Information Bulletin, Vol. 2, No. 5., Turrialba, C. R.

"Every cacao tree a high producer". Cacao, Vol. 2, No. 8. Turrialba, C. R.

"Propagation of cacao by softwood cuttings". Cacao, Vol. 2, No. 9. Turrialba, C. R.

Holdridge, L. R. 1950. "Notes on the native and cultivated cacaos in Central America and Mexico". Cacao Information Bulletin, Vol. 2, No. 1. Turrialba, C. R.

"Report on visit to the main cacao area in Guatemala". Cacao Information Bulletin, Vol. 2, No. 3., Turrialba, C. R.

McLaughlin, J. Harvey. 1950. "Observations on cacao in Ecuador". Cacao Information Bulletin, Vol. 2, No. 4. Turrialba, C. R.

"Observations on cacao in Colombia". Cacao Information Bulletin, Vol. 2, No. 6. Turrialba, C. R.

McLaughlin, J. Harvey. 1950. "Observations on cacao in Peru". Cacao Information Bulletin, Vol. 2, Nó. 6. Turrialba, C. R.

"Some symptoms of Phytophthora palmivora Butl. infection on Theobroma cacao L. in Costa Rica". Cacao, Vol. 2, No. 10. Turrialba, C. R. (reprint of paper presented at First Latin American Assembly of Phytoparasitologists, Sept. 25-Oct. 7. Mexico D. F.)

and Luis Siller F. 1950. "A method of evaluating fungicides for the control of Phytophthora palmivora Butl. on Theobroma cacao L". Cacao Vol. 2, No. 10. Turrialba, C. R. (reprint of paper presented at First Latin American Assembly of Phytoparasitologists, Sept. 25-Oct. 7, Mexico, D. F.

ANIMAL INDUSTRY DEPARTMENT

Albert O. Rhoad

INTRODUCTION

Of particular significance was a very successful meeting of livestock experts from thirteen countries, including several representatives from the Caribbean territories. The Inter-American Livestock Production Meeting, held from October 9 to 20, was under the joint auspices of the Institute and the Food and Agriculture Organization of the United Nations. A complete report of the proceedings is to be published by the latter organization. On the occasion of the livestock meeting the Animal Climatic Laboratory was dedicated at special ceremonies with guest speakers and a representative of the King Ranch, the donors, present.

It was possible to complete several feeding experiments with dairy cattle and swine, which indicate that a useful source of feeds may be developed from cacao pod meal. Other experiments verified the rather good feeding value of fresh banana leaves when fed to dairy cattle.

The experimental program of the Department was greatly aided by a grant from The Rockefeller Foundation for a tropical dairy cattle improvement project with native Nicaraguan cattle.

The Animal Industry Department is also a service department in that it supplies to the Institute and staff, pasteurized milk and milk products, meats, and poultry. This commercial aspect has grown during the year to a point where the Department is more than fifty percent self-supporting.

The Head and Associate Head of the Department have participated in four foreign travel assignments and have attended three scientific meetings outside of Costa Rica.

The Department's dairy cattle breeding program has been somewhat seriously affected due to reductions necessary following the discovery of tuberculosis in the herd. Also, due to an accident, the major portion of the small purebred Brahman beef herd was lost.

In spite of the above reverses, partly compensated with the Tropical Dairy Cattle Grant of The Rockefeller Foundation, and the loss, through resignation, of one staff member, it is anticipated that during the forthcoming year the Department will fulfill its major objectives. This will be especially true if it is possible to fully operate the climatic laboratory.

TRAINING

Three students were in training during 1950. Of these, one was a registered graduate student, while two were special students. These latter students represent a type of educational service that the Institute is particularly well equipped to offer. Of the two students one was enroute to the United States as a graduate student under a Rockefeller fellowship, the other was returning to his home country after obtaining an undergraduate degree from an agricultural college in the States. The first student, Dr. Jaime Santos Salgado, from Colombia, who was also a government employee, received an orientation course in tropical livestock problems and methods of investigation. The objective was to help guide him in selecting his graduate work. The second student, Jaime Basadre Andraca, from Perú, also received an orientation course in tropical livestock husbandry with special emphasis on tropical dairying, and actively participated in the Department's program of investigation. The objective was to help him in transferring his knowledge of animal husbandry obtained under conditions in the United States to conditions as they are in his home country. These special students remained in Turrialba two and three months respectively.

The graduate student, Hernán García Llosa, from Perú, studied tropical livestock problems with special interest in nutrition. He received the Magistri Agriculturae degree on September 30, 1950. His thesis was entitled, "Valor comparativo de las hojas de banano, puntas de caña de azúcar, y pasto elefante para producción de leche."

It is of interest that the Department received six additional requests for scholarships that had to be refused for lack of funds.

RESEARCH PROJECTS

Project 156. The Comparative Value of Fresh Banana Leaves, Sugar Cane Tops and Elephant Grass for Milk Production. Hernán García Llosa.

In a double change-over experiment with twelve dairy cows in three 28-day periods, it was found that green banana leaves were equal to elephant grass and both were superior to sugar cane tops. The average daily production was 4.83, 4.85, and 4.53 kilograms of milk, while average consumption of fresh chopped forage was 18.32, 19.91, and 19.47 kilograms. This represented a consumption of 3.45, 4.32, and 3.95 kilograms of dry matter per day of banana leaves, elephant grass, and cane tops respectively.

Project 158. A Plan for the Selection and Preservation of Pure Criollo Dairy Cattle in Central America. Albert O. Rhoad and Jorge de Alba. 1950.

In a group of fifty criollo cattle from Nicaragua purchased in 1947 by the Institute, there developed four exceptional animals

in both dairy type and production. Recognizing their importance as good genetic stock upon which to select a rather homogeneous tropical dairy strain of cattle, the Animal Industry Department purchased eight additional females and two bulls in Nicaragua. These are now in the Institute herd. The Rockefeller Foundation is assisting in the initial financing of this long-time project.

Project 160. Mixtures of Concentrates for Feeding Dairy Cattle. Jorge de Alba and graduate student Hernán García Llosa.

The experiment with concentrates included three rations each with 50% ground corn, 50% yucca meal, and 50% cacao pod meal. The rest of the ration was balanced in each case with rice polishings and cottonseed meal. Slightly higher production was obtained with cacao pod meal and yucca meal than with corn meal. These results indicate that completely satisfactory results can be obtained by the substitution of cacao pod meal and yucca meal for corn in rations for tropical dairy cattle.

Project ___. The Effect of Cobaltized Salt Feeding on the Forage Consumption of Yearling Steers and Heifers. Jorge de Alba.

The low consumption of certain tropical roughages by bovines has been the subject of widespread speculation. Such low consumption was observed at Turrialba in feeding experiments with dairy cattle. In view of the recent findings that reveal that cobalt deficiency is far more widespread over the world than formerly believed, it appeared necessary to determine if the addition of cobalt would increase forage consumption in the Turrialba area. Six pairs of steers and heifers were used, three pairs receiving mineralized salt plus cobalt and three pairs receiving mineralized salt without cobalt. The differences in feed consumption of the pairs could not be attributed to the presence or absence of cobalt. However, much greater volumes of banana trunks were consumed by all pairs, than were consumed of Elephant grass.

Project ___. The Experimental Study of Fattening Diets for Pigs, Utilizing Tropical Foodstuffs. Jorge de Alba assisted by graduate student, Jaime Basadre.

Three experiments were performed. In the second of these experiments, with pigs over 110 days of age, four pigs were used per pen, and four rations as follows: basal with corn, sesame oil meal, and fishmeal; cacao pod meal substituting for corn in the basal ration; ripe bananas and basal ration in proportion of 6 to 1; and free choice of ripe bananas and fishmeal. The gains obtained in this experiment with fattening pigs were far superior to anything obtained before at Turrialba. The daily gains on the basal ration were 0.835 kg. (1.83 lbs.); on the cacao pod meal ration 0.607 kg. (1.33 lbs.);

on the bananas plus basal ration 0.674 kg. (1.48 lbs.); and on the bananas and fishmeal ration, both free choice 0.608 kg. (1.33 lbs.). This experiment has not been analyzed yet and will be fully described in future issues of Turrialba.

Project 161. The Feeding Value of Bananas at Three Levels of Intake and a 50 Percent Yuca Cereal Dry Ration Compared with a Ration Based on Corn, Peanut Meal and Skim Milk. Jorge de Alba . 1950

Five outcome groups of five pigs each were fed as follows: Group I, corn mixture; Group II, 50 percent yuca; Group III, 100 percent bananas; Group IV, 50 percent bananas; and Group V, 25 percent bananas. Group II, yuca-fed, produced the largest daily gains, followed by I, corn-fed; IV, fifty percent bananas; V, twenty-five percent bananas; and III, one hundred percent bananas, the lowest gains. In TDN consumed per kilo gain in weight, the order was I, II, V, IV, and III.

List of Active Department Projects

Project 35. Control of "Dermatobia hominis" Larva (Tórsalo) in Cattle.

Project 64. The Improvement of Native Costa Rican Poultry.

Project 158. A Plan for the Selection and Preservation of Pure Criollo Cattle in Central America.

Project ___. The Improvement of Local Type Beef Cattle Through Use of Hybrid Sires.

Project ___. Studies on the Suitability of the Santa Gertrudis Breed of Beef Cattle to Conditions of the Wet Tropics.

Project ___. The Improvement of Local Type Dairy Cattle Through the Use of Hybrid Sires.

Project ___. The Selection and Improvement of Local Type Swine.

Project ___. The Improvement of Local Type Ranch Horses Through the Use of Quarter Horse Sires.

COOPERATION AND CONSULTATION

Albert O. Rhoad, Head of the Department, took part as an observer in the Livestock Conference held under the auspices of the Caribbean Commission in Trinidad, B.W.I. from February 28 to March 3, 1950. This was the first conference to deal specifically with livestock problems in the Caribbean area. The proceedings are to be published by the Commission.

From March 6 to April 2 the Head of the Department made a study of the livestock experimental projects in Venezuela at the invitation of the Minister of Agriculture of that country. A report of the study and recommendations were made directly to the Minister of Agriculture.

Dr. Jorge de Alba attended the Forty-Fifth Annual Meeting of the American Dairy Science Association held in Ithaca, New York, from June 20 to 22, 1950. At this meeting he presented a paper outlining the Nicaraguan Criollo Dairy Cattle Project of the Institute.

At the invitation of the Government of the State of Michoacan, Mexico, Dr. de Alba made a survey of the cattle industry in the zone of Tepalcatepec in that State. His report covers general recommendations on the organization of a livestock improvement program.

In connection with the economic survey of Guatemala conducted by the International Bank for Reconstruction and Development, the Head of the Animal Industry Department and other members of the Institute staff assisted in the agricultural part of the survey. A report published by the Bank will be available sometime in 1951.

In September 1950, the Head of the Department was made a member of the Standing Committee on Livestock Improvement of the Pacific Science Council.

The Inter-American Livestock Production Meeting was held in Turrialba from October 9 to 20 under the joint auspices of the Institute and the Food and Agriculture Organization of the United Nations. There were 42 members registered from 13 countries and 5 international organizations. The proceedings of the meeting will be published by FAO.

A. O. Rhoad attended the Forty-Second Meeting of the American Society of Animal Production, November 24-25, Chicago, Illinois.

During November, Jorge de Alba made a survey of the livestock industry of Honduras at the invitation of the Banco Nacional de Fomento.

ORGANIZATION AND ADMINISTRATION

Livestock Inventory, January 1 - December 31, 1950

	Jan. 1	Dec. 31	Difference
Dairy Cattle	117	86	- 31
Beef Cattle	264	242	- 22
Horses	12	17	+ 5
Swine	86	29	- 57
Poultry	561	885	+324

The reduction in the number of dairy cattle was in part due to slaughter of TB reactors (16) and in part to culling of low producers. The reduction in the beef cattle herd was due primarily to the reduced number of steers on hand. It was found necessary to reduce the swine herd from eleven brood sows to six because of short supplies of feed, especially for the fattening of any large number of pigs. The size of the poultry flock remains about the same; the apparent increase is due to the large number of chicks on hand at the end of the year.

The year 1950 was the first year of operation for the creamery and for the abattoir. That this aspect of the Department's work has now reached sizable proportions is evident in the following table of total income.

Income January to December 1950

	Colones
Creamery	$172,496.36
Abattoir	19,089.09
Poultry	3,377.75
Livestock *	34,543.00
Pasture rental	2,458.00
Petty cash sales	6,650.70
TOTAL	$238,614.90

This represents an income of $29,826.88 (U.S. currency) or about 55 percent of the Department's annual budget.

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* Livestock sold off the Institute (does not include animals credited to the abattoir).

During the year a vacancy in the position of nutritionist was created through the resignation of Dr. Jorge de Alba in December. It is anticipated that this vacancy will be filled in the near future.

PUBLICATIONS

Jorge de Alba	"The Criollo Cattle of Rivas, Nicaragua." Paper presented to the 45th Annual Meeting of the Dairy Science Association, Ithaca, New York, June 20-22, 1950.
Hernán García Llosa and Jorge de Alba	"Valor comparativo de las hojas de banano, puntas de caña de azúcar y pasto elefante para producción leche." Turrialba, 1 (2) 78-85, October 1950.
Albert O. Rhoad	"New Developments and Special Problems in Livestock Management." Proceedings of the Inter-American Livestock Production Meeting. Turrialba. October 9-20, 1950. In press.
Albert O. Rhoad	"Los propósitos y programa del laboratorio climático animal de Turrialba, Costa Rica." Prepared for the Fourth Inter-American Conference on Agriculture. Montevideo. December 1950.

AGRICULTURAL ENGINEERING DEPARTMENT

Norton C. Ives

INTRODUCTION

Crop processing and storage has been the major project in Agricultural Engineering Department. Various types of driers and storage units for on-farm or near-farm use have been developed or adapted and tested under tropical conditions. The various systems of handling the air and grain that have been developed and adapted include the sack system; the bulk or bin drying and storage system combined, with only a perforated false floor, and with the false floor plus upper layer distribution ducts; column batch driers, stationary and trailer mounted types; and deep-bin batch type driers for course materials such as ear corn, forages, and sorghum heads.

A special, low-cost dew point moisture indicator for grain and other materials have been developed to the point where it appears to have very good possibilities as a commercial field instrument. Final testing awaits construction of a commercial-type model and special laboratory apparatus.

A short course for grain storage technicians from the equatorial areas of the Americas was conducted cooperatively with the Food and Agriculture Organization of the United Nations and the Consejo Nacional de Producción of Costa Rica.

A project on coffee processing was initiated on November 15, 1949; and a series of preliminary trials were run during January and February, 1950. No top quality samples were obtained by drying the whole cherry before shelling or pulping, but very good quality samples were produced by certain drying procedures for the pulped bean with mucilage still intact and without fermentation. It was also discovered that the unfermented and dried pulp or entire by-product from the cherry during its processing is highly palatable to dairy cattle.

The Head of the Department devoted six months of the year to advanced study in courses related to the general field of mechanical conditioning at Iowa State College and was therefore absent from the Institute a large portion of the year.

TRAINING

Service courses were conducted in Agricultural Engineering for vocational trainees at the Institute by Señores Balma and Alfaro, but no students were in training in this department during the year.

RESEARCH PROJECTS

Project No. 50 - Drainage

Only a small portion of the field in which the tile drainage system is installed was cropped during the year. However, records of the drainoff through the tile system and the ground water fluctuations were taken for the heavy rainstorm periods throughout the year. These performance data are shown in the table below. It will be noted that for the heavy storm period from February 26 through March 1, during which time 13.79 inches of rain fell, flooded or nearly flooded conditions prevailed, but two days after the heavy rains ceased, the water table was down four inches or more below the surface at midpoint between the tile lines, and in two more days, it was down to two feet below the surface. Shallow surface drainageways would help somewhat in shortening the time of flooded conditions, and appear therefore to be desirable for the heavy rainstorm conditions that occur from time to time in these regions.

It was necessary to remove again the roots of the gramalote grass from a short section of the main tile line where the ground cover was less than two feet. Either clean cultivation or a greater tile depth would have prevented this difficulty.

The table on page 3 shows performance data of the tile drainage system for four of the heavy storm periods during the past year. The first column gives the equivalent depth of water in inches for the ten-acre area drained, which was discharged at the tile outlet and measured by the 90-degree V-notch weir and automatic water level recorder. The second column gives the inches of rainfall for twenty-four hours, and the last three columns give the depth of the water table, or distance from the surface of the ground to the water table at a point midway between the parallel lateral tile lines for the three different spacings shown.

Project 53 - Soil Erosion Control Plots

This is the fourth full year of data from the erosion observation plots. With the exception of the storm of December 1949, during which a total of 21.2 inches of rain fell over a period of seven days, climaxed by a storm period of less than ten hours during which 11.35 inches fell and the resulting flood caused runoff that overflowed the catchment system and caused heavy soil loss, there has been insignificant soil and water runoff from any of these plots. The most extreme exposure is that in the bare plots with 45 percent slope. These four years of observations will be published in the future.

TABLE

Subsurface Tile Drainage System Data
for
Storm Periods during 1950 and through March 5, 1951

Date	Inches Drainoff	Inches Rainfall	Water Table Depth in Centimeters for Spacings of: 50 ft.	100 ft.	150 ft.
Nov.14	0.685	0.94	48	40	10
15	0.549	0.04	70	60	38
16	0.524	0.22	80	75	50
17	0.405	0.28	82	75	55
18	0.391	0.58			
Totals	2.534	2.06			
Dec.15	0.187	0.43	80	75	55
16	0.158	0.19			
17	0.153	0.00			
18	1.744	1.20	65	60	32
19	0.749	3.40	28	25	5
20	0.786	0.95			
21	1.011	2.00	18	10	0
22	0.499	0.52			
23	1.500	2.00	8	+ 5	+ 15
Totals	6.787	9.60			
Dec.23	1.500	2.00	8	+ 5	+ 15
24	0.817	2.25			
25	0.631	1.30			
26	0.499	0.09	30	40	5
27	0.364	0.04	50	55	30
28	0.245	0.01			
29	0.186	0.00	80	75	60
30	0.148	0.00	78	80	68
31	0.120	0.00			
Totals	4.510	5.69			
Feb.22	0.979	0.14			
23	0.161	0.91	80	75	60
24	0.152	0.14			
25	1.763	0.68			
26	0.444	4.00	5	+ 5	+ 8
27	0.842	2.25			
28	2.144	3.00	- 3	+ 8	+ 10
Mar. 1	1.706	4.54			
2	0.475	0.70			
3	0.287	0.04	30	10	10
4	0.186	0.00			
5	0.132	0.00	85	60	60
Totals	9.271	16.40			

Project No. 58 - Grain Drying and Storage in the Tropics

Due to the absence of the leader of this project, little progress was made at the Institute during 1950. However, the leader devoted the entire six months of his sabbatical leave to special advanced study in this specific field and brought himself more or less abreast of the work being conducted at various locations throughout the United States.

A paper entitled "Grain Drying and Storage in the American Tropics" was prepared and presented at the winter meetings of the American Society of Agricultural Engineers in December. Also developmental work on the dew point moisture indicator was advanced considerably during the leader's tenure at Iowa State College, and a tentative draft describing this device has been prepared for publication.

Project No. 152 - Coffee Processing, Dry-Process Study

This project, initiated on November 15, 1949, was designed to investigate the possibilities of a dry-process system for processing and drying coffee. Such a system would eliminate soaking, fermentation, and washing, or the need of any water at the drying location, which would greatly simplify the processing procedure, and perhaps make it possible to have better quality control. All the work this year was exploratory in nature, and the general conclusions and recommendations based on this initial work were as follows:

Conclusions

1. It was possible to get good appearing, uniform-colored dried coffee bean "oro" by drying in the cherry form, but all the samples that were cup tested in San José were judged to have an objectionable winey flavor. Thus, while the method of drying coffee in the pulp merits much more detailed study due to its general use in the large coffee growing areas, it does not appear that top quality coffees, as judged by present day standards, can be processed in this manner.

2. High quality samples were produced in Runs IV and VII. The results of Run IV indicate that there are some good possibilities for drying fresh pergamino (freshly pulped beans with mucilage intact) in a well-designed drier. Several factors need special consideration and study to determine the ultimate possibilities in this direction.

3. Removing the pulp before drying provides for mechanical removal of a large portion of the water as well as more rapid drying rates for given exposure conditions. Where

the pulp is not to be dried, the drying load per pound of dried beans is reduced to about one-half by removing and separating the pulp before drying.

4. If the rapid-dried coffee hull (pulp, parchment, and honey) proves to be high in feeding value for dairy cows, (it has been shown to be highly palatable) it may be good business and highly desirable in coffee processing to dry the pulp also. If water must be used for the pulping process, mechanical removal of free water from the pergamino surface before drying is desirable, and centrifuging may best accomplish this.

5. Where natural fermentation occurs or is used, two things have appeared to be indispensable: (a) the dissolved mucilage must be thoroughly removed within a certain time limit, and (b) the washed coffee must be aerated, preferably in thin layers with good air circulation for a period of time to remove all trace of the fermentation before it can be dried at a high rate, aeration and initial slow drying taking place simultaneously on a patio.

6. Three basic methods may be used to accomplish mucilage removal: (a) fermentation and washing, (b) washing alone in combination with a high pressure spray, and (c) mechanical removal by abrasion. During these experiments the writer observed the performance under experimental conditions of a commercial product called "accelerator" which, by the use of a high dosage, accelerated the fermentation process to such a degree that fresh pergamino was cleanly washed within two hours after pulping. The possible advantages to be gained in both drying rate and resultant coffee quality by mucilage removal before drying need thorough investigation.

Recommendations for Future Work

In view of the above, future work ought to proceed in the following directions:

1. Thoroughly investigate possibilities of drying freshly pulped coffee. Various procedures should be given special consideration, but the first, perhaps, should be that of drying in thin layers on trays, as it appears doubtful that any mechanical pulper will remove the mucilage well enough to avoid the sticky stage through which the unwashed pergamino passes as it dries down. A two-way flow shallow depth column may be a good approach if a successful system of agitation of the upper layers to prevent sticking and provide uniform air passage can be developed.

2. Study more rapid mucilage removal methods and subsequent drying procedures.

3. Study and develop coffee pulp driers with special consideration given to mechanical removal of the free water.

4. Determine the feeding value of unfermented dried coffee pulp with and without the pergamino, honey, and parchment.

SERVICE PROJECTS

Meteorological Station and Studies

Gregorio Alfaro has continued in charge of the weather station at the Institute and during the year has made much progress in the collection and analysis of weather data from this area and regions in the neighboring countries. This has been made possible through the cooperation of the Pan American Airways, United Fruit Company, and other meteorological stations in Honduras, Guatemala, Nicaragua, Costa Rica, Panama, and Colombia. Studies are being made as to the possibilities of establishing micro-climatic investigations in critical regions throughout Central America and analyzing and interpreting such data according to methods developed by Thornwaite and Holdridge.

Engineering Services to the Institute

Señor Luis Balma, in addition to his assistance in regular departmental projects, devoted much time to surveying, layout work, and drafting as a service to the entire Institute.

CONSULTATION AND COOPERATION

During 1950 the department cooperated with FAO and the Consejo Nacional de Producción of Costa Rica in conducting a short course for technicians on grain preservation. The Head of the department has consulted with STICA on irrigation, erosion control, drying and horse-drawn machinery development and demonstration activities. The coffee drying project was made possible in part by the cooperation of the Cámara de Cafetaleros de Costa Rica. The department Head has consulted with government organizations and private enterprises on grain drying and storage in Colombia, Panama, Costa Rica, Honduras and Guatemala, and has maintained good working relationships with the grain storage infestation prevention and control program of FAO in Latin America, and with the personnel operating and managing the recently constructed grain silo unit in San Jose, Costa Rica.

ORGANIZATION AND ADMINISTRATION

Personnel

Norton Ives, Head	Agricultural Engineer
Gregorio Alfaro	Meteorologist
Luis Balma	Surveyor

PUBLICATIONS

A paper entitled "Grain Drying and Storage in the American Tropics" was presented by the Head of the Department at the winter meetings of the American Society of Agricultural Engineers in December 1950.

A Series of plans and mimeographed reports, seminars, and articles on grain drying and storage, which had been prepared over a period of time, were assembled and made available for the April short course on grain preservation.

List of Plans of Grain Driers and Grain Storage Units

Trailer de dos ruedas para la finca (1 sheet), 8/14/48

Sacked rice drier-storage unit layout (sheet No. 1 only), 9/20/48.

Four-wheel trailer drier (1 sheet), 9/24/48.

Five 8 1/2" x 11" diagrams for FAO conference paper, 2/20/49.

1. Moisture equilibrium curves.
2. Gallons of water per 100 pounds of dry grain to be removed versus grain moisture content.
3. Sack drier frame systems.
4. Perforated false floor drying systems.
5. Two and four wheel trailer drying systems.

Two-wheel trailer drier systems (3 sheets), 3/1/49.

General purpose drying and storage experimental unit with wood furnace design (3 sheets), 4/1/49.

Ear corn silo for drying, storage, and fumigation 7 meters diameter by 12 meters height (1 sheet), 5/1/49.

Seed drying and storage cabinet (1 sheet), 6/1/49.

Institute Experimental Drying Center (1 sheet), 12/1/49.

Seminars, Reports and Articles on Grain Drying and Storage

Drying and Storage of Grains and Beans in the Tropics. 12-page mimeograph. (English), 8/24/48.

Corn Drying and Storage Experiments of the Department of Agricultural Engineering. 4-page mimeograph. (English), 12/28/48.

Conditioning Grain for Safe Storage in the Tropics. Paper presented at Palmira Conference, February 1949. 12-page mimeograph. (English and Spanish), 2/1/49.

Design Data for Storage Silo (Plan of 5-1-49) for Ear Corn or Any Grain and Providing for Mechanical Drying and Fumigation. 4-page mimeograph. (English), 5/1/49.

Las cargas de secamiento y los pesos con humedad inicial para cualquier grano, y maís en mazorcas de dos calidades. 1-page mimeograph. (Spanish), 7/28/49.

Resumen de los experimentos efectuados en secado de maíz. 5-page mimeograph. (Spanish), 7/30/49.

Graneros para la América Tropical. 3-page reprint from La Hacienda. August 1949. (Spanish), 8/49.

Nuevos sistemas para el secamiento de granos en los Trópicos Americanos. 5)page reprint from La Hacienda, October, 1949. (Spanish), 10/49.

Preliminary Report of Experiments Using Two-wheel Trailer Driers for Rice. 3-page mimeograph. (English), 10/4/49.

A Report to the Instituto de Fomento de la Producción of Guatemala on National Food Production and Conservation Program. 7-Page mimeograph. (English), 11/24/49.

Measurement of Moisture Content. 3-page mimeograph. (English), 11/28/49.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL LIFE

Julio O. Morales

INTRODUCTION

The number of students in the Department of Agricultural Economics and Rural Life has been increased primarily due to the grant of the Carnegie Foundation to Michigan State College to strengthen its agreement with the Institute. Some of the aspects of our experimental graduate training program were tested for the first time during 1950, giving satisfactory results.

A major effort was made during the year to analyze the data already collected under the various research projects. As a result, a considerably increased number of articles will be published during the coming year. A Spanish translation and adapted version of Dr. John Hopkins' book, Elements of Farm Management will be issued early in 1951.

Research in sociology was concentrated on the study of leadership patterns, social stratification, and relationships between levels and standards of living in different social strata. Significant differences were found between proportions of the population in the various social strata in "hacienda" type and "family-sized farm" type communities. Leadership patterns were also significantly different; they were largely conditioned by communication between social strata. Social status was found to be closely associated with the established "standards" of consumption and behavior.

Health and nutrition studies in the Turrialba Rural Area have led to the conclusion that poor sources of running water, lack of adequate facilities for disposal of human refuse, exceedingly high rate of infant mortality, bad dental condition, and inadequate community health and sanitation services are among the most pressing "real" health problems. The first two and the last are the most widely "felt" problems among the rural population.

A preliminary analysis of the dietary data revealed that lack of adequate protein, riboflavin, niacin, vitamins A and C, and calcium appear to be the main faults of the diet. Arrangements have been completed with the Costa Rican Ministry of Health and the Nutrition Institute of Central America and Panama to conduct a nutritional and health status survey on the same families from which the dietary data was obtained.

Population figures analyzed during the year indicate that, in the community under study, only one-third of the inhabitants are in the active productive force. Eighty-five percent of the adult population had only third grade or less formal elementary education.

Considerable care should be taken in the choice of extension and rural education methods for service to these types of populations.

The area of more recent volcanic soils (Area 1) of the community was compared to one of the areas of older volcanic soils (Area 2). There was one hectare of land per person in each area. As Area 1 had a higher proportion of the land in intensive crops and had higher yields, the production per person in terms of money was nearly three times higher than in Area 2. As the two areas are within the same agricultural region, the higher land productivity in Area 1 is apparently reflected in a higher production per person, rather than in a higher population density.

Eight neighborhoods have been selected to evaluate the work of the school on the one hand, and the school and extension agent on the other. The neighborhoods are divided equally into "hacienda" type and "non-hacienda" type neighborhoods. Twenty-six rural school teachers were given a two-months' course in cooperation with the Costa Rican Ministries of Agriculture, Health and Education, which would enable them to work more practically and effectively within each of these neighborhoods. A continuous evaluation process of their work and that of the extension agent has been instituted, with them participating in the evaluation of their own work.

The cost of production and farm management study of coffee farms is now definitely established in Costa Rica and Colombia. In the latter country the study is carried on in cooperation with the Colombian Coffee Federation. The number of farms under study has increased, and the quality of information obtained from farmer cooperators is more accurate.

A careful study of seasonal, geographical, and wholesale variations of prices of agricultural products, both at wholesale and retail levels, was advanced during the year. The relationship of wages to price of food staples was analyzed.

Cooperation and consultation services included trips to Guatemala, Mexico, and Colombia. Relations with Costa Rican institutions were developed further during the year.

Major emphasis will be placed during the coming year on evaluation of rural education and extension methods and on the publication of results.

TRAINING

Nine graduate students received training in the Department during 1950. Colombia, Mexico, the United States, and Canada were represented by these students. Some of the aspects of our experimental training program, described in previous reports, have been

tested for the first time during 1950. The conducting of the thesis "in absentia", under a cooperative agreement with the national supporting institution, in this case the Colombian Coffee Federation, has worked very well. The extension of the orientation period at Turrialba to a whole year, preparatory for graduate course work in a college or university, seems to have definite advantages in most cases over the three-months' period initially used. Six of these students have been interested in pursuing studies towards their Ph.D. degrees, in which cases our principal contribution is in offering facilities to carry out their Ph.D. theses. The Ph.D. degree is granted by the college or university in which the students received their formal training. The Institute, on the other hand, can advance its research program more rapidly, increasing at the same time the quality of the work.

The Michigan State College-Institute cooperative training program was strengthened by a grant from the Carnegie Foundation to Michigan State College enabling three students and Dr. Charles P. Loomis, Head of the Sociology and Anthropology Department, to come to Turrialba for a year. One Institute student, on the other hand, is taking course work leading to his Ph.D. degree at Michigan State College. Another, following a similar arrangement, is doing likewise at Pennsylvania State College. A third one took his M.S. degree at Montana State College and is at present writing his thesis for the Institute's Magistri Agriculturae degree.

The Spanish translation and adaptation of Elements of Farm Management, by Dr. John Hopkins, for use in Central and South America, will be ready for sale in three or four months. The Department initiated this project three years ago and has taken responsibility for the technical aspects of the adaptations in cooperation with the author. The Scientific Communications Service has handled all other matters connected with translations and editorial and publishing activities.

RESEARCH PROJECTS

Community Development Project

Sociology and Anthropology

The following studies were advanced in this sub-project during 1950:

1. Differences in Consumption and Behavior Patterns of Individuals in the Different Socio-Economic Levels of the Town of Turrialba: A sample of 300 families was classified, according to ratings made by 19 estimators and further refined by the use of data on visiting relationships, into five social classes: lower, upper lower, lower middle, upper middle, and upper.

The established "standards" of consumption and behavior are closely associated with social status. These "standards" were analyzed in four main categories:
(1) "luxuries" of a certain social level, which, if assumed by an individual, help to establish and strengthen his position within that respective social category; (2) "substitutes", the holding of which tends to diminish the individual's social status; (3) "rarities"; and (4) "necessities" which do not have value coloration on the respective social level.

In the lower class, for example, which consists mainly of farm laborers, the value of "luxury" is connected with bathroom and toilets, lottery tickets, cigarettes, some food articles, and schooling of children leading to reading knowledge.

In the upper lower class, which included laborers in various industries, some field workers, etc., some of the "luxuries" would be improvements in housing, especially expressable in hygienic and aesthetic terms, consumption of certain foods, etc., whereas items like cigarettes or lottery tickets will be closer to the indifferent position. The high evaluation given to more adequate schooling shows up more clearly in this level than in the lower class.

The lower middle class seems to evaluate such items as glass windows, cooking with charcoal rather than with smoky wood, painted walls, and complete sets of furniture. Keeping the children in school to finish their primary education also appears as a valued trait.

In the two upper levels identified in this study, the upper middle and upper classes, the analysis becomes more difficult because of the wide range of choices economically available to the individuals on these higher strata. Two or more items often serve the same purpose and have apparently equal value positions. In the education of children, for example, for the upper middle class, the entering of secondary school is an evaluated trait, but for the upper class the corresponding trait would be finishing of secondary schooling and entering the university.

This type of information is expected to throw light on the value formation in various social levels, leading to a more thorough understanding of the patterns of "felt needs". A knowledge of these patterns is invaluable in discovering the spontaneous forces operating in a community which should help guide action programs functioning in the area.

The final publication of results of this study will be made in 1951.

2. Rural Social Stratification: The class structures of a community of family-sized farm operators and of a community of large "haciendas" were compared in a study presented by Loomis and Powell in Sociometry, Vol. XII, 1949. This comparison, as well as certain aspects of the methods employed, represents new contributions to the field.

The community of family-sized farm operators comprised a large middle group (class 2) including nearly three-fifths of the families; a smaller body (class 3) comprised one-sixth of the families, which in terms of the national class structure could be called lower middle class; and a relatively small number in the lower group (class 1) composed one-fourth of the families. Four of the five prestige leaders were ranked in the highest class (lower middle) in the community. The prestige and friendship group leaders tend to be more diffused throughout the community than in the large "hacienda" village.

In the "hacienda" type community, the two upper classes are removed in orientation from the other people in the village, and their associations are directed largely outside the community. The top prestige leaders were not chosen from these two upper groups, and there exists a barrier of significant proportion between the two lower groups and the two upper groups. High mobility and lack of differentiation of function and initiative on the part of the laborers has led to a situation in which friendship and prestige group leaders are the same in the community, particularly so in the group from which the lower, larger class takes its orientation. These leaders, having a minimum of worldly possessions, but considerable ability to handle people, may be potential direction-givers in times of crisis.

3. Rural Informal Leadership: The 519 interviews made in 25 neighborhoods of the Turrialba Rural Area led to the determination of 91 group leaders. These were classified into three categories: (1) prestige leaders, (2) clique or friendship leaders, and (3) prestige-friendship leaders. The neighborhoods were divided into "hacienda" type and "non-hacienda" type neighborhoods.

In the "hacienda" type neighborhoods the major proportion of group leaders, regardless of type, was chosen from the farm workers group. In the "non-hacienda" type neighborhoods, farmers, who figured very unusually

as leaders in the "haciendas", were by far the most frequently chosen as leaders. The managers, farm superintendents, and owners of stores were frequently chosen as prestige leaders in the "haciendas", but they were not as important in friendship leader classification. The prestige-friendship leader was somewhat more common in the "hacienda" type neighborhoods.

Thus, the basic conclusions on leadership of the study on two neighborhoods appear applicable to the entire number of neighborhoods. Hypotheses as to how most effectively to conduct extension and rural education on these two significantly different social structures and leadership patterns will be tested under the educational sub-project.

This material will be published during 1951.

Home Economics

The activities under this sub-project related to two studies:

1. Health: The analysis of the sample of 140 rural family questionnaires was carried further during the year. The information was transferred to two sets of IBM cards to facilitate grouping for descriptive purposes and analysis of relationships. Final tables relating to the analysis of the first card are ready. A final run will be made relating occupation and leadership status to important health problems, to complete the analysis. The publication of these results will be made during the year.

   Poor sources of drinking water, lack of adequate facilities for disposal of human refuse, exceedingly high rate of infant mortality, bad dental condition, and inadequate community health and sanitation services appear to be the most pressing "real" problems. The first two and the last are the most widely "felt" problems among the rural population.

2. Nutrition: The majority of the families interviewed in the health study, plus replacements for families that had left the area, were interviewed in a dietary study. The material gathered is now being analyzed. Arrangements have been completed with the Costa Rican Ministry of Health and the Nutrition Institute of Central America and Panama, to conduct a nutritional and health status survey on these same families, which in combination with the dietary data will result in one of the most thorough studies of its type conducted in Latin America. The field work will be done in March and April, 1951.

A preliminary analysis of the dietary data revealed that the quality and quantity of food consumed by groups of families of farm owners, farm management personnel, artisans and merchants, and field workers varied considerably. The proportion of food needs that was home-produced also showed significant variations.

The findings present a serious situation for almost all families studied, but they are most acutely distressful in regard to the families of farm laborers. Lack of adequate protein, riboflavin, niacin, vitamins A and C, and calcium appear to be the main f[illegible] of the diets.

Corn, blocked brown sugar (panela or dulce), beans, rice, and starchy vegetables were, in order of importance, the principal sources of calories of the families interviewed. Corn also rated as the most important source of vitamin A, thiamin, riboflavin, and niacin and was among the four most important sources of calcium and iron. Blocked brown sugar rated high as a source of calcium, iron, and riboflavin. Beans are crucially important as a source of proteins, calcium, iron, and most of the vitamins.

A table of food values of foods commonly consumed in the region was made, in terms of common household measures. The table is in Spanish, and we believe it is a useful tool for nutrition work by teachers, nurses, and others in this area.

Economics

The analysis of the census data for the Central District of Turrialba has been advanced to cover most aspects relating to use of human and natural resources. A map showing the distribution of rural houses, schools, coffee processing plants and similar structures was completed. The distribution of population in the total District is shown on another map, indicating at the same time the people residing in each house as represented by circles of varying size. A third map of the Urban Area of the District shows the residences, business places, and buildings occupied by public services and utilities. The number of rooms and the quality of each residence are also shown.

The population figures indicate that only one-third of the inhabitants in the district can be classified in the active productive force. Only six percent of the feminine population was productively employed. Two-fifths of the total population were either too young or too old to work. Unemployment was negligible. It appears that the only important untapped source of manpower is in the adult feminine group.

Nearly one out of every three adults in the rural population of the Central District of Turrialba did not know how to read and write. Another third had only one or two years of elementary education. Eighty-five percent of the adult population had third grade or less formal elementary education. Only three percent had higher than elementary education. This is a fact which should have considerable bearing on the choice of extension and rural education methods.

The two most significantly different areas of the community were chosen to test the effect of ecological and institutional factors on productivity per person. Area 1 represents the core of the coffee area of the community, having the good volcanic soils of recent origin northeast of Turrialba and being mainly organized in large farms or "haciendas". Area 2 has the less productive, old volcanic soils southeast of Turrialba, which are predominantly cultivated in small family-sized operations.

There was one hectare of land per person in each area. As Area 1 had a higher proportion of the land in intensive crops and had higher yields, the production per person, in terms of money, was nearly three times higher than in Area 2. As the two areas are within the same agricultural region, imposing similar comparative advantage as to types of land-use, the higher land productivity in Area 1 is apparently reflected on a higher production per person rather than on a higher population density.

This study was conducted in cooperation with the Renewable Resources Service.

Various articles are planned for publication during the coming year.

Education

The following activities were carried out under this subproject:

1. A Ten-Lesson Course on "The Teacher, the Community, and the Home": The Home Economist took advantage of the data gathered in the Health and Nutrition Studies to give a short course for rural teachers of the District.

2. Intensive Six-Weeks' Course for Rural Teachers: The considerable amount of information on "felt" and "real" needs, social structure and leadership patterns of the people of the Community was used as a basis for the course given to a selected group of twenty-six rural teachers. The Ministry of Education of Costa Rica selected the teachers and financed

the course. These teachers will accept appointments during the coming school year in especially selected neighborhoods of the rural area of Turrialba. Four of these neighborhoods are of the large "hacienda" type and four of the "non-hacienda" type. In two neighborhoods of each type, the teacher will be the primary "change" agent, while in the rest the extension agent and the school teacher will combine to perform this function. With this course, the Community Development Project will slowly change the emphasis from the study of conditions to the evaluation of the educational program in promoting change.

The course was designed to give basic knowledge and develop attitudes among the rural teachers which will enable them to function more broadly with the major age groups of rural people, touching on their basic problems. The section of the course on health and nutrition was in charge of a physician from the Ministry of Health. Home economics and 4-H Club work were the responsibility of the STICA staff. Agriculture, home improvement, gardening, and rural social organization were covered by the Institute staff. The Ministry of Education was in charge of the section on pedagogy. The course had a very pronounced practical orientation, the rural teachers actually being responsible for building improvements in a typical laborer's home, planting vegetable plots, etc.

In order to guide and insure a broader and faster application of the findings of this experiment through the educational system of the country, an "Observation Committee" has been established, giving representation to the Ministry of Education, the two principal normal schools, and the Institute.

3. Evaluation of the Course: The rural teachers, at the initiation of the course, were given a test to determine their attitudes toward work in rural areas and toward cooperation with a school program reaching the entire community. Their knowledge of various subject matter fields to be covered in the course was also tested. The same evaluation tool will be given at the end of the course to assess the change in knowledge and attitudes brought about by the course.

Cost of Coffee Production - Farm Management

The methods used during 1949 were considerably revised and simplified in order to encourage a larger number of farmers to keep their records according to the suggested system. The

information on about twenty Costa Rican farms will be completed for the year ending September 30, 1950. The Colombian Coffee Federation using a modified version of this system, will analyze the accounts of thirty farms.

A larger number of farms studied and the more exact information secured will make possible a more thorough study of relationships, especially concerning harvesting costs. It appears that future research should place emphasis on means of increasing labor efficiency in the harvesting operation.

Price Structure of Agricultural Products

A graduate student is using this project for his Ph.D. thesis. Long-term, seasonal, geographical variations of prices of over thirty agricultural products have been studied. The relationships of retail and wholesale prices have also been analyzed.

Seasonal variations of the staples (corn, beans, rice, and blocked brown sugar) are not pronounced, while variations in vegetables such as onions, tomatoes, and cabbages are consistent and pronounced. Starchy vegetables, like yuca and sweet potatoes, and beef cattle, cheese, and butter have only limited seasonal variations. All these variations tend to be consistent, year after year, in most products, once long-term variations are removed.

The wholesale prices of corn, beans, blocked brown sugar, and rice were in 1949 from two to two-and-a-half times what they were in 1936. Most of this increase occurred from 1943 to 1945. Wages have increased consistently during the period, but not at a fast enough rate to match increases in these prices. The period 1943 to 1945 brought the largest disparity between wages and prices of staples, while during the 1946-1949 period, the gap tended to be narrowed.

A detailed study of potato prices seemed to indicate that the cooperative effort of growers, as well as later government initiatives, to bring orderly marketing of potatoes contributed to sharper variations in prices and more unstable market conditions.

COOPERATION AND CONSULTATION

The Department participated in some of the agricultural economics phases of the International Bank for Reconstruction and Development Mission to Guatemala. The Head of the Department also made a visit to Mexico, under the sponsorship of the Rockefeller Foundation, to consult with their staff in that country, as well as to develop cooperative ties with various public and semi-public institutions.

An extended visit was made to Colombia to review the Institute's cooperative program with the Colombian Coffee Federation. As a result of this careful review, the program has been expanded, and an Agricultural Economics Section has been created within the Coffee Research Center at Chinchiná.

Arrangements have been outlined with the Nutrition Institute of Central America and Panama in order to pool the resources of the two institutions in Community Projects already initiated by either institution.

A cooperative agreement has been signed between the Costa Rican Ministry of Agriculture, the Inter-American Statistical Institute, and the Agricultural Institute in Turrialba, whereby a permanent crop production estimating organization will be set up. This project is already under way.

Excellent relations have been established with the Cámara de Cafeteros de Costa Rica. A Coffee Day was organized, which was attended by over one hundred coffee growers, to give them a view of the coffee research program. This activity was organized and conducted as a combined project of the Plant Industry Department and the Department of Agricultural Economics and Rural Life.

A six-months' course was given at the Facultad de Pedagogía of the University of Costa Rica entitled, "The School and the Rural Community". This course has led to the development of very close cooperative ties with the Ministry of Education, the two normal schools, and the Institute. Arrangements are being made to train a person for a year at the Institute, so that he can take over the course a year from now.

Dr. Elizabeth Hoyt of Iowa State College asked the Department to cooperate in a study of relations between levels and standards of living in the Tiquisate area of Guatemala. A graduate student was sent to cooperate with her during the period of her study. The distortion of consumption patterns brought about by a sharp increase in income, the failure of the Company to take into account the value orientation of local people, and some other basic problems were studied by Dr. Hoyt.

ORGANIZATION AND ADMINISTRATION

Permanent Personnel

	Julio O. Morales, Head	Economist
*	Ana Teresa de Sariola	Home Economist
**	Sakari Sariola	Sociologist
**	Eduardo Arze	Sociologist
	Antonio Arce	Assistant in Sociology
	Edwin Murillo	Assistant in Sociology
**	Carlos Montañez	Assistant in Economics

* On leave

** [illegible]

Visiting Scientists

Charles P. Loomis . . . . . Sociologist
Paul C. Morrison . . . . . Geographer

PUBLICATIONS

The following articles were published during the year: "Estudio sobre higiene y salud en la zona rural de Turrialba, Costa Rica, 1948", by Julio O. Morales and other staff members, and "Estudio económico de fincas cafeteras", by Julio O. Morales, W. E. Keepper, and Francisco Gómez Q.

EXTENSION EDUCATION SERVICE

Fernando del Río *

INTRODUCTION

The Extension Education Service of the Inter-American Institute of Agricultural Sciences has been conducted this year toward the attainment of its basic objectives: training in applied rural sciences and extension methods; evaluation of extension methods, and research in extension. Great emphasis has been placed on the training of students in applied rural sciences and extension methods.

An event that is worth special mention is the Evaluation Course or Extension Training Center to be held at the Institute during February 1951, jointly sponsored by FAO and this Institute. We hope that some projects in evaluation of research will be designed as a result of this course.

TRAINING

The following students enrolled in our Service in September 1949 and completed their studies by August 15, 1950:

Applied Rural Science

NAME	COUNTRY	CERTIFICATE
Abreu, Rafael	Venezuela	Estudios y Prácticas
Amaro, Antonio	Venezuela	Estudios y Prácticas
Bernard, Carlos	Venezuela	Estudios y Prácticas
Carrillo, Rafael	Venezuela	None. Six months' course.
Celis, Oswaldo	Venezuela	Estudios y Prácticas
Colmenáres, Fortunato	Venezuela	Estudios y Prácticas
Garrido, Gerardo	Venezuela	Estudios y Prácticas
Infante, Pablo	Venezuela	Estudios y Prácticas
Jahn, Atilio	Venezuela	Estudios y Prácticas
Loreto, Miguel	Venezuela	Estudios y Prácticas
Meléndez, Aristides	Venezuela	Estudios y Prácticas
Muñóz, Antero	Venezuela	Estudios y Prácticas
Parra, Raúl	Venezuela	Estudios y Prácticas
Rivero, Antonio	Venezuela	Estudios y Prácticas
Suárez, Angel	Venezuela	None. Left Feb. 1950.
Suárez, Fernando	Venezuela	Estudios y Prácticas.

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* Report was prepared by Fernando del Río since the Head of the Service, Dr. D. Spencer Hatch, was on leave of absence as UNESCO adviser to the Government of India.

Extension Methods

NAME	COUNTRY	CERTIFICATE
Medina, Adolfo	Venezuela	Métodos de Extensión
Pinto, Enrique	Venezuela	Métodos de Extensión
Romero, Froilán	Venezuela	Métodos de Extensión
Tovar, Evelio	Venezuela	Métodos de Extensión

On october 1950, a new group of Venezuelan students arrived to start studies in specific fields of Applied Rural Science and Extension Methods. This meant a modification of our plan of instruction of the last year, especially in the program of Applied Rural Science under the direction of Prof. Juvenal Valerio.

The following students enrolled in October 1950:

NAME	COUNTRY	FIELD OF WORK
Abreu, Rafael	Venezuela	Animal Industry
Loreto, Miguel	Venezuela	Animal Industry
Noguera, Orlando	Venezuela	Animal Industry
Plaza, Roberto	Venezuela	Cacao
Reyes, Daniel	Venezuela	Cacao
Gómez, Leopoldo	Venezuela	Coffee
Sánchez, Humberto	Venezuela	Coffee
Amaro, Antonio	Venezuela	Extension Methods
Colmenárez, Fortunato	Venezuela	Extension Methods
Infante, Pablo	Venezuela	Extension Methods
Meléndez, Aristides	Venezuela	Extension Methods
Muñóz, Antero	Venezuela	Extension Methods
Suárez, Fernando	Venezuela	Extension Methods

Benjamín Vallarino, a student from the United States, was recommended to study in this department by Mr. José L. Colóm, Secretary of the Inter-American Institute of Agricultural Sciences. He is developing some projects in livestock raising.

Reports have been prepared by Professors Valerio and del Río on the extension training program for the American International Association in Venezuela. These reports give an idea of the quality and extension of the training that is being offered to our students.

Especially noteworthy has been the result of the training given to the students who finished by August 15, 1950. Most of them are now employed with different agencies of the Venezuelan Government, and private agencies, such as the Consejo de Bienestar Rural, Instituto Agrario Nacional, etc.

RESEARCH PROJECTS

A series of projects and subprojects have been prepared. Most of them are in progress. A brief description of each one is as follows:

Training for Extension

Ten students have been under training this year in our community of Turrialba and in Alajuela and Palmares. They are developing certain extension practices, prepared by our office, in each community with the technical assistance of STICA. The training is now under progress.

ORGANIZATION AND ADMINISTRATION

The staff during this year has been as follows:

Dr. D. Spencer Hatch, January 1 to August 17, 1950. After that date he was on leave, acting as UNESCO Adviser to the Government of India.

Dr. Emily G. Hatch was in charge as Acting Head from September 25 to December 31, 1950.

Sr. Fernando del Río joined the staff as Extension Educationist on June 10, 1950.

Prof. Juvenal Valerio has been in charge of Applied Rural Science since January 1, 1950.

Sr. Otón Páez Castro resigned his position on May 15, 1950 in order to engage in private business.

Sr. Gerhard Lück joined the staff as Field Superintendent on May 8, 1950, replacing Sr. Páez.

Miss Inés Stone has served as secretary during the entire year.

Considerable and valuable help was drawn from staff members from the other departments of this Institute.

PUBLICATIONS

The following teaching material has been prepared by the staff members:

Extension Practices, by Fernando del Río:

Crianza de Aves
Crianza de Ganado Vacuno
Cultivo de la Caña

Conservación de Suelos
Organización, Desarrollo y Funcionamiento de Clubes
Uso del Solar de un Hogar Campesino o una Escuela Rural
Relacionándose con la Comunidad (Métodos de Extensión I)

Habilidades para la Vida Rural, by Juvenal Valerio

Elaboración de Abono Orgánico
Aprovechamiento del Suelo en una Finca Pequeña
Inventario para una Finca Pequeña
Contabilidad para una Finca Pequeña
Cultivo de Rábanos, Zanahoria, Remolacha, Espinacas, Lechugas y Mostazas
Poda de Diversos Sistemas en el Café
Selección y Preparación de la Semilla de Café

Preparation of a Prospectus for the Practical Teaching of Extension Methods

A prospectus for the teaching of extension methods in Latin America has been prepared and is being tried with our students.

Preparation of Extension Practices

This subproject is related to the Training in Extension. The following Extension Practices have already been prepared and are being tried in different communities.

1. Poultry raising.
2. Beef cattle raising.
3. Sugar cane cultivation.
4. Soil conservation.
5. Organization, development, and functioning of clubs.
6. Use of the garden of a country house or a rural school.
7. Relating oneself to the community. (Methods of Extension I)

Research and Evaluation of Extension Methods

Data is being recompiled in relation to extension methods. A research project will be designed at the end of the Evaluation Course to be carried on with the participation of STICA.

Development of the Rural Reconstruction Center

This project has been abandoned due to financial shortage.

COOPERATION AND CONSULTATION

Dr. D. Spencer Hatch, Head of the Extension Education Service, left the Institute on August 17, 1950 enroute to New Delhi (India) to act as UNESCO Adviser to the Government of India.

From El Salvador, through the Scientific Communications Service, an article for publication purposes was sent for our criticism. Close cooperation has been established with the national extension program of this country in the training of extension students.

Mr. Fernando del Río has been invited by the Ministry of Education of Costa Rica to study the rural education program of this country. The Normal Rural School at Liberia and the Cervantes Escuela Granja have been visited, and plans are under way for further studies of these schools. Our Service is in charge of courses on home and farm improvement for rural teachers of this country (Community Project).

Habilidades para la Vida Rural, by Juvenal Valerio (Cont.)

Formación de Semilleros de Café
Producción de Almácigo de Café
Producción Higiénica de la Leche
Proyecto de Estudio de la Composición de la Leche y su Valor Nutritivo
Reparación y Mejoramiento de una Casa Campesina
Observación del Desarrollo desde la Flore hasta la Mazorca Madura del Cacao
Estudio de Diversos Tipos de Cacao
Podas en el Cacao
Estudio del Sistema Radical del Cacao

SCIENTIFIC COMMUNICATIONS[1/]

Introduction

Seven of the ten major activities of the scientific communications program were initiated during 1950. Thus, if the first six months of operation of the Scientific Communications Service were dedicated primarily to setting the foundations for the new program, as indicated in the first progress report,[2/] the program entered an active phase in 1950. At the same time, following the recommendation of the Advisory Board during its first session in September, in the latter part of the year the personnel and resources were concentrated on a few key projects. Other activities that had been started on a limited basis were discontinued or kept in abeyance, and the development of new programs postponed. The program for 1950, therefore, was concentrated primarily in the publication of the journal "Turrialba," the abstracting service, the photocopying service, and the farm management text, the other activities being considered collateral to the main program.

The new quarterly technical journal, "Turrialba," was initiated following the plans and policy as laid down for it by the Publications Committee in 1949. Two issues, of 3,000 copies each, were published. The new publication has been well received, both from the point of view of the material and the layout. Although the establishment of a new technical journal is a slow process, "Turrialba" is already filling the need for a technical journal, in Spanish, of wide, inter-American circulation. It has been planned to serve a specific purpose, and in some respects it is unique. Manuscripts from scientists and institutions in the Americas, including those from the Institute, are considered: the scope is not restricted to the agronomic sciences as such; all fields pertaining to agriculture and rural life, as well as to the related sciences, are covered. The tech-

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1/ Second annual progress report submitted to the Administrative Committee during its February 1951 sessions.

2/ "Progress Report on the Improvement of Scientific Communications among the Agricultural Workers in Latin America." This report, submitted to the Administrative Committee during its sessions of February 1950 covered the first six months of operation of the Service (July to December 1949); it dealt primarily with the background of the scientific communications program, status of scientific communications in Latin America, and the organizational and background work done during those six months from which the 1950 program stems.

nical notes section furnishes an outlet for informal progress reports on research underway, and should prove to be an effective means of improving scientific communications. By means of the abstracts and the Library listings of current acquisitions of literature, the scientists that do not have access to adequate library facilities have an additional source of information to keep abreast of the new literature in their fields. The articles abstracted, and smaller pamphlets listed, are available to them through the photocopying service. Information is also supplied as to where and how to obtain the books and bulletins listed. By the end of 1951 we will have a clear picture of the response to the Journal and its acceptance, as reflected primarily in the statistics on exchange, complementary subscriptions to institutions, and subscriptions taken by individual technicians.

The abstracting section of "Turrialba" represents a cooperative service that will require time before it can be established on a firm basis. The original goal of 1,200 abstracts per year proved to be too high for the time being; the Advisory Board, therefore, recommended a goal of 400 abstracts for the first year. For the first two issues of the Journal, 128 abstracts, summaries, and annotations were published. Seventy-five of these were prepared by 21 staff members and two outside cooperators. The number of original abstracts increased from 22 in the first issue to 53 in the second. It is evident that during 1951 it will be necessary to increase substantially the abstracting rate of staff members (now an average 3.6 per staff member) and to enlist the cooperation of several more outside abstractors, even to reach the goal of 400 set for the first year. Part of the program for 1951 will be to determine methods of evaluating the comparative efficiency of the Spanish abstracting service of "Turrialba" with other methods used for the improvement of scientific communications in Latin America among agricultural technicians.

The original goal established for the photocopying service was 5,000 photocopies per year. During the first fiscal year, 1949-50, the service was below the goal since only 1899 photocopies were distributed. For the comparable 12-month period of the calendar year 1950, nevertheless, the goal was exceeded since a total of 5,284 photocopies were distributed. In comparison with a total of 827 photocopies for the period July-December 1949, a total of 4,212 photocopies were distributed from July to December 1950. Of the total distributed in 1950, 47.27% was requested by individual technicians in the Americas, 26.87% by the Library of the Institute, and 25.86% by the Libraries of 31 institutions. The institutions making greater use of the service were the Escuela Nacional de Agricultura, Lima, Perú; Escola Superior de Veterinaria, Belo Horizonte, Minas Gerais, Brasil; and the Facultad de Medicina Veterinaria, Lima, Perú. The largest number of requests came from Argentina, Brazil, Colombia, Peru and Venezuela. Although we believe that charging those using the photocopying service in Latin America the full cost of US$ 0.10 per page would limit to a large extent the

scope of the service, the increasing amount of requests and the limitations of funds will make it necessary to adopt a system of payment at, perhaps, the rate of five cents per page. It is expected that during 1951 the Rockefeller Foundation will agree to release the funds allocated for the establishment of the photocopying service in Turrialba to reinforce the services now received from the Library of the United States Department of Agriculture and the Library of the Facultad de Agronomía y Veterinaria, Universidad de Buenos Aires. The verification of references and the preparation of limited lists of reference, services furnished by the Institute Library, have proven to be a valuable by-product of the photocopying service.

In 1950 the program for the distribution of abstract journals and bibliographies was initiated, to supplement the other aspects of the overall program. The object of this project is to improve the facilities, at selected agricultural institutions in the Americas, for the location of references and the preparation of bibliographies. A total of 153 one-year subscriptions to 21 journals (ranging from three to ten per institution) were donated to 23 agricultural colleges and other institutions in Latin America. We have noticed a very definite increase in photocopying orders that originate in consultation of these journals. By recommendation of the Advisory Board, during 1951 the level of subscriptions will be kept as it was in 1950. By 1952 the amount allocated will be reduced by approximately 50% and the institutions will be expected to assume directly the payment of half of the subscriptions.

The revision and translation of "Elements of Farm Management," by John A. Hopkins was completed in 1950 and the printing contract signed with Editorial Atlante, Mexico, D.F., for an edition of 3,000 copies. The book will be ready for distribution early in 1951. This is the first agricultural text to be revised, translated and published by the Institute. The publication was made possible by a grant from the U. S. Department of State. With this text it is expected that the teaching of agricultural economics in Latin America will be substantially improved. The Advisory Board recommended that proceeds from the sale be placed in a special fund to be applied to the publication of other agricultural texts in the future.

The collateral activities of the program for 1950 included the publication of the "Information Bulletin," the bulletin "Cacao," and other publications; assistance in the handling of technical meetings, and the centralization of the photographic files in the Service. The "Information Bulletin" was placed on a monthly basis and a Spanish edition added; over half of the present Spanish edition mailing list of 922 was added during 1950. For the bulletin "Cacao" (formerly "Cacao Information Bulletin"), the Scientific Communications Service furnished the part-time services of an Editor; in June, a questionnaire was sent to the readers of the

bulletin, requesting their opinion as to its usefulness and suggestions for the improvement of the publication; although the replies to the questionnaire clearly indicated that the bulletin was rendering a useful service, because of lack of funds the publication was discontinued effective January 1951. During 1950, seven publications were added to the Reprint Series; the distribution of this series from Turrialba was limited and in no month reached a hundred.

The Scientific Communications Service cooperated with other Departments in the FAO Grain Drying and Storage Conference (April 24-25 at Turrialba, other in San José), the joint FAO-Turrialba Inter-American Livestock Production Conference (Turrialba, October 9 to 20), and the Third Session of the Inter-American Technical Cacao Committee (Trinidad, November 20 to 24). The documents for six technical meetings in which the Institute participated were registered in the files of the Service. Following the recommendation of the Advisory Board, the registry of documents of technical meetings will be passed to the Central Files of the Institute in 1951. The photographic file was centralized in the Service and cooperation was given to other departments in the preparation of exhibits. The Advisory Board recommended that visual aids, with the exception of the photographic file, be handled by the Extension Service of the Institute.

Exchange among institutions and personal exchange among technicians are leading functions of the program for the improvement of scientific communications. Outside of the activities indicated above, no further services were started in 1950 due to limitations of personnel and funds. Thus, for example, the files of technicians and institutions that had been contemplated have not been organized and no special studies were made. The steady increase in the volume of correspondence, nevertheless, partially indicates the relationship with outside institutions and technicians: the average letters per month increased from 69 in the second semester of 1949 to 149 in the first semester of 1950, to 189 in the second semester. At the same time, in 1950 the volume of correspondence was kept from increasing by using postal cards to handle routine mail and eliminating unnecessary correspondence. Although we will continue avoiding direct mail, it is expected that the volume of correspondence will continue to be larger as the services increase.

It is expected that in 1951 it will be possible to initiate, on an exploratory basis, one of the special projects for which preliminary information has been accumulated in the past, but that were held in abeyance because of pressure of work along the active programs reviewed above. A study of the characteristics and frequency of use of the Latin American agricultural technical journals; the preparation of glossaries of technical terms in the agricultural sciences, leading eventually to the publication of a four-language technical dictionary; and the compilation of periodic directories of workers in agricultural experiment stations, other research institutions, and agricultural colleges in Latin America,

would set the foundations for further improvement of scientific communications in the Americas and would contribute directly as well towards the accomplishment of that end.

Progress Report by Activities

"Turrialba" - The first issue of the new quarterly technical Journal of the Institute was published in July 1950, the second in October. The two issues had a total of 126 pages, including the Library listings of recent acquisitions which, in the first issue, were published as a supplement. The material published in the first two issues included nine articles, six technical notes, 128 abstracts and annotations, 28 information items, 19 biographical sketches of authors, and 540 Library listings of books and pamphlets. A total of 30 manuscripts were considered during 1950 for publication in the Journal. Of the 15 published, nine were by members of the staff at Turrialba, three of the U. S. Office of Foreign Agricultural Relations in cooperation with the Centro Nacional de Agronomía, San Salvador, El Salvador, and the Estación Experimental Agronómica, Santiago de las Vegas, Cuba; one each from Johns Hopkins University, Baltimore, Maryland, and to the Viking Foundation, New York, New York, and one from a scientist resident of Costa Rica. The classification, by crop subjects and by fields of science, of the articles published is as follows:

Subjects		Fields	
Coffee	3	Agricultural Engineering	1
Corn	2	Animal Nutrition	1
Henequen	1	Animal Physiology	1
Kenaf	1	Entomology	2
Roughages	1	General Agriculture	1
Tomatoes	1	Geology	1
Others	6	Plant Genetics	2
Total	15	Plant Pathology	2
		Plant Physiology	1
		Rural Sociology	1
		Seed Technology	2
		Total	15

Practically all of the first issue of the Journal was distributed on a complementary or exchange basis to the colleges of agriculture in Latin America and the United States, the agricultural experiment stations in the United States and to practically all in Latin America, to the Ministries of Agriculture, and to leading technicians, including all those who last year organized an informal association of geneticists in Mexico City. Approximately 2,500 copies were distributed. Beginning with the second issue, and following the policy established by the Publications Committee of the Institute, the Journal has

been sent on exchange by our Library to institutions only. Individuals receive it on a subscription basis at the cost rate. While an overall plan is formulated to accept payment in national currencies by means of a coupon system, specific arrangements have been made in Colombia, Costa Rica, and Nicaragua to accept payment in national currencies. (Armando Samper).

Abstracting Service - With the first issue of "Turrialba" this new service was initiated as a fundamental project in the scientific communications program. Below are summarized the sources of abstracts, summaries, and annotations; the journals from which abstracts have been translated; and the distribution of the abstracts by subjects covered.

The abstracts used in "Turrialba" have the following sources: a) those prepared by the technical staff of the Institute and outside cooperators; in the table given below they are grouped as "original" since they are prepared especially for the Journal; b) those translated from abstract journals published in English; in the table they are given as "translated"; and c) those lifted from other sources in which they were published in Spanish; these are selected by the staff members at Turrialba and in the table appear as "reprinted". These groups accounted for the following number of abstracts and summaries published in the first two issues of "Turrialba":

Source	July Issue	October Issue
	1/	2/
Original	22	53
Translated	22	8
Reprinted	20	3
Total	64	64

For the translations, 11 abstract journals were used, as follows:

Animal Breeding Abstracts
Dairy Science Abstracts
Field Crop Abstracts
Forestry Abstracts
Herbage Abstracts
Horticultural Abstracts
Nutrition Abstracts and Reviews
Plant Breeding Abstracts
Review of Applied Mycology
Journal of Soils & Water Conservation
Soils and Fertilizers

1/ Of the total of 75 original abstracts, 72 have been prepared by 21 Institute technicians and three by two outside cooperators.

2/ In this figure are also included 23 annotations, also prepared by members of the staff at Turrialba.

Those journals from which abstracts were lifted were "Boletín Informativo," publication of the Library of the Centro Nacional de Investigaciones de Café, Chinchiná, Caldas, Colombia; "Ciencias Sociales," published by the Office of Social Sciences, Pan American Union, Washington, D.C.; "Revista Analítica de Educación Fundamental," Education Clearing House, UNESCO, Paris; and "Revista de Investigaciones Agrícolas," Ministerio de Agricultura y Ganadería, Buenos Aires, Argentina.

In the first two issues of "Turrialba" a total of 128 abstracts, summaries, and annotations were published on the following subjects:

Almacenamiento de granos	3	Fitopatología y entomología	11
Cacao	4	Frutas tropicales	3
Café	4	Genética	4
Ciencias bibliotecarias	3	Hortalizas	3
Crianza animal	5	Meteorología (climatología)	4
Cultivos tropicales	7	Nutrición animal	7
Cultivos zonas templadas	2	Nutrición humana	5
Economía agrícola	9	Plantas oleaginosas	3
Educación rural	7	Silvicultura	3
Estadística	2	Sociología	11
Fisiología animal	2	Suelos y abonos	13
Fisiología y taxonomía	11	Varios	2
		Total	128

(Alejandro Mac Lean)

Photocopying Service - This service, by which technicians in the Americas may request photocopies of journal articles pertaining to agricultural research in which they are working, supplied free of charge 475 requests for a total of 5,118 photocopy pages to 31 institutions and 67 technicians in 18 Latin American Republics; 28 orders for 166 photocopy pages were sold for a total of $16.60 (see Appendix A). We believe the increase in the number of requests for photocopies was due primarily to the placement of abstract journals and bibliographies in the various Latin American institutions and to direct promotion among technicians. Orders for photocopies of the articles abstracted in "Turrialba" have already been received. Next year we will be in a better position to indicate more accurately the sources of these requests for photocopies.

Photocopies are supplied by the USDA Library at a cost of US $0.10 per page. It is expected that as soon as the volume of requests justifies the placement of a photostatic machine in Turrialba, the Institute will request formally from the Rockefeller Foundation, which is cooperating in this phase of the scientific communications program, the photostatic laboratory for which funds are now available. (Helen C. George).

Plan for the Strategic Location of Collections of Abstract Journals and Bibliographies in the Americas - In connection with the scientific

communications program of the Institute, and aided by a grant from the Rockefeller Foundation, this Service has located 153 subscriptions to 21 abstract journals and bibliographies in 23 agricultural institutions during the first year of this phase of our program (see Appendix B). Eleven colleges of agriculture, 4 colleges of veterinary medicine, 3 agricultural experiment stations, 4 practical agricultural schools, and 1 national library cooperated in this program during 1950, representing 13 of the American Republics. Subscriptions were placed to 6 U. S. journals and to 15 journals of the Commonwealth Agricultural Bureaux.

Thirteen one-year subscriptions to "Bibliography of Agriculture" were donated free to cooperators in this program by the Library of the USDA.

Invitations to participate in this program were also sent to 12 additional institutions in 5 other American Republics, from which no replies were received.

We have noticed a very definite increase in the number of photocopy orders that originate in consultation of these journals. We are expecting now the reports of the librarians on the circulation statistics for these journals in their respective institutions.

The allocation for 1950 for the placement of abstract journals and bibliographies was $1,500; the actual expenditure amounted to $1,341. (Helen C. George)

Farm Management Text - In June the translation of "Elements of Farm Management," by John A. Hopkins, was completed. The manuscript has 587 pages divided into 26 chapters, has 69 illustrations, and contains an English-Spanish and a Spanish-English glossary of farm management terms. This is the first text to be published by the Institute, and the publication has been made possible with a grant of the Department of State of the United States made through Science Service, Washington, D.C. The author rewrote more than 60% of the text in order to adapt it to the conditions prevalent in Latin America; this revision was made on the basis of the professional experience the author has had principally in Argentina, Brazil, Colombia, and Mexico, where he has worked for the past seven years. In collecting and interpreting essential farm management information he had the cooperation of several of the agricultural attachés in Embassies of the United States in Latin America, and the assistance of several persons interested in the economics of agricultural production, especially from the Dirección de Economía Rural, Secretaría de Agricultura y Ganadería, Mexico, D.F.; Facultad de Agronomía y Veterinaria, Universidad de Buenos Aires, Argentina; Facultad de Economía Industrial y Comercial, Gimnasio Moderno, Bogotá, Colombia, and from the Department of Economics and Rural Life of the Institute.

The translation was done by B. F. Osorio-Tafall, Regional Officer for Latin America, Food and Agriculture Organization of the

United Nations. Julio O. Morales read and criticized the manuscript, and assisted us in the revision of the translation. The book will be published for the Institute by Editorial Atlante, in Mexico, in an edition of 3,000 copies. It will be ready for distribution around April 1951. (Armando Samper, Alejandro Mac Lean)

"Information Bulletin" - Beginning with the January 1950 issue, a Spanish edition was started and the Bulletin became a monthly publication; prior to that time it had been published only in English and it was irregular. Bulletin Number 26 was published in December. From September 1946, when the publication was started, to August 1949, 14 issues had been published.

During 1950 the articles published fell in the following groups:

Technical inter-American meetings	9
Cooperative projects in member countries	9
Research work at Turrialba	11
Programs of institutions in other countries	6

The last page of the Bulletin is dedicated to announcements of the photocopying service and of recent publications of the Institute. The Spanish mailing list as of December 1950 had 922 cards, of which 552 were added during the year (see Appendix C). Among the subscribers are workers in the agricultural sciences, farmers, official and private organizations concerned with agriculture, agricultural experiment stations, and Ministries of Agriculture in Latin America. Argentina, Brazil, Colombia, Costa Rica and Mexico are the countries where the largest number of copies are distributed. In October a card was sent to those receiving the Bulletin, requesting them to ratify their interest in receiving it and verifying the address. Thus, the mailing list will be brought up-to-date with only those actually interested in receiving the publication. (Armando Samper, Alejandro Mac Lean)

"Cacao" - This Bulletin, formerly called "Cacao Information Bulletin," was published during 1950 in both the English and the Spanish editions. Beginning in May, the Scientific Communications Service assisted the Cacao Center by furnishing the part-time services of an editor. In June, a questionnaire was sent the readers with a view to analyzing the actual services rendered by the publication. By December, 71 replies had been received from 20 countries. Practically all the replies indicated that the service was considered valuable by the readers. The replies to the questionnaire will be tabulated and analyzed. During the Third Session of the Inter-American Technical Cacao Committee, held in Trinidad in November, a committee studied the exchange of information on cacao. Pertaining to "Cacao" the group concluded that: 1) the Bulletin was rendering valuable services; 2) the press run should be increased; 3) the same type of audience should

be maintained, that is, that it should continue to publish information of interest to technicians, farmers, and other persons interested in the cacao industry; and 4) the new sections introduced to the Bulletin - news and abstracts - add usefulness to the publication.

The name was changed in July; at the same time improvements were made by giving it a new masthead in cacao color, using halftones, and adding the new sections on news and abstracts. To satisfy the increased demand for the Bulletin, the press run was increased from 700 to 1,000 copies in the English edition as well as in the Spanish. The Spanish mailing list increased during the year by 98 cards and the English mailing list by 53. (Alejandro Mac Lean)

Other Publications and Registry of Manuscripts - With the initiation of "Turrialba" most of the work of the Institute has been published in the Journal; no technical bulletins, therefore, were published during 1950. The practice of reproducing in the Reprint Series the technical and popular articles by members of the staff published in "Turrialba" or in outside journals was continued. During the year the following reprints were published:

Number in Series	Title, Author and Reference
30	The Santa Gertrudis breed; the genesis and the genetics of a new breed of beef cattle, by A. O. Rhoad. Journal of Heredity 40(5): 115-126. May 1949.
31	Graneros para la América tropical, por Norton C. Ives. La Hacienda 44(8):38-40. Agosto 1949.
32	Nuevos sistemas para el secamiento de granos en los trópicos americanos, por Norton C. Ives. La Hacienda 44(10):35-38, 58. Octubre 1949.
33	The development of dairy breeds for the tropics, by A. O. Rhoad. Paper presented at the Twelfth International Dairy Congress, Stockholm, Sweden, 1949. 4 p.
34	Bases económicas para la investigación sobre café y cacao, por Julio O. Morales y L. Paul Oechsli. Agricultura Tropical (Colombia) 5(12):19-26. Diciembre 1949.
35	Producción de variedades de tomates para los trópicos húmedos, por E. H. Casseres y Pedro J. Linares. Turrialba 1(1):7-11. July 1950.

36 Dissemination of Omphalia Leaf Spot of Coffee, by Frederick L. Wellman. Turrialba 1(1): 12-27. July 1950.

37 Un programa de selección para Coffea arabica, por Manuel Elgueta. Turrialba 1(1):37-43. July 1950.

The circulation of reprints was handled principally by the Washington office; few copies were distributed directly from Turrialba as indicated by the following monthly figures:

January	14	July	2
February	8	August	39
March	12	September	31
April	2	October	5
May	14	November	79
June	21	December	81
1st Semester	71	2nd Semester	237

Until the fiscal year 1949-50, 2,000 copies were processed at the Pan American Union by our Washington office of each article included in the Reprint Series. During the present fiscal year this figure was lowered to 1,000. Due to fiscal limitations, for the coming fiscal year, 1951-1952, the Series will either be discontinued or only 100 copies reprinted of each article.

Beginning in 1949, the annual report was shifted from a fiscal year basis (the last one being 1947-1948) to a calendar year basis. Beginning with the 1950 report, a new system of presentation will be adopted to facilitate consultation of the annual report.

The registry of manuscripts started in 1949 was continued during 1950. This registry consists of manuscripts prepared by members of the staff, of which a copy is sent to the Scientific Communications Service, and includes manuscripts intended for publication, papers presented at technical meetings, special reports, etc. A total of 43 were registered during 1950; the list by index numbers, authors, and titles is indicated in Appendix D. (Armando Samper)

Technical Meetings and Conference Files - The Service handled the registration for the Turrialba sessions of FAO's Grain Drying and Storage Conference April 24-25 at the Institute. It also handled all preliminary arrangements and the actual mechanics of the joint FAO-Institute Inter-American Livestock Production Conference held at Turrialba, October 9-20, and assisted the Cacao Center at the Third Session of the Inter-American Technical Cacao Committee, held at Imperial College, Trinidad, November 20-24.

The documents for the following conferences were registered: First Livestock Conference of the Caribbean Commission, Trinidad, Albert O. Rhoad, delegate; Turrialba sessions of the FAO Grain

Drying and Storage Conference, Norton C. Ives and Emilio Viale, delegates; Cuarta Asamblea General y Quinta Conferencia Técnica de la Federación Cafetalera de Centro América y México, Tegucigalpa, Honduras, Manuel Elgueta, delegate; the Forty-Fifth Annual Meeting of the American Dairy Science Association, Ithaca, New York, Jorge de Alba, delegate; the first meeting of the Advisory Board of the Scientific Communications Service, Washington, D. C., Armando Samper and Helen George, delegates; the joint FAO-Institute Inter-American Livestock Production Conference, Turrialba, Costa Rica, Albert O. Rhoad, delegate. While the international conference files were located in the Scientific Communications Service in 1950, next year they will be turned over to the Central Files. (Helen C. George)

Visual Aids - In cooperation with the Ministries of Agriculture and Hygiene, this Service arranged for Institute exhibits at the National Fair at Cartago April 15-20. Four exhibits, indicating the cooperation of the Institute with the Ministry of Agriculture, were prepared in cooperation with the Plant Industry Department on the corn, potato, sugar cane and coffee work now underway; a nutrition exhibit, in conjunction with the display by the Ministry of Hygiene, was prepared by the Department of Agricultural Economics & Rural Welfare; a grain and rice storage exhibit, by the Department of Agricultural Engineering; the Extension Service prepared an exhibit on the effective use of chlordane in the control of ants; and animals from the Animal Industry Department were displayed.

At the request of the Scientific Communications Service, Jim Mitchell, Visual Aids Specialist of OFAR, came to the Institute in May and took 121 photographs and 111 slides covering various phases of Institute projects. These are now on file in this Service for use by the staff.

In August, a photographic display covering the various phases of cacao cultivation was prepared with the cooperation of the Cacao Center for the American Cocoa Research Institute, to be used at the International Congress of Chocolate and Cocoa Manufacturers in Lausanne, Switzerland. Twenty-three photographs, 8" x 10", mounted and with legends, were delivered to the American Cocoa Research Institute in Washington.

It was recommended by the Advisory Board that visual aids, with the exception of the photographic file, be handled by the extension Service of the Institute. (Helen C. George)

Cooperation and Consultation

Argentina

Universidad de Buenos Aires - With assistance from Hans Gravenhorst, Librarian, an agreement was made with the Facultad de

Agronomía y Veterinaria to obtain from it, in cooperation with the Facultad de Ciencias, photocopies of material not available at the U. S. Department of Agriculture Library.

Great Britain

Colonial Office - With the visit of G.A.C. Herklots, Secretary for Colonial Research, to the Institute in March, an agreement was made by which the Colonial Office will supply requested information and literature pertaining to agricultural research work carried on in the Colonial research institutions; the Institute will, likewise, supply information on work carried on in the Americas. Several times during the year technical information and publications requested from us by Latin American technicians were obtained from the Colonial Office.

Commonwealth Bureau of Animal Breeding and Genetics - Through the cooperation of J. P. Maule, an agreement was made with this Bureau by which one-year subscriptions to "Animal Breeding Abstracts" will be supplied in 1951 as a contribution of the Bureau to the program of the distribution of abstracts and bibliographies in Latin America.

United States

Cornell University - Consultation was held in Ithaca, New York, with members of the staff of the Department of Extension Teaching and Information concerning techniques used in the preparation of extension leaflets. Mr. Thomas R. Humphrey, Chief Engineer of the Cornell University radio stations and the Rural Radio Network, supplied excellent advice on recording equipment for technical meetings.

National Research Council - Close contact was established with the Committee on International Scientific Publication, with assistance from Mrs. Christina Buechner, Executive Secretary, and information supplied for the directory of scientists and scientific institutions in Latin America that is being prepared by the Committee.

Pan American Union - An agreement was made with Dr. Arthur Gropp, Librarian of the Columbus Memorial Library, by which limited reference services will be supplied to the Institute to supplement those of our own Library and the Library of the United States Department of Agriculture. With the Office of Social Sciences an agreement was made, through Mr. Theo R. Crevenna, by which that office will contribute one subscription of its abstract bulletin "Ciencias Sociales" to each of the institutions participating in the program for the distribution of abstracts and bibliographies.

United States Department of Agriculture - Ralph Shaw, Librarian, contributed to the program for the distribution of abstracts with one-year subscriptions to "Bibliography of Agriculture" for each of the participating institutions, and with back files for selected ones.

Helen George received training in the Photocopying Laboratory of the Library on the operation of the photocopying equipment. In cooperation with Frederick L. Wellman, Office of Foreign Agricultural Relations, a leaflet on seed treatment was prepared, as a trial in the preparation of that type of material. OFAR sent the leaflet in consultation to the cooperative stations in Latin America.

Uruguay

Oficina de Cooperación Científica para la América Latina (UNESCO) - A. Giuntoli, of this office, visited the Institute in February and ideas were exchanged on the possible cooperation between the two services. Preliminary inquiries have been made with the Director of this Office to coordinate the bibliographical services they supply with the photocopying service of Turrialba.

Trinidad

Caribbean Commission - Information was supplied to the Caribbean Commission as cooperation in the directory on research in the Caribbean that was published by this office at the end of the year.

Organization and Administration

The Advisory Board was formally established in May, following the resolution approved by the Administrative Committee in February 1950. Six members were appointed for a two-year term:

Walter N. Bangham, former Editor, "La Hacienda", New York City.

R. E. Buchanan, former Dean of the Graduate School and Director of the Experiment Station, Iowa State College, Ames, Iowa.

John E. Flynn, Editor, "Biological Abstracts," Philadelphia, Pennsylvania.

Hans Gravenhorst, Librarian, Facultad de Agronomía y Veterinaria de la Universidad de Buenos Aires, Buenos Aires, Argentina.

Carlos Madrid, Dean, Facultad de Agronomía, Medellín, Colombia.

Ralph R. Shaw, Librarian, U. S. Department of Agriculture, Washington, D. C.

A seventh member will be appointed in the near future. The first session of the Advisory Board was held September 5 to 7 at the Pan American Union. Ralph R. Shaw was elected Chairman of the

Board and presided over the meetings. The conclusions of this first session have been summarized in a separate report (see Appendix E).

An addressing machine was ordered to mechanize the mailing of publications. The file of publications was organized in magafile boxes.

Alejandro Mac Lean joined the staff of the Institute on July 1 as half-time editor of the bulletin "Cacao" and Assistant Editor in the Scientific Communications Service. Iris Proudfoot de Arevalo was appointed Stenographer on July 1 and became Secretary on November 15, when Helen George was promoted to Information Assistant.

APPENDIX A
Photocopying Service
Photocopies Distributed to Institutions and Technicians by Countries

Argentina - 334

Institutions - 164

Facultad de Agronomía, La Plata - 75
Facultad de Agronomía y Veterinaria, Buenos Aires - 89

Technicians - 170

Ing. Rubén A. Mattos, Roque Saenz - 20
Dr. Ovidio Nuñez, La Plata - 138
Ing. Benigno Segovia, Valle de Río Negro - 12

Brazil - 342

Institutions - 142

Escola Superior de Veterinaria, Belo Horizonte - 121
Instituto Agronómico, Belo Horizonte - 7
Escola Superior de Agricultura, Vicosa - 7
Escola Agronómica da Bahia, Cruz das Almas - 7

Technicians - 200

Dr. Gustavo do Valle, Belo Horizonte - 104
Dr. Joao Barisson Villares, São Paulo - 50
Mario Bezerra de Carvalho, Pernambuco - 46

British West Indies - 1

Technician - 1

H. J. Page, St. Augustine, Trinidad, B.W.I. - 1

Chile - 7

Institutions - 7

Escuela de Agronomía, Universidad de Chile, Santiago - 7

Colombia - 645

Institutions - 53

Estación Agrícola Experimental, Armero - 7
Facultad de Medicina Veterinaria, Bogotá - 7

Centro Nacional de Investigaciones de Café, Chinchiná - 18
Estación Agrícola Experimental, La Picota - 7
Facultad de Agronomía, Medellín - 7
Facultad de Agronomía del Valle, Palmira - 7

Technicians - 592

Dr. J. G. Hawkes, Bogotá - 149
Fernando Suárez de Castro, Chinchiná - 51
Antonio J. Posada, Bogotá - 9
Dr. Jaime Santos S., Bogotá - 32
Ing. Carlos Garces O., Medellín - 40
L. J. Carvajalino Jacome, Bogotá - 87
Sr. Jorge Zuluaga, Bogotá - 1
Ing. Juan Orejuela N., Cundinamarca - 40
Dr. Otto Urhan, Chinchiná - 30
Sr. Gilberto Rioja, Popayán - 87
Ing. Alberto Machado, Chinchiná - 1
Sr. Rodrigo Jaramillo, Palmira - 37
Ing. Christopher Navarrete, Barranquilla - 28

Costa Rica - 260

Institutions - 90

Facultad de Agronomía, San Pedro de Montes de Oca - 59
Inter-American Institute of Agr. Sciences, Turrialba - 31

Technicians - 170

Armando Samper, Turrialba - 17
Edward J. Tanner, San José - 1
J. W. Brumbelow, San José - 1
Howard M. Gabbert, San José - 1
George Woodbridge, San José - 1
Francisco Seravalli, San José - 1
Antonio Arce, Turrialba - 62
Gregorio Alfaro, Turrialba - 40
Jorge León, Turrialba - 35
F. J. Peralta, San José - 11

Cuba - 73

Institutions - 7

Estación Agrícola Experimental, Santiago de las Vegas - 7

Technicians - 66

Ing. Arturo Pino Navarro, Balma Sariano - 6
Ing. Mateo Ones, Havana - 5

Fremiot Rodríguez, Matanzas - 31
Sr. Roberto Barreto, Jovellanos - 24

Ecuador - 184

Institutions - 26

Estación Agrícola Experimental, Quito - 7
Facultad de Agronomía, Universidad Central del Ecuador, Quito - 7
Instituto Ecuatoriano del Café, Manabi - 12

Technicians - 158

Abel Gilbert, Guayaquil - 66
Russell Desrosiers, Guayaquil - 47
Miguel Aspiazu, Guayaquil - 1
Ake Burchardt, Guayaquil - 1
Dr. Laurenz Greene, Quito - 1
Oswaldo Guerra, Quito - 42

El Salvador - 24

Institutions - 7

Centro Nacional de Agronomía, Santa Tecla - 7

Technician - 17

Dr. Jorge Flores M., San Salvador - 17

Guatemala - 12

Institution - 7

Escuela Nacional de Agricultura, Villa Nueva - 7

Technicians - 5

Dr. W. Cowgill, Guatemala City - 1
Joaquín Goubaud, Guatemala City - 1
Marco Flores, Guatemala City - 1
Dr. Ellis Darley, Guatemala City - 1
Graham Quate, Guatemala City - 1

Haiti - 207

Institution - 7

L'Ecole Nationale d'Agriculture, Damien - 7

Technicians - 200

M. Georges Cadet, Port-au-Prince - 197
Bertran Daidaille - 3

Honduras - 3

Technicians - 3

Dr. Pompilio Ortega, Tegucigalpa - 1
Dr. Albert S. Muller, Zamorano - 1
L. A. Richardson, La Ceiba - 1

Mexico - 77

Institutions - 14

Escuela Particular de Agricultura, Ciudad Juárez - 7
Escuela Superior de Agricultura, "Antonio Narro", Saltillo - 7

Technicians - 63

Manuel Zamara, Jr., Veracruz - 38
Ing. Salvador Sánchez Colín, San Jacinto - 11
Ing. Leonardo Cabrera V., Tapachula - 5
Dr. Antonio Vargas, San Jacinto - 9

Nicaragua - 87

Institution - 65

Escuela Nacional de Agricultura, Chinandega - 65

Technicians - 22

Ing. Manuel Salazar, Managua - 8
Paul G. Adams, Managua - 10
Dr. Edmundo Saballos, Chinandega - 4

Panama - 8

Institution - 7

Escuela Nacional de Agricultura, Divisa - 7

Technician - 1

Guillermo Villegas, Panamá City - 1

Paraguay - 13

Institution - 7

Escuela Nacional de Agricultura "Mariscal Estigarribia," Asunción - 7

Technician - 6

Alfredo Ruiz, Santa Rosa, Misiones - 6

Peru - 1020

Institutions - 751

Escuela Nacional de Agricultura, Lima - 631
Facultad de Medicina Veterinaria, Lima - 120

Technicians - 269

Ing. Bartolomé Ríos, Lima - 31
Dr. José C. Plaza Roca, Lima - 50
Juana C. Infantes Vera, Lima - 62
Ing. Manuel Lescano Alva, Tingo María - 7
Hernán García L., Lima - 108
Dr. José Santivañez, Lima - 11

Philippine Islands - 206

Technicians - 206

Rafael Bartolomé - 7
Romeo Martínez - 199

Uruguay - 7

Institution - 7

Facultad de Agronomía, Universidad de la República, Montevideo - 7

U.S.A. - 9

Technicians - 9

Dr. R. E. Buchanan, Ames, Iowa - 4
Dr. Claud L. Horn, Washington, D. C. - 1
Dr. H. M. Miller, Jr. - 3
Dr. Leonard J. Schwarz, Washington, D. C. - 1

Venezuela - 345

Institution - 5

Facultad de Ingeniería Agronómica, El Valle - 5

Technicians - 340

Manuel Palma, Ocumare de la Costa - 1
R. E. Pontis Videla, Maracay - 3
Carlos Bernard Ponce, Caracas - 28
Hernán Oropoza, Maracay - 67
Dr. Rafael Videla, Maracay - 171
Ing. Guillermo Bonilla, Caracas - 70

5,284 photocopies supplied 31 institutions and 68 technicians in 18 American Republics.

Photocopy Service Summary - 1950

Month	Number of Orders			Number of Photocopies		
	Outside	Library	Total	Outside	Library	Total
January	3	--	3	69	--	69
February	28	--	28	199	--	199
March	11	24	35	114	156	270
April	--	13	13	--	85	85
May	3	--	3	9	--	9
June	47	5	52	367	73	440
1st Half	92	42	134	758	314	1,072
July	9	12	21	158	124	282
August	82	17	99	706	114	820
September	55	--	55	584	---	584
October	28	--	28	243	---	243
November	75	41	116	1,039	750	1,789
December	44	6	50	376	118	494
Total	385	118	503	3,864	1,420	5,284

Average number of pages per order - 10-1/2.

APPENDIX B

1950 Location of Collections of Abstract Journals and Bibliographies in the Americas

Argentina

Facultad de Agronomía y Veterinaria, Buenos Aires (10 sub.)
Facultad de Agronomía, La Plata (4 sub.)

Bolivia

Facultad de Ciencias Agronómicas, Cochabamba (7 sub.)

Brazil

Escola Superior de Veterinaria, Belo Horizonte (5 sub.)
Instituto Agronómico, Belo Horizonte (8 sub.)
Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba (4 sub.)
Escola Superior de Agricultura, Vicosa (6 sub.)

Chile

Escuela de Agronomía, Santiago (7 sub.)

Colombia

Estación Agrícola Experimental, Armero (9 sub.)
Facultad de Medicina Veterinaria y Zootecnia, Bogotá (7 sub.)
Centro Nacional de Investigaciones de Café, Chinchiná (8 sub.)
Facultad de Agronomía, Medellín (9 sub.)
Facultad de Agronomía del Valle, Palmira (10 sub.)

Costa Rica

Facultad de Agronomía, San Pedro Pontes de Oca (8 sub.)

Guatemala

Escuela Nacional de Agricultura, Villa Nueva (3 sub.)

Mexico

Escuela Particular de Agricultura, Ciudad Juárez, Chih. (4 sub.)
Escuela Sup. de Agr. "Antonio Narro," Saltillo (6 sub.)

Nicaragua

Escuela Nacional de Agricultura, Chinandega (4 sub.)

Panama

Biblioteca Nacional, Ciudad de Panama (3 sub.)

Peru

Escuela Nacional de Agricultura, Lima (6 sub.)
Facultad de Medicina Veterinaria, Lima (9 sub.)

Uruguay

Facultad de Agronomía, Montevideo (8 sub.)

Venezuela

Facultad de Ingeniería Agronómica, El Valle (9 sub.)

One hundred fifty-three one-year subscriptions to 21 journals were donated to the 23 above institutions in Latin America in 1950.

Subscriptions Placed	Journal
14	Soils and Fertilizers
13	Animal Breeding Abstracts
13	Bibliography of Agriculture
13	Horticultural Abstracts
11	Nutrition Abstracts and Reviews
11	Plant Breeding Abstracts
10	Biological Abstracts - Complete
10	Herbage Abstracts
9	Field Crop Abstracts
8	Veterinary Bulletin
7	Chemical Abstracts
6	Forestry Abstracts
5	Agricultural Index
5	Review of Applied Entomology, Series B
5	Review of Applied Mycology
4	Biological Abstracts, Section D
4	Review of Applied Entomology, Series A
2	Dairy Science Abstracts
1	Bacteriological Reviews
1	Helminthological Abstracts
1	Index Veterinarius
153	Subscriptions

APPENDIX C

Mailing List - "Information Bulletin" (Spanish)

	4/1/50*	12/31/50	Increase
Argentina	33	67	34
Bolivia	7	12	5
Brazil	43	98	55
Chile	12	24	12
Colombia	50	138	88
Costa Rica	41	102	61
Cuba	13	31	18
Dominican Republic	4	11	7
Ecuador	12	40	28
El Salvador	13	26	13
Guatemala	18	36	18
Haiti	1	7	6
Honduras	7	13	6
Mexico	30	71	41
Nicaragua	7	22	15
Panama	6	16	10
Paraguay	4	9	5
Peru	10	32	22
Puerto Rico	0	10	10
United States	22	38	16
Uruguay	7	24	17
Venezuela	30	84	54
Other countries	0	11	11
Totals	370	922	522

* The mailing list for the "Information Bulletin," which was in the Central Files, was transferred to the Scientific Communications Service as of April 1, 1950.

APPENDIX D

Manuscripts Registered in 1950

Index No.	Author	Title
123	Ralph H. Allee	Cooperation between agriculture and nutrition.
124		Final report of the Technical Meeting on Agricultural Extension.
125	Antonio M. Arce	Investigación social (el cuestionario, la entrevista, el análisis).
126	Armando Samper	Progress report on the improvement of scientific communications among agricultural workers in the Americas.
127		Informes de los Países - Abstractos de la reunión técnica sobre extensión agrícola celebrada del 23 de agosto al 2 de septiembre de 1949, Turrialba, Costa Rica.
128	D. Spencer Hatch	For action in economic aspects.
129	Armando Samper	Scientific Communications Service plan for the strategic location of collections of abstract journals and bibliographies in the Americas.
130	Manuel Elgueta	Algunos resultados de experimentos de poda de cafetales.
131	Lucy Hastings	Necesidad y funciones de un laboratorio de semillas.
132	L. R. Holdridge & F. Bruce Lamb	The Forests of Guatemala.
133	Antonio M. Arce	Reunión de vecinos en Atirro.
134	Ana P. Blanco de Sariola	La alimentación de la madre durante el embarazo y la lactancia.
135	Florence Thomas	Report on trip to Panama.

Index No.	Author	Title
136	Manuel Elgueta	Un programa de selección para Coffea arabica.
137	Armando Samper	Improvement of scientific communications to facilitate the flow of technical assistance.
138	Julio O. Morales et al	Estudio sobre higiene y salud en la zona rural de Turrialba, Costa Rica, 1948.
139	D. Spencer Hatch	Toward freedom from want through rural adult education.
140	Ralph R. Shaw	Instrucciones para usar "Bibliography of Agriculture".
141	Pierre G. Sylvain	Report on a trip to study coffee production and research in El Salvador, Guatemala and Nicaragua.
142	Frederick L. Wellman & Romeo F. Martinez	Heart injection of abaca plants with an herbicide for eradication to control virus diseases.
143	D. Spencer Hatch	UNESCO-Asian seminar on rural adult education.
144	Ana T. Blanco de Sariola	Fuentes principales de calorías, proteinas, calcio, hierro, vitamina A, tiamina, riboflavina, niacina y ácido ascórbico (vitamina C) en alimentos de consumo frecuente en Costa Rica.
145	Emilio Viale	Datos sobre algunos insecticidas orgánicos sintéticos.
146	Jorge de Alba	Report on the Forty-Fifth Annual Meeting of the American Dairy Science Association.
147	Jorge de Alba	Informe sobre el reconocimiento hecho a la ganadería de la zona del Tepalcatepec, Michoacán, México.
148	Armando Samper	Summary of quarterly reports for 1949-1950.

Index No.	Author	Title
149 -	L. R. Holdridge	- The Alder, Alnus acuminata, as a farm timber tree in Costa Rica.
150 -	Sakari Sariola y Antonio M. Arce	- Clases Sociales. Curso de Sociología, Universidad de Costa Rica.
151 -		- Información general sobre el Instituto (inglés y español).
152 -	Antonio M. Arce	- Programa corriente de la escuela rural del distrito primero de Turrialba.
153 -	Jorge León	- Técnica y conservación.
154 -		- Programa de investigación en café.
155 -	Emilio Viale y Humberto Rosado	- Chinche de la raíz del maíz (Cyrtomensus sp.)
156 -	Hernán García Llosa y Jorge de Alba	- Valor comparativo de las hojas de banano, puntas de caña de azúcar, y pasto elefante para producción de leche.
157 -	Pierre G. Sylvain	- Programa de investigación sobre fisiología del cafeto.
158 -	Lucy Hastings	- Estudios sobre la viabilidad de la semilla en Costa Rica.
159 -	Julio C. Morales, W.E. Keepper y Francisco Gómez.Q.	- Estudio económico de fincas cafeteras.
160 -	Julian C. Crane y Frederick L. Wellman	- Edad del henequén en relación con las características de la fibra.
161 -	Norton C. Ives	- Grain drying and storage in the American tropics.
162 -	Frederick L. Wellman	- The control of ojo de gallo, Omphalia flavida, by defoliation of diseased coffee trees.
163 -	Frederick L. Wellman	- Special report, meeting of plant protection technicians of Latin America in Mexico, September 25 to October 6, 1950.

Index No.	Author	Title
164 -	Frederick L. Wellman and T. Rodolfo Quesada	- Certain factors limiting cercospora disease on coffee leaves.
165 -	Frederick L. Wellman, J. C. Walter, Allyn Cook and M. Gallegly, Jr.	- Effects of temperature on vegetative growth of five coffee disease fungi.

ORTON MEMORIAL LIBRARY

Angelina Martínez

INTRODUCTION

During the year 1950 the Library was increasingly called upon to supply literature, compile bibliographies, answer reference questions, and perform other services within its scope and program. Since its organizations four years ago, the Library has almost doubled its holdings and has increased its annual circulation from 257 in 1946 to 7,415 in 1950.

The establishment of the Scientific Communications Service has added new responsibilities to the Library staff, and with the publication of the journal Turrialba the Library has started an exchange program which will bring in increasing numbers of periodicals and other publications.

TRAINING

The Librarian of the Ministry of Agriculture of Costa Rica, Sr. Fernando Solís Prado, spent six weeks (March-April 1950) of in-service training at the Library of the Institute. At the end of this training period, Sr. Solís started to organize the Library of the Ministry in San José under the supervision of the Librarian of the Institute.

SERVICE TO STAFF MEMBERS AND STUDENTS

The Library is open 59 hours a week, and the daily average attendance is 20.

Circulation

In 1950 the Library circulated 7,415 publications, as compared with 3,690 in 1949.

The annual circulation statistics subdivided by types of publications are as follows:

Books	3,512
Pamphlets	2,417
Journals	1,486
Total.....	7,415

It has been almost impossible to keep a record of the number of publications consulted in the Library due to the fact that our students and personnel have access to the stacks, but we estimate

that about 6,000 publications were consulted in the Library during 1950.

Reference Work

The amount of reference service provided in 1950 was considerably higher than in 1949. The Librarian handled more than 2,000 reference questions in comparison to around 500 in 1949. About 50 percent of the questions answered required half an hour or more of searching.

The Librarian prepared about 50 lists and bibliographies during the year. Two lists including 439 items were prepared for inclusion in the journal Turrialba. Several other lists were also prepared for the Scientific Communications Service. The Librarian circulated 193 journals to the staff members for them to abstract articles for the journal. She also checked and corrected the bibliographical citations to 151 abstracts. The bibliographies of 15 student theses were checked and corrected.

THE LIBRARY COLLECTION

Because of overcrowding in the stacks, some of the materials in the stackroom have had to be placed on tables and on the floor. Both the publications and the library service suffer badly from such an arrangement. The work on the conditioning of the north attic was 75 percent completed by the end of 1950, and the Librarian is making plans to move the Library publications to this attic by the beginning of 1951.

Additions to the Collection

The Library acquired through purchase a collection of 43 titles on botany and agriculture that belonged to the late Costa Rican botanist, Sr. Alberto María Brenes. Among these there were a few out-of-print works of particular interest. A few of them were: Arboles y arbustos de Costa Rica, by Brade; Ensayo sobre las plantas usuales de Costa Rica, by Pittier; El médico botánico criollo, by Grossourdy; and Origine des plantes cultivées, by Candolle.

Also added to the Library collection through purchase and exchanges were 213 books, 139 photocopies, 34 microfilms, and several thousand pamphlets.

Donations received were more numerous than in the preceding year. The Library received the following gifts during 1950:

The American Institute of Cooperation gave the Library a set of 24 volumes of their publication American Cooperation.

The College of Agriculture at Cornell University contributed 12 volumes of the journal Scientific Monthly.

Dr. H. C. Thompson's gift to the Library consisted of 17 volumes of the journal Plant Physiology and 25 volumes of the Proceedings of the American Society of Horticultural Science.

The Office of Foreign Agricultural Relations of the United States Department of Agriculture donated 49 volumes of the Experiment Station Record.

The Cultural Center in San José contributed around 300 fiction books.

There were also smaller donations of books, pamphlets, and reprints.

Periodicals and Exchanges

46 new subscriptions were placed in 1950, bringing the total number of paid subscriptions up to 128. The Library also received about 350 periodicals on a complimentary or exchange basis. This means that about 500 periodicals were checked in during the year.

213 back volumes of journals were ordered during the year, out of which 147 were abstract journals from England.

The first issue of Turrialba was sent, together with a letter requesting exchange of publications and a questionnaire, to 350 institutions, societies, associations, and government offices that are known to issue publications on agriculture and related fields. By the end of the year 80 replies had been received agreeing to the proposed exchange.

Ordering of Materials

314 books were ordered during 1950 and special requests were made for 364 pamphlets and 27 reprints. 139 photocopies and 34 microfilms were ordered through the Scientific Communications Service. Supplies and other materials were also ordered.

Organization of the Material

168 sets of Library of Congress cards were ordered during the year. Most of the publications received were prepared for use and the cataloging of publications was continued. The author numbers in many of the books were revised according to the Cutter system.

COOPERATION AND CONSULTATION

The Librarian was elected Secretary of the Association of Costa Rican Librarians and has been actively cooperating with this Association since its organization in 1949.

Out of the Institute Library's duplicate collection, a donation of 7 books and 131 pamphlets was made to the Library of the Ministry of Agriculture in San José. The Librarian spent some of her time at this Library helping in the organization of the collection.

A paper on the improvement of agricultural libraries in Latin America was prepared by the Librarian for presentation to the Coordinating Committee on Technical Assistance.

PERSONNEL

Sra. Emilia J. de Rodríguez resigned her position as clerical assistant in November. No replacement had been made by the end of the year.

PLANS FOR 1951

One of the most important jobs for the year 1951 will be the moving of the Library collection over to the new stackroom on the north side of the attic.

Another job that should be undertaken is the moving of the workroom from the porch into the southside of the attic. This would entain the opening of dormer windows and the installation of a glass door between this side of the attic and the reading room.

The Librarian would like to bring out into the reading room all the bibliographical tools and other reference works available in the Library, but before this can be done, the partitions in this room should be closed and a door installed so that the Library could be locked up completely and thereby insure that nobody enters when the Library staff is not on duty. Several issues of current journals and two dictionaries have been taken out of the reading room due to the fact that the Library cannot be closed properly.

Other plans for the year include the following:

1. Increase the number of publications received on an exchange basis.

2. Acquire back volumes of important journals.

3. Increase holdings of books in Spanish, Portuguese, and French.

4. Index articles from journals in Spanish and Portuguese for inclusion in the catalog.

5. Promote friendly relations between the Institute Library and other agricultural libraries in the Americas through exchange (not only of publications, but also of duplicates), etc.

RENEWABLE RESOURCES SERVICE

Leslie R. Holdridge

INTRODUCTION

The Renewable Resources Service has been organized at the Inter-American Institute of Agricultural Sciences for the purpose of carrying on training and consultation work in the development, use, and conservation of renewable resources in the Americas. The overall aims and objectives of the proposed program for this service have been summed up in Project No. 35-51 (Rev. 1) which was presented to the Coordinating Committee on Technical Assistance on August 21, 1950. Due to the delay in allocation of Point IV funds, the service operated during 1950 with limited support from the Institute and the Pan American Union.

TRAINING

Student fellowships for the various fields within Renewable Resources are proposed in the 1951 budget, but training during 1950 consisted only of cooperation on training of students in other departments. Dr. Holdridge conducted a six months' course in plant ecology during the first half year for the graduate students of all departments. In addition, a three months' course in farm forestry was given to the Venezuelan extension students.

RESEARCH PROJECTS

Ecological Map of Costa Rica

A preliminary forest formation map based on climatic zones has been prepared for Costa Rica. This will serve as a base map for forestry and land use investigations.

Dendrological Studies

As a background for ecological and forestry studies, recognition of species in the field is important. Over 150 species of trees have been determined in the Turrialba Valley alone as well as many others in different formations of the country.

Silvicultural Studies

Alnus acuminata

Considerable study of the silviculture of the local alder, called "Jaul", was carried out in the highlands. This tree is commonly planted as a pasture shade tree in the dairy region and

offers an excellent combination of agriculture and forestry. To obtain accurate growth data for application to management, six growth plots were established during the year.

Other Timber Species

Similar observational studies have been made on several other timber species in Costa Rica during cooperative trips with government officials.

Test and Demonstration Work on Institute Property

Considerable forestry work in the form of improvement cutting, reforestation and care of an existing teak plantation was carried out on Institute lands. This work will be valuable principally for demonstration but also provides work areas for future forestry students and will be productive of some research information. As no budget was available for such work, it was financed by firewood harvest. The expenses and incomes by sections were as follows:

Area	Expense	Income	Net
Nursery	C102.00	--	C-102.00
El Chino	2.00	--	- 2.00
Madriz Forest	31.00	--	- 31.00
Teak Plantation	62.00	C 67.50	+ 5.50
La Isla Woodlot	219.00	130.00	- 89.00
Florencia Forest (East section)	142.50	--	-142.50
Florencia Forest (West section)	130.50	567.00	+436.50
TOTALS	C689.00	C764.50	C+ 75.50

Economic Land-Use Study in the Turrialba Valley

Dr. Peterson and Ing. Pánfilo Rodríguez, a student of the Department of Economics and Rural Welfare, have made a comparative study of production and incomes per person in two areas in the Turrialba Valley, one the almost solid coffee area along the Turrialba river, and the other, the mixed-crop, small-farm area near San Juan Sur and San Juan Norte. This has brought out some very striking differences in productivity between two different economic land class areas.

COOPERATION AND CONSULTATION

Guatemala

In late 1949, an agreement was reached with the Instituto de Fomento de la Producción of Guatemala for a cooperative forest sur-

vey of that country. INFOP furnished the travel and subsistence funds for the party and paid the salary of a photogrammetrist and forester. The Institute at Turrialba organized the survey and furnished the services of Dr. Holdridge. The field work and report preparation occupied the first months of the year, and the report was completed and sent to INFOP in May.

El Salvador

Drs. Holdridge and Peterson visited El Salvador in late September to discuss the establishment of a renewable resources project in that country and selected the area for work. Dr. Loomis carried on further discussions of the project during a visit to El Salvador in November. At the end of the year, funds for the project were still not available, but the area study is still contemplated in cooperation with the Ministry of Agriculture of El Salvador, the Office of Foreign Agricultural Relations of the United States Department of Agriculture, and the Food and Agricultural Organization of the United Nations.

Costa Rica

Dr. Holdridge has been cooperating with the Division of Silviculture and Fruiticulture of the Ministry of Agriculture in Costa Rica on the study and solution of forestry problems in various parts of the Republic of Costa Rica.

A cooperative agreement was reached also with the Ministry of Agriculture for land-use studies in the Turrialba region of Costa Rica. Dr. Dondoli, geologist, Ing. Torres, and soil assistants from the Ministry have been working with Dr. Peterson on maps and land-use studies. At the end of the year, discussions were in progress to expand this cooperative project to include the whole upper watershed of the Reventazón River in Costa Rica.

ORGANIZATION AND ADMINISTRATION

Due to the lack of a budget for Renewable Resources, the Service itself was not organized until late in the year, when it appeared that Point Four funds would be available in the near future. Dr. Holdridge was the only member of the Institute, assigned to renewable resources work, with salary paid from other Institute budget funds. He started this work on the first of February.

Mr. Bertell Mason, Jr., a photogrammetrist with a commercial company in the United States, was secured for two months for assignment to the Guatemalan forest survey.

Mr. Bruce Lamb, a special forestry student at the Institute, was assigned to the same forestry survey for five months through May.

Dr. Arthur Peterson, Land-Use Economist of the Pan American Union, who is on a one-to-two-years' leave of absence from Washington State College, came to the Institute in September to cooperate on land-use surveys in the Renewable Resources Service program.

Dr. Charles Loomis, Sociologist and Anthropologist of the Office of Foreign Agricultural Relations, who is on leave of absence from Michigan State College, arrived at the Institute in September. He and Dr. Morales of the Department of Economics and Rural Life have cooperated closely in preparation of plans and proposed projects of the Renewable Resources Service.

TEACHING PROGRAM

Fernando del Río, Registrar.

COURSES OFFERED AT TURRIALBA *

During 1950, the following courses were offered:

Plant Industry Department

Experimental Designs . . . (Manuel Elgueta)
Methods of Science . . . . (Manuel Elgueta)
Plant Physiology . . . . . (Pierre Sylvain)
Taxonomy . . . . . (Jorge León)

Department of Economics and Rural Life

Statistics . . . . . (Julio Morales)

Renewable Resources Service

Ecology . . . . . (Leslie Holdridge)

Extension Education Service

Prerequisites:
Elements of Agricultural Mathematics . . . . . (Juvenal Valerio)
Fundamentals of Natural Science . . . . . (Juvenal Valerio)
Methods of Extension I. . (D. Spencer Hatch)
Practical Apiculture. . . (Otón Páez)
Soils and Fertilizers . . (Guillermo Bonilla)
Animal Industry . . . . . (Hernán García)
Tropical Grasses . . . . (Jorge León)
Nutrition . . . . . (Ana Teresa de Sariola)
Genetics . . . . . (Juvenal Valerio)
Farm Management . . . . . (Julio Morales)
Methods of Extension II . (Fernando del Río)
Farming Skills:
Coffee, Cacao, Animal Industry, Rural Construction, Soils, Horticulture, and Agricultural Economics . . . . . (Juvenal Valerio)

The courses under Plant Industry and Economics and Rural Life are of a post-graduate nature leading toward the Magistri Agriculturae for those with a Bachelor of Science degree, Ingeniero Agrónomo title or its equivalent, and for the title of Especialista for undergraduates.

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* These do not include special courses offered to others than regular students, such as the course in Sociology offered to the School of Pedagogy at the University of Costa Rica and a

The Extension Education Service extends a "Certificado de Estudios y Prácticas" for undergraduates in the Applied Rural Science program, and a "Certificado de Métodos de Extensión" for those training in Extension.

GRADUATE STUDY COUNCIL

Members of the Graduate Study Council, which met five times in 1950. were:

Manuel Elgueta, Chairman
George F. Bowman
Frederick L. Wellman
Fernando del Rio
Jorge de Alba

STUDENT ENROLLMENT AT THE INSTITUTE BY COUNTRIES * 1946 - 1950

Country	1946	1947	1948	1949	1950	1951	Total by Country
Costa Rica	1	1	5	2	1		10
Bolivia	1						1
Brazil					2		2
Canada			1				1
Colombia	2	1		4	1		8
Dominican Republic	1						1
Ecuador			2	3	3		8
Finland				1			1
Guatemala	1		1	3			5
Haiti		2		2	1		5
Honduras			1		1		2
Mexico	2	1	4	4	2		13
Nicaragua	1	1			2		4
Panama				1			1
Perú				1	2		3
Philippines				2			2
Surinam				1			1
United States		2	8	5	7		22
Venezuela		1	24	17	5		47
Totals by Year	9	9	46	46	27		137

* Numbers given do not include students who remain for a second year, but only for the year of initial matriculation. For example, in 1950, eight Venezuelan students were second-year students in Applied Rural Science, and three graduate students from the United States and one from Mexico remained for the second year, bringing the total number of students in residence in 1950 to 39.

STUDENT ENROLLMENT AT THE INSTITUTE BY DEPARTMENTS *
1946 - 1950

Department	1946	1947	1948	1949	1950	1951	Total by Department
Plant Industry	6	4	4	5	6		25
Cacao		3	10	19	9		41
Agricultural Engineering	2						2
Animal Industry	1	1	3		1		6
Agricultural Economics		1	4	4	4		13
Applied Rural Science			25	17	6		48
Library				1	1		2
Total by Years	9	9	46	46	27		137

DEGREES OR TITLES GRANTED TO STUDENTS BY DEPARTMENTS
1946 - 1950

Degree or Title	1946	1947	1948	1949	1950	1951	Totals
	(None)						
Plant Industry							
Especialista en Fruticultura		1					1
Magistri Agriculturae.		1	3	2	2		8
Cacao							
Especialista en Cacao.				9	12		21
Magistri Agriculturae.				4	4		8
Agricultural Engineering							
Especialista en Conservación de Suelos.		1					1
Animal Industry							
Magistri Agriculturae.			1	1			2
Certificado de Estudios y Prácticas				1			1
Applied Rural Science							
Certificado de Estudios y Prácticas				8	18		26
Certificado de Estudios en Tomates y Papas.				1			1
Certificado en Métodos de Extensión					4		4
Totals		3	4	26	40		73

SEMINARS - 1950

Date	Subject	Leader
January 9	UNESCO Asian Seminar on Rural Adult Education	D. Spencer Hatch
January 10	Reaction of the Cacao Tree to Pruning	Lionel Murga
January 16	Report on the Coffee Project of the Department of Economics and Rural Life	Julio O. Morales
January 17	Renovation of a Cacao Plantation by Means of Grafting Basal Chupons	R. Velásquez B.
January 31	Pollination of Cacao in Costa Rica	Anton G. Smit
February 14	Agriculture in the Philippines	Rafael Bartolomé
February 20	Insects in Stored Products	R. A. Davis
February 28	Research Work of the University of Miami Tropical Plant and Food Research Center	Arthur Leibovit
March 6	Agricultural Colonies in Costa Rica	Curtis Goode
March 7	Abnormality in the Growth of Small Cacao Plants	José E. Vivero
March 21	Mahogany in Central America and the Caribbean	F. Bruce Lamb
March 28	Abacá Cultivation in the Philippines	Romeo P. Martínez
April 11	The National Coffee Growers Federation of Colombia	Cristóbal Navarrete
April 18	Studies on Livestock and the Ant Problem in San Juan Sur	Evelio Tovar Froilán Romero
May 2	Sociological Study of Jesus María	Enrique Pinto Adolfo Medina
May 8	Some Interesting Plants on the Institute Grounds	Jorge León

Date	Subject	Leader
May 9	The Cooperative Movement in Guatemala	Alejandro MacLean
May 16	Social Class as a Unit of Analysis in Sociological Treatment	Sakari Sariola
May 22	The Scientific Article from the Point of View of the Writer, the Editor, and the Reader	Armando Samper
May 30	Post-budding Treatment of Cacao Seedling Stocks	Bertin Dadaille
June 12	Introduction and Propagation of Plants in Relation to Campaigns of Agricultural Extension Carried Out in Costa Rica during the First Quarter of the Present Century	Juvenal Valerio R.
July 10	Human Mycosis Produced by Certain Saprophitic Fungi	Alfonso Trejos W.
July 24	Preliminary Study of the Price Structure of Potatoes in Costa Rica, 1936 - 1950	Roger Perreault
July 25	Effect of Fruitification on the Metabolism of Carbohydrates and Nitrogen on Coffee Tree Roots	Cristóbal Navarrete
July 31	Agricultural Production and Nutritional Requirements in Latin America	Ana T. Sariola
August 1	Stimulation of Basal Chupons in Old Cacao Trees	José Vázquez M.
August 8	Performance of New Growth on Cacao after Pruning	Gustavo H. López
August 14	The Teacher and Rural Community Organization	Eduardo Arze
August 21	Control of "Ojo de Gallo" of Coffee	Frederick Wellman
August 28	Some Factors that Affect the Production per Man in the Coffee Industry	Julio O. Morales
September 4	A Study of the Effect of Applying Fertilizers on the Frequency of Wilting of Young Cacao Fruits	Rafael Bartolomé

Date	Subject	Leader
September 5	Minor Crops in the Tropics	Geo. F. Bowman
September 11	Feeding Value of Yuca Meal and Bananas for Weanling Pigs	Jorge de Alba
September 12	Post-Treatment of Cacao Chupon Budding	Rosendo Pacheco
September 18	Forestry in Costa Rica	L. R. Holdridge
September 19	Comparison of Two Types of Budding on Cacao	Zenaido Calderón M.
September 25	Some Characteristics in the Introduction of Major Crops in the American Tropics	Jorge León
September 26	Study of the Relations between Measurable Characteristics and Production in Cacao Trees	Francisco García R.
October 2	Extension Activities through the Rural School in Guatemala	Fernando del Río
October 3	Effect of Variations in Temperature and pH on Cacao Fermentation	Enrique Mejía L.
October 23	Improvement of Corn	Humberto Rosado
November 6	A Method of Economic Land Classification Used in the State of Washington, U. S. A.	A. W. Peterson
November 20	Physiological and Phytopathological Aspects of Die-Back in Coffee	Lucy Hastings
November 27	Methodology for a Study on Acculturation in a German Catholic Community in the United States	Tom L. Norris
December 11	Experimental Work on Vegetables	Florence Thomas
December 18	Rooting of the Rubber Tree, *Hevea brasiliensis*	Luis E. Gregory
December 26	The Role of Some Fungi and an Insect in the Wilting of Young Cacao Fruits	David Torres Arturo Gonzáles

INSTITUTE SERVICES

George M. Slater

The 1949-50 budget for the Institute Services shows that income was expected to exceed expenditures by the sum of $8,281.00. The final figures show expenses exceeding income by $98.76, but these figures do not take into account the unsold coffee crop in the hands of the contractor and on which he had advanced the Institute the sum of C170,000 ($30,303 at the conversion rate of 5.61). This sum has to be divided between the Demonstration Farm and the Institute Services. For labor charges, the Demonstration Farm should be credited with $11,213.00, and the balance of $19,090.00 to the Institute Services income. It has been the practice not to credit money advanced on crops, but rather to wait until final liquidation of the crop account has been made, so some of the cash from the sale of the crops will appear in this budget. If the money advanced on coffee had been credited to the account, then income would have exceeded expenditures by $18,990.24. This sum would have been increased by $12,000.00 if milk products and meat had been transferred to the kitchen from the Demonstration Farm, as originally stated in the budget.

Sugar cane sold to the mill amounted to 5,270 tons, compared with 3,900 tons the previous year. The cane produced by the contractors using Institute land is decreasing, and next year their fields will revert to the Institute when the area in sugar cane will be increased to about 450 acres. Sugar cane brought in $44,685.18, which is $2,685.18 over the estimate of $42,000 in the budget.

The coffee farm presently being handled by the Institute Services shows considerable improvement, and higher yields can be seen in the future. The area in coffee will be increased next year to 450 acres.

The kitchen served 69,000 meals, and the dormitory and laundry had from 50 to 60 people to care for.

The electric light plant and the water service were not sufficient to supply all of our needs at peak hours, and there were many serious stoppages in the supply of electric current. Several costly repairs were made to the electric plant, and a new lining of cement was put in the water tank, all of which helped to keep the service going.

The machine shop takes care of more cars and Jeeps each year; the number of cars, trucks, Jeeps, etc. being cared for now is 35.

The quarry has supplied stone for building new roads through to coffee and sugar cane fields, in addition to supplying stone for road repairs and construction work.

Construction work done by the carpenter shop and electrical shop has been limited to additions to existing cottages and to the erection of a warehouse and machine shop near the main building.

A gift of four hectares of land to the Municipality of Turrialba reduces the area of Institute land to 996 hectares.

The cost of living has increased considerably, and it is expected that the Costa Rican Government will order an increase in pay to farm laborers in the near future.