

ANNUAL REPORT
of the
INTER-AMERICAN INSTITUTE
OF AGRICULTURAL SCIENCES
for the year
1949



Turrialba, Costa Rica
1949

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REPORT OF THE DIRECTOR

FOR THE YEAR 1949

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 calendar year 1949. For convenience the reports will from now on be presented to cover the progress made during a given calendar year, thereby maintaining a continuous record of technical progress attained in Turrialba.

The following brief notes will give the Members of the Board an idea of the general activities, by services, in which the Institute is engaged.

Within the Institute the Director has formed an Executive Committee composed of the heads of the four research and training departments and other technical personnel. The Executive Committee has considerable authority in determining internal policy of the organization and its individual members assume a great deal of responsibility in the operation of the Institute's program.

The Director also devotes time to developing constructive relations with the Institutions of the American Republics and to arranging for financial support beyond that available from quotas of the Contracting States.

The Administrative Committee of the Institute, entrusted with the responsibility for the general plan of development of the organization and the integration of its program of research and education, met in Turrialba from March 28 through 31, 1949. The activities of the Institute were reviewed and plans for future programs were made during these meetings.

The technical personnel of the Institute was increased by only three members over the 27 included in the previous report. However, the level of competence and accomplishment increased considerably as certain temporary staff members were replaced by permanent workers. Significant in the personnel picture is the increase in highly trained younger men from several countries. Thirteen of the staff members are from the United States of America, including three Puerto Ricans. The remainder come from Chile, Colombia, Costa Rica, Mexico, and Haiti.

Since plant science is basic to all agriculture, the Plant Industry Department assumes a leading place in the Institute's service to the American States. The Department coordinates work with experiment stations of member countries, holds conferences of specialists, promotes close relationships between scientists in its

field, and fosters development and continuity in the various branches of the field. In 1949 its projects dealt with coffee, corn, vegetables, potatoes, sugar cane, and other food crops. The Cacao Center is budgeted separately.

A significant personnel development in the Department was the appointment of Dr. Pierre G. Sylvain as Head of the Plant Physiology Section.

Two hundred and ten new plants were introduced during the year, making a total of 1,338 trees and shrubs producing nuts, fruit, vegetable oils, timber, or other products, available for research and for distribution to member countries. An herbarium was initiated which now has 5,000 specimens of value for verification and study purposes.

Due to the economic significance of coffee and the suitability of Turrialba for solving problems in this field, the coffee program has been given increased importance during recent years. To the projects on propagation and cultural practices and the disease studies there have been added selection projects. A major part of the coffee program is being developed by the Department of Plant Industry, although the Agricultural Engineering Department is working on a project that deals with the coffee-drying process and the Department of Agricultural Economics and Rural Life is developing methods to enable economists and farmers to study the economic aspects of coffee production. The coffee program was carried out in the following major fields of study and experimentation: physiology, agronomic trials and breeding, pathology, and entomology. Cooperative projects have been initiated with Colombia and Guatemala and another agreement is being arranged with Brazil.

Corn improvement projects are now approaching the third and fourth generations; improved seed and methods adapted to conditions in the tropics are the objectives. During the year relative efficiency of different breeding methods was tested.

Seed treatment studies were also made during the year.

The Inter-American Cacao Center, organized in 1948, conducts research training, and the interchange of information on cacao production. Its main experimental work is carried out on the La Lola Farm in the lowlands of the Atlantic region. There is also a cacao section at the Institute, where work on propagation and selection is being done. During the year under review important advances were made in propagation methods; and new information was obtained on disease transmission, flowering, fruiting, and on a series of cultural practices. In addition, acquaintance with workers in the hemisphere and their problems was broadened. The Inter-American Technical Cacao Committee of which the Cacao Center is secretariat held its conference in Turrialba in 1949.

The Animal Industry Department is responsible for finding facts leading to the solution of livestock, dairy, swine, and poultry problems and its projects involve breeding, nutrition and pest

and disease investigations. The central program of the Department has continued to be that of livestock improvement in tropical areas, with precedence given to projects on climatology, tórsalo control and nutrition. Work has progressed on the animal climatology laboratory provided for out of funds from the King Ranch grant of \$33,000. The Community demonstration creamery, the slaughter house and the horse barn started during the preceding year were completed. Two additional residences for staff members were constructed. Forty Brahman-Hereford-Santa Gertrudis heifers and five purebred quarter horses were supplied by the same ranch in a cooperative project to determine the place of their superior animals under tropical conditions. A swine herd of fifty was acquired as a start in a program of selection, feeding and sanitation. A survey was also made of the agricultural and veterinary curricula in Latin America.

The Agricultural Engineering Department is responsible for research and training in applying engineering to farm production, including engineering phases of soil and water conservation, farm machinery, farm structures, and the processing of agricultural crops. Work was continued and extended in grain drying and storage, with a new project in coffee drying and processing. Performance records of the erosion and tile drainage plots were maintained and accomplishments made in connection with rice-drying processes. A consultation service was also extended to certain member countries.

Through research, teaching, and extension, the Department of Agricultural Economics and Rural Life promotes a better understanding of the part played by man in agricultural production. It is also concerned with the flow of this production through the channels of trade and ultimate consumption. As low productivity is the principal cause of low standards of living in most of the member countries, the Department is concentrating on the crucial problem of increasing productivity per man. The solution is being approached along two broad lines: improving man himself and the conditions under which he lives (Community Projects) and increasing of effectiveness of his management of agricultural enterprises (Coffee Studies). The stress throughout the entire research program is on the development of methodology, so that similar studies can be undertaken elsewhere. The process of getting these methods out to member countries was initiated in the memorandum of understanding on cooperation between the Institute and the Colombian Coffee Federation. Also, the first cooperative project under this agreement was carried out with Colombia and was accompanied by an exchange of visits of personnel between the two countries. Most of the year was devoted to analyzing the data gathered during the previous year and to preparing these data for final publication.

The Vocational Education and Extension Service is responsible for developing and operating a program for application of the latest findings in the field of rural sciences and for training leaders in this field. Extension services are made available to the 24,000 rural people in the Turrialba area and research is conducted to further improve methodology. A meeting on Agricultural Extension was held at

the Institute under the joint auspices of the Food and Agriculture Organization of the United Nations and the Institute, in which representatives of 19 countries took part. Another international meeting in which the Institute participated was the Asian Seminar on Rural Adult Education held at Mysore, India in November-December; the Head of the Service, was chosen by UNESCO as chairman of the Seminar. UNESCO also wants the Institute to train students under a cooperative plan in comprehensive extension methods with the community approach.

The Orton Memorial Library provides library facilities indispensable to a research and graduate teaching program. It acquires by gift, purchase, or exchange the books, periodicals, pamphlets, and maps required. Publications from most of the agricultural experiment stations and departments of agriculture of the Americas are catalogued, indexed, and circulated. Total library holdings amount to over 13,000 items. During the year bibliographies on cacao, coffee, potatoes and corn were prepared in the library. It is proposed to integrate the library and publications of the Institute with a broader Service to promote access to the scientific and technical information, lack of which now limits the effectiveness of agricultural and rural life work in many American countries.

The Demonstration Farm is a pilot farming operation on a 1,120-acre plot cut out of the Institute's total acreage. It is operated separately for training and demonstration purposes, testing crops, and determining the best methods of farm management.

On May 20, 1949 the Rockefeller Foundation made a grant to the Institute providing up to \$60,000 to strengthen the library resources and make possible the development of a scientific communications program during the period ending June 30, 1955. Effective July 1, 1949, Mr. Armando Samper was made head of the new service, temporarily called Interchange and Information Service. During the same year an experimental photocopying program was initiated, studies were made in connection with distribution of bibliographic and abstract journals among libraries in Latin America, and a Publications Committee was organized. The Technical Bulletin Series was started, since final results of full research projects are becoming available and should reach research men in the Americas and other regions. A quarterly scientific journal, Turrialba, will also be published. Personal exchange between scientists through meetings, societies, etc. has also been encouraged.

Respectfully submitted

RALPH H. ALLEE
Director

STAFF OF THE INSTITUTE

1949

Ralph H. Allee
José L. Colom
Lowell Curtiss
Anna Marie Dye

Director
Secretary
Treasurer
Purchasing Agent and
Assistant in the Office
of the Secretary
Secretary to the Director

Wilhelmina C. Hayes

PLANT INDUSTRY DEPARTMENT

Manuel Elgueta
Frederick L. Wellman

Head
Phytopathologist, employed
by the United States
Department of Agriculture
and assigned to the
Institute in Turrialba
Assistant Plant Pathologist
Olericulturist
Plant Physiologist
Geneticist,
Associate Plant Breeder
Associate Plant Breeder
Assistant
Botanist

Lucy Hastings
Ernest H. Casseres
Pierre G. Sylvain
Humberto Rosado

Mario Gutiérrez G.
Napoleón Murillo E.
Jorge León

Inter-American Cacao Center

George F. Bowman
J. Harvey McLaughlin
Leslie R. Holdridge

Head
Phytopathologist
Ecologist

ANIMAL INDUSTRY

Albert O. Rhoad
Jorge de Alba
Oscar Echandi

Hernán Sobrado

Head
Assistant Head
Assistant in charge of
Herd
Assistant in Charge of
Creamery

AGRICULTURAL ENGINEERING

Norton C. Ives	Head
Gregorio Alfaro	Assistant
Luis Balma	Assistant

AGRICULTURAL ECONOMICS AND RURAL LIFE

Julio O. Morales	Head
Antonio Arce	Assistant
Ana Teresa Blanco de Sariola	Home Economist
Carlos Morañéz	Assistant

EXTENSION EDUCATION SERVICE

D. Spencer Hatch	Head
Juvenal Valerio	Professor
Otón Páez	Superintendent of Students and Developments

SCIENTIFIC COMMUNICATIONS SERVICE

Armando Samper	Head
Helen C. George	Secretary

LIBRARY

Angelina Martínez	Librarian
Catherine Noel James	Assistant Librarian

BUSINESS OFFICE

George M. Slater	Business Manager
Francis P. Shanks	Comptroller

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 and the integration of its program of research and education, met in Turrialba from March 28 through 31, 1949. The activities of the Institute were reviewed and plans for future programs were made during these meetings.

The March 1949 meetings of the Committee were attended by the following:

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

Dr. Robert E. Buchanan, Director
Agricultural Experiment Station
Iowa State College of Agriculture
and Mechanic Arts
Ames, Iowa

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

Mrs. Ruth Quintanilla (by invitation)
Valle de Bravo
Estado de México, México

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

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

Department Heads and other staff members for
some of the meetings.

Dr. Hume's and Dr. Buchanan's two-year appointments to the Committee were to expire in December 1949. However, on October 11, 1949 the Board of Directors approved the reappointment of Dr. Hume to the Committee for two more years and in addition approved the appointment of the following new members:

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

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

There are still three vacancies on the Committee, and these are to be filled when new ratifications to the Convention are received.

No meeting of the Committee was held in the fall of 1949 since several members were unable to attend. It was decided, therefore, to refer matters for discussion to the meetings scheduled for March 1950.

PLANT INDUSTRY DEPARTMENT

Manuel Elgueta

PERSONNEL

Changes in Personnel

It was possible to secure the collaboration of a plant physiologist, Dr. Pierre G. Sylvain, who began work on July 1, 1949 as Head of the Plant Physiology Section. His work will deal mainly with projects on coffee.

Ernest H. Casseres will leave for the United States on January 12, 1950 on a Rockefeller fellowship to proceed with his studies at Cornell University for his Ph.D. degree. Dr. Florence Thomas will be added to the Staff of the Department to take charge of Mr. Casseres' work during his absence.

Mario Gutiérrez left for the United States in December 1949 to pursue studies for his Ph.D. degree at the Iowa State College of Agriculture and Mechanic Arts on a Rockefeller fellowship. Humberto Rosado, formerly with the Rockefeller Foundation program in Mexico, has taken charge of Mr. Gutiérrez' work during his absence.

Meetings Attended by the Personnel

Manuel Elgueta attended the conference of the Federación Cafetalera de Centro-América y México, held in San Salvador, El Salvador, in May 1949. Some preliminary discussions on cooperative work with this Federation have taken place. Manuel Elgueta and Mario Gutiérrez attended the Plant Breeders' Conference held in Mexico City from September 26 to October 7, 1949. Manuel Elgueta also attended the Conferencia de Campesinos y Agrónomos held in Mexico City in October 1949, sponsored by the Mexican Government.

INTRODUCTIONS, FORAGE PLANTS AND GENERAL HORTICULTURE

Jorge León

During the year 210 plants have been introduced making a total of 1,338. The most important groups have been: sorghum, eucalyptus, different fiber plants, and selected cinchona clones.

Plantings

Two plantings were made during this year of each of the crops listed in this section. Each planting included: (1) standard varieties planted for comparison with the varieties developed at the Institute and (2) Institute varieties being increased for distribution.

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 Boreaux 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 1,082 trees in the rehabilitation experiment and from 1,571 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.

Sorghums

Belleza (0148), 10 individual selections; Especial (0162), 10 individual selections; Especial (0160), massal planting.

Cowpeas

Chinegra (0189), 3 lines; Chinito (0190), 5 lines; Garbancito (0151), 7 lines; Azul Grande (0153), 5 lines; Black mildew resistant (0154), 3 lines, Blue mildew resistant (0154a), 2 lines; Canelo (0128), massal. Besides these varieties developed at the Institute, six standard varieties were planted.

Peanuts

Bonita (0134), 5 lines and seven standard varieties.

Soybeans

Twelve standard varieties (introduced).

Beans

Two plantings of massal and individual selections of the Portuguese variety have shown a marked resistance to diseases, yield a good crop, and promise to be a good variety for wet climates.

Squash

Three varieties developed at the Institute: Pepino (0173), Clavagorda (0171), and Peraoro (0172).

Miscellaneous

Three varieties of watermelon, 2 of velvet beans, and 2 types of Colocasia.

Collection of Trees

A total of seventy-two trees have been planted.

Herbarium

This project was begun during the middle of last year. Up to now there are about 5,000 specimens, 1,100 of which are already classified. They represent 126 families of a total of 227 families that occur in the area (Central America to Colombia).

VEGETABLE CROPS

E. H. Casseres

The work with potatoes has advanced considerably during this year. Some clones have been found with a higher tolerance to Phytophthora infestans and are in the process of further increase and testing. Varieties like Harford and Fillmore have shown tolerance and adaptation to definite altitudes. The first one especially shows wide adaptability and vigorous growth and promises to be a good introduction. From the clonal material under study clones EVI-2 and DUA-2 have been increased.

The Ministry of Agriculture of Costa Rica is cooperating in this work and will be directly in charge of seed distribution in Costa Rica.

Work on other vegetables has been carried on from former years. A variety trial and seed treatment study with peas were conducted. Ten varieties of onion have also been tested. Varieties White Grano and Excel show good promise for the humid conditions of Turrialba. Snap bean varieties such as Tendergreen, Florida Belle, and Sure Crop Wax have been tested.

The tomato breeding work has been continued. Ten lines from former crosses have been selected and are being tested. An article on the work will appear in the first issue of the journal, Turrialba. Several standard varieties like Bonny Best, Rutgers and Stokesdale are also being tested.

Studies on sweet potatoes, sweet peppers, cabbages and lettuces are being continued.

CORN

Mario Gutiérrez

The corn program has been developed during the year with two crops. The Institute mass selected variety I-452 has been used as basic material for testing the relative efficiency of different breeding methods. To obtain information on the material used, a study was made of the variability of five plants and five ear characters and their interrelationship. The plant characters studied were: date of silking, number of nodes, plant height, ear height and root lodging.

Date of silking was taken at two-day intervals on 4098 plants. A random sample of 2048 was taken for further study and from these 243 plants were discarded, because of having incomplete records or being otherwise unfitted for the study, leaving a total of 1805 individuals.

The ear characters studied were: ear shank length, ear length, ear weight, shelled corn, and shelled percentage. In the case of two ear plants the summation of the character for the two ears was used. The two-ear plants yielded 63.6% more shelled corn than the one-ear plants, and this difference was significant at the 1% level.

A character association study was also made. The important associations developed were:

1. Ear weight is a good indication of shelled corn yield, making it possible even to omit shelling in field trials.
2. Selection for yield in mass selection should be guided by selection per ear length.

The plant material developed under the program of study of relative efficiency of breeding methods was the following:

1. Mass-selection. One hundred and fifty ears were selected and their seed composited to make a solid planting in an isolated block and practice a second cycle of selection with the same methods.
2. Mass-selection with bi-parental control. Composite seed was produced from one hundred ears that had been selected from crosses of plants considered desirable by visual evaluation.
3. Ear-to-row material. One hundred and sixty-five ears were chosen by mass selection to be devoted to the ear-to-row phase of the study.
4. Inbred lines from I-452 and I-451. Over six hundred self-pollinations were made in each one of the two varieties I-452 (yellow endosperm) and I-451 (white endosperm). Only the first variety is involved in the comparison of methods of breeding. Lines from I-451 will be used in the production of white endosperm synthetic varieties by recombination of top-crosses and lines using early testing. One hundred and ninety-seven S1 pollinations from I-452 and one hundred and seventy-four from I-451 were saved. Remnant seed of all this material was saved, dried to about nine percent moisture, treated with Arasan, and properly stored for later use.

COFFEE

The coffee program has been developed since July 1, 1949 from projects which were started in 1946. The major part of this program is being developed by the Plant Industry Department. In cooperation with this program the Agricultural Engineering Department is working on a project that deals with the coffee drying process, and the Department of Agricultural Economics and Rural Life has under way a project

for developing methods that will enable economists and farmers to study the economic aspects of coffee production. This project is being developed in Costa Rica and in Colombia under a cooperative agreement with the Colombian Coffee Federation.

Personnel

Manuel Elgueta, Head of the Plant Industry Department, is in charge of the coordination of the various phases of the program. The program of this Department has been divided into four different fields: (1) Physiological studies, under Dr. Pierre G. Sylvain; (2) Agronomic trials and breeding, under Manuel Elgueta and Guillermo Bonilla; (3) Pathological studies, under Dr. F. L. Wellman, Plant Pathologist from the United States Department of Agriculture; and (4) Entomological studies to be made under Dr. Emilio Viale. As this is a new phase to be started, it is necessary to state here briefly the aims of the entomological studies. The coffee borer (Stephanoderes hampei) is causing serious damage to crops in Brazil. Up to now there have been no official reports of its occurrence in other countries. However, there is some information that this insect, or some closely related one, is endemic to other regions without having developed into a real pest as yet. It is important to survey very comprehensively all coffee regions in order to ascertain the existence of this or similar insects which can be a menace to the coffee crops of the future. It must be understood that one of the main objectives of this program is the prevention of future damage to the crop. Current problems of insect damage in stored coffee and of ant damage on plantations will be studied.

Students

The following students are working on this program at present:

1. Manley Boss, graduate student, U.S.A. Arrived on September 6, 1949. His project deals with some internal and external factors affecting the vegetative growth of coffee.
2. Donald Fiester, special student, U.S.A. Will arrive on January 3, 1950. He will work on a project of vegetative propagation.
3. Roger Jean-Baptiste, graduate student, Haiti. Will arrive on January 4, 1950. His project will deal with studies of blossom and fruit drop.
4. Cristóbal Navarrete, graduate student, Colombia. Will arrive on January 4, 1950. He will start a project on coffee transplanting and will initiate another on some physiological phase.

5. Rodolfo Quesada, graduate student, Costa Rica. Arrived on October 27, 1948. He is working on the disease caused by Cercospora coffeicola.

Plantation Management

Agronomic Trials.

In 1946 this program was started with agronomic trials on old coffee plantations. It was necessary at first to obtain a working knowledge of experimental techniques. Old plantations are difficult to study because of difference in age and condition of coffee plants and irregularity of shade.

1. Old Plantation Trials. One trial was begun in 1946 and the others in 1947. These trials are already giving valuable information and have helped considerably in the development of criteria for experimental techniques. The results are as follows:

Project No. 99. Factorial Fertilizer Trial. This trial studies the effect of N.P.K. and Ca. alone and in all possible combinations. First-year results, though not statistically significant, indicated a definite and beneficial effect of P and Ca. The second crop is just being harvested and no data are yet available. If the first-year results are confirmed, a good orientation as to the possible value of chemical fertilizers in coffee will be granted.

Project No. 37. Renovation of Old Plantations by Cultural Treatments and Fertilizer. This is the only trial running since 1946. The third crop is just being harvested, and no data from it are yet available. If present trends continue, the experiment will give us some measure of the loss from excessive working of the soil.

Project No. 87. Shade effect on an Old Plantation. Four different shade intensities were studied in this trial: (a) no shade, (b) heavy pruned shade, (c) normally pruned shade, and (d) unpruned shade. As the trial has a split plot design, there are also sub-treatments. These include coffee plants pruned vs. unpruned and fertilized with N.P.K., with N.P.K. and Ca., and without fertilization. The second harvest has just been finished, and though no statistical calculations are available so far, the second results coincide very well with the first. The results can be summarized as follows:

- a. In the first crop there was a significant difference at the 5% level in favor of normal shade vs. no shade. Coffee trees under unpruned shade and heavily pruned shade yielded less than those under normal shade in the order indicated. The results of the second crop agree exactly with those of the first.
- b. In the first crop the unpruned coffee trees yielded 50% more than the pruned ones. The differences were statistically significant at the 1% level. This year results increased this difference to almost 100% of unpruned over pruned coffee trees. It appears that we have a cumulative deterioration effect of pruning.
- c. Last year fertilization produced an increase in yield only in the unpruned coffee trees. The interaction between pruning and fertilization reached the 5% level. This year fertilization is producing an overall effect of about 50% increase of yield of fertilized trees vs. no fertilization.

2. New Plantation Trials. With the first statistical results of the former trials and the results of studies on experimental technique, which are described later in this report, it was considered that there were sufficient antecedents to design a set of new trials. In order to have plant material for these new trials a nursery of about 30,000 seedlings was planted. The seed was obtained from a mass selection made from vigorous and high-yielding trees. The following new trials have already been planted:

- a. Transplanting from the seedbed to the nursery. Three series of trials have already been run to ascertain the best stage of the young seedlings for transplanting and handling them in the nursery. The last two series were planted in a split plot design. Three stages of seedling development were tried: (1) "abejón" (cotyledon leaves not yet open), (2) "copita" (cotyledon leaves already open), and (3) those with the first pair of true leaves open.

Two planting depths were tried also: (1) with cotyledon leaves about one inch above ground and (2) with leaves just touching the ground. Finally, and as major treatments, four types of shade were used: no shade, artificial shade, shade of Ricinus communis and dried leaves of a palm. The series planted coincident with the dry season, showed the advantage of artificial shade over the others in such a way that all the nursery was planted

with this type of shade. There was no statistical difference among the different types of plants to be transplanted, but there was a difference in favor of planting with the cotyledon leaves one inch above the ground. The last series was counted in December, and this study is ready for a final report which will appear as an article in the Institute journal Turrialba.

- b. Transplanting from the nursery to the field. Transplanting is done with the roots in a ball of earth. The new methods of having artificial shade in the nursery make it convenient and economic to have the same place for nursery for several years. A factorial trial was designed to study the effect of transplanting with ball of earth vs. bare roots. Three different types of leaf pruning were also tried. No significant differences were obtained between transplanting with ball of earth vs. bare roots, but in both types a very detrimental and significant effect was noted when any mutilation of the leaves was made. Growth of the plants where leaves were pruned was arrested in direct relation to the proportion of pruning. We must correlate this result with the detrimental effect of pruning already noted in one of the trials.
- c. Factorial fertilization trial. In view of the results of the fertilization trial on the old plantation, it was considered interesting to design a new experiment in order to study the effect of N.P.K. and Ca. each in three levels and in all possible combinations. The 81 different formulae resulting were arranged in a simple lattice design with two replications. This kind of design will enable us to measure relatively small differences in yield produced by the fertilizers and study all possible interactions among them. This trial was planted in October, 1949.
- d. Variety trial. A definite and precise knowledge as to the relative value of the different coffee varieties actually used in plantations is needed. Variety trials of the "typica", "bourbon", "nacional" and "híbrido" have been started. It will be important to study their value not only in relation to yield but also to quality.
- e. Pruning and distance of planting. The planting distance varies in different countries. It is possible that a dense planting increases the yield. In that case pruning may exert an influence upon this effect. Both factors will be studied in this trial, to be started in May, 1950.

- f. Methods of cultivation. Many of the aspects of coffee growing are based mainly on traditional beliefs. One of these is soil management. Coffee plantations are subjected to fancy methods of cultivation which involve enormous quantities of hand labor and possible damage to the plants through root pruning. There is a definite need for rationalization of all the methods of cultivating this crop. This trial will study the main practices in actual use in comparison with natural cover and clean cultivation. The different methods will be studied also with reference to soil conservation. This trial has been under way since November, 1949.

Improved Planting Material

Pollination Studies

It is very important to know the type of pollination in order to formulate any breeding program. References in the literature indicate that coffee arabica may be self-pollinated, but we have found only one reference to the proportion of self-pollination occurring in nature. Whole branches were enclosed in cloth bags and counted periodically. Check branches on the same trees were controlled. Fruits were formed in proportion not significantly different on the enclosed branches from those on the checks. In order to ascertain the time of pollination, stigmas were cut in certain buds immediately before opening. Fruits were formed, though in lower proportion. From 695 flowers treated, 96 fruits were obtained. These studies will be carried into genetic investigations.

Individual Tree Performance

Coffee shows a very high yield variability from tree to tree and from year to year on the same tree. Tree performance studies are important as an orientation to experimental methods and the selection of mother trees. This program is giving more importance to progeny testing. Performance studies were initiated on a private farm where a block of 100 trees was marked. The first harvest recorded gave a variation from 1/2 liter to 17 liters of fruits per tree. The mean production per tree was five liters; the mean weight of a liter was 676 grams. The present harvest is not yet finished, so full data will be given in a later report.

Selection Plots

A number of growers in the Meseta Central have been stimulated to select, through a hundred-tree study plot, high-bearing trees for the development of their own best adapted coffee variety. This work is being done cooperatively with the STICA organization, and it is believed that it will mean much to the development of higher bearing fincas in Costa Rica.

Selection

Although we have not yet conclusive evidence of self-pollination in coffee arabica, it was considered important to advance a project of line selections. A first selection of 220 lines is already ten months old, and another selection of about 750 new lines was made during the last crop from trees all over the coffee regions of Costa Rica.

Collection of Species and Varieties

<u>Coffea arabica</u> L.	var. <u>typica</u>
" "	var. <u>guadaloupe</u>
" "	var. <u>philippinean</u>
" "	var. <u>erecta</u>
" "	var. <u>padang</u>
" "	var. <u>Blue Mountain</u>
" "	var. <u>maragogipe</u>
" "	var. <u>kona</u>
" "	var. <u>sumatra</u>
" "	var. <u>preanger</u>
" "	var. <u>bourbon</u> o <u>culta</u>
" "	var. <u>San Ramón</u>
" "	var. <u>Surinam</u>
" "	var. <u>murta</u>
<u>Coffea canephora</u>	var. <u>Pierre</u>
" "	var. <u>laurenti</u> (de Wild.) Chev. (robusta)
" "	var. <u>uganda</u> (Cramer Chev.)
" "	var. <u>quillou</u>
<u>Coffea dewevrei</u> de Wild. & Dur.	var. <u>excelsa</u> Chev.
<u>Coffea abeokutae</u> Cramer	
<u>Coffea stenophylla</u> G. Don	
<u>Coffea moka</u> Hort. Bogor. ex Cramer	var. <u>laurina</u>
<u>Coffea liberica</u> Linden	

The species were collected on the "Finca Atirro" from material introduced many years ago from Batavia, Java. Cuttings were rooted at the Institute. The variety collection has been increased recently through material which was sent to Dr. F. L. Wellman from Guatemala. We are in some cases doubtful as to species determination, but this will be ascertained.

Shade Tree Collections

One important aspect of the coffee industry of most areas is the use of shade. The trees most commonly used in Costa Rica are of the genus Inga, but several other leguminous trees are used in other countries, and there are still others which offer possibilities. The different species of shade trees will be studied from a collection which has already been planted. Each species forms a group of nine trees in squares which will give us the possibility of studying growth characteristics, root development, and shade intensities and types. The collection includes sixteen species from the genera Inga, Erythrina, Leucaena, Pithecolobium, Piptadenia, Acacia, Entada, and Erythrophleum.

Pest and Disease Control

Dr. F. L. Wellman's studies have covered all the diseases found attacking coffee in Costa Rica. A brief review follows:

Omphalia flavida (leaf spot)

A complete study on the life cycle of the fungus has been completed. A paper entitled "Dissemination of the Omphalia leaf spot of Coffee" is ready for publication. The method of distribution was found to depend on rain drops. Studies on the culture and physiology of the fungus, though not yet completed, will be ready for publication in the near future. Methods of control have also been worked out, and the disease can be eliminated by pruning and defoliation.

Rosellinia (coffee root rot)

The "Maya" has not been readily studied as the organism grows slowly in the culture. Though it kills trees, investigations have shown that it causes less total reduction in yield than either the Omphalia or Cercospora leaf spots. In addition to studying the organism in culture on several media, the disease has been found for the first time on the Institute plantation, thus providing an opportunity to study it at close range.

Cercospora coffeicola (leaf spot and fruit rot)

Rodolfo Guesada, one of the students mentioned above, has been studying this disease intensively. His work has covered three phases: (a) the spore, studying its mycological, development, and germination characteristics, (b) the organism in culture, and (c) the problem of the attack on the organism in the field, age of leaf and environment as regards infection, effect of insects and injuries on infection, and results of these studies as they relate to control and field practices.

Temperature Relationships of Six Coffee Organisms.

Arrangements have been made to have the effect of temperature studied on the growth of six important coffee disease-producing organisms. This work is being done at the University of Wisconsin in the Department of Plant Pathology and paid for by the Office of Foreign Agricultural Relations, United States Department of Agriculture. Cultures furnished for study were of Omphalia, Cercospora, Colletotrichum, Fusarium, Pellicularia, and Rhizoctonia. Some interesting facts were found; for instance, the almost continuous temperature of twenty-four degrees centigrade in the laboratory at the Institute is the optimum temperature for the Omphalia flavida organism.

Macho Disease of Coffee.

An abnormal tree condition by this name has been causing considerable discussion and worry among coffee growers. Trips have been made to

the region where it is especially severe, and studies of symptoms have been carried on. At first the trouble seemed to have much in common with a virus infection. However, grafting experiments proved this wrong, and culture studies proved that bacteria or fungi were not connected with the trouble. Tomato and corn seedlings grown in soil samples from the region did show either deficiency or toxicity symptoms. Samples for complete soil analysis have been taken to the United States.

Physiological Studies and Experimental Techniques

Physiological Studies

These studies were planned to secure knowledge of physiological reaction of the coffee plant in order to understand it and interpret correctly the best methods of cultivation. Some of the results that are being obtained in the agronomic trials can be understood only when a better knowledge of the physiology of the plant is acquired. Pruning, shade, and fertilization effects must be thoroughly understood in order to solve the problems of cultivation.

The first physiological studies have been based mainly on the actual agronomic trials. These are as follows:

1. Annual variation in individual yield of coffee trees growing under different conditions. Yields of ten trees of each sub-treatment in the major plots with no shade and normal shade were taken during the last crop. Six pickings were necessary, the last one being on the twenty-second of December. An enormous variability was observed from 0 to 16.867 grams per tree. Greater variation was shown among the trees without shade than those under shade.
2. Effect of shade upon growth and differentiation of coffee seedlings as expressed by physical measurements and chemical composition. Shade is a very important factor in coffee growing, and an understanding of the way in which it affects growth and differentiation is needed to interpret results of agronomic trials and to formulate methods of regulating shade in plantations. As a preliminary to these projects, studies were made upon the seedlings planted in the nursery in December 1948 and submitted to four different intensities of solar radiation: (a) 75% shade, (b) 50% shade, (c) 25% shade, and (d) no shade. Terminal growth was not affected by different shade intensities, but lateral growth under full sun was more than twice as great as under 75% shade. The number of leaves on plants under full sun was also more than twice those under 75% shade. From September 26 to October 13, twenty-five plants from each block of the four treatments were pulled out, and the following determinations were made: fresh and dry weight of top and roots, percentage of dry matter of tops and roots, top-root ration, stem diameter,

and number of laterals. Significant differences were obtained in dry weight, number of laterals, and stem diameters in favor of the greater insolation. A new and more refined experiment will be made with plants in pots.

3. Some internal and external factors affecting vegetative growth of coffee. This project was undertaken by Manley Boss, graduate student. Nitrogen absorption by the plant is one of the important factors of growth and production. A group of trees has been selected, and measurements of branches are taken regularly. Sodium nitrate has also been applied to some of the trees, and soil samples are collected monthly for nitrogen analyses. Rain water has also been collected to investigate nitrogen content. These periodic analyses will give the nitrogen cycle in the soil and enable us to find out whether it can be correlated with growth periods.
4. Some carbohydrates and nitrogen constituents of branches of bearing and non-bearing coffee trees throughout the season. Carbohydrate formation and nitrogen absorption are the two most important factors in fruit production with carbohydrate-nitrogen ratio playing an important part. A trial was arranged with three replications consisting of defruited and control trees. It is proposed to run chemical analyses of a certain number of branches several times during the year in order to study the variations in carbohydrates and nitrogen content throughout the season. Branches suffering from physiological die-back have been included to learn more about the nutritional aspect of this disease.

Experimental Techniques

One of the problems confronting us in the development of the program has been that of the size and shape of the plots to be used in the experiments. One tendency has been to consider the fact that, due to plant variability, the size of the plot should be large, at least 75 trees and preferably 100. With this in mind only very simple trials with a few variables could be carried on, and even in these the effect of the soil heterogeneity could be of too great a magnitude to permit measurement of small differences. The first trials on the old plantation, already reported, seem to prove that comparable results can be obtained with relatively small plots even with very heterogeneous plant material. In the split plot design more significant results were obtained in subtreatments with plots of only 12 trees than in the major treatments with plots of 72 trees. In order to study this problem further, data were obtained on a block of 900 trees individually harvested during five years. These data are from the "Centro Nacional de Experimentación en Café", Chinchiná, (Caldas), from the Colombian Coffee Federation, and are being studied on a cooperative basis with Ing. Alberto Machado, Head of the Coffee Breeding Program of that Center. This study is part of the work being carried out under the cooperative agreement between the Colombian Coffee Federation and the Institute.

A block of 576 trees has been divided into different plot sizes and calculated. Even though calculation is not yet finished, it seems that plots from 12 to 36 trees are similar in efficiency, the elimination of soil heterogeneity being on a similar level, but on plots from 48 to 72 trees, which is the highest number being studied, this efficiency diminished progressively, and in the last number, the effect of soil heterogeneity is confounded with treatment effect. These data will be used also to try to determine the comparable effect in tree performance for environment and heredity. This is important in order to ascertain the value of tree performance as a basis for selection.

Cooperative Relations and Extension

Emphasis has been given to the development of cooperative programs with other countries of the hemisphere. At the present time an agreement with the Colombian Coffee Federation is under way; exchange of technical personnel has been agreed upon, and a series of parallels and complementary projects will be developed in both countries.

Dr. Ramón Mejía Franco, Director, Sección Técnica de la Federación Nacional de Cafeteros de Colombia, visited us on January 23, 1949.

Data from tree performance at Chinchiná is being studied as a basis for experimental techniques, heredity, and environmental influence on individual tree variability. In the near future Manuel Elgueta will visit Colombia. Upon his return to Turrialba, Alberto Machado, Head of the Coffee Breeding Program, in Chinchiná, Colombia, will spend some time at the Institute.

Another agreement is being arranged with the Instituto Agronómico of Campinas, Brazil. Dr. Coaracy M. Franco is spending six months at the Institute studying shade effect on soil humidity and is collaborating with Dr. Pierre G. Sylvain in his work. Both will visit some of the Central American countries later.

SEED TREATMENT STUDIES

Lucy Hastings

These investigations have been continued with additional seed lots and varieties.

Problems of Seed Storage

A series of laboratory and greenhouse tests have been run in evaluating various storage conditions for seeds and in studying the development of the numerous fungi involved, determining their importance as disease pathogens in the seedling phase with loss in stand through the damping-off by the destruction of the seeds before emergence, by the killing of the germinating seeds and young seedlings (post-

emergence damping-off), in studying their importance as systemic disease carriers, and their importance as storage rotting organisms.

Seedling Diseases and Chemical Control

Special disease problems studied have been:

The Conidiobolus disease of Kenaf
Fusarium seedling disease and head blight of sorghums
Fusarium seedling disease of field corn
Bacterial blight of sweet corn
Fusarium root disease of coffee nurseries
Coffee seedling anthracnose
Anthracnose of coffee cuttings
Cercospora infections of young coffee seedlings
A blossom and leaf spot of Poró, the coffee shade tree
Helminthosporium of rice

Lesser Investigations in Seed Treatment

A field stand and yield trial of three varieties of peanuts was designed and carried out.

A sorghum test (4 randomized blocks of 12 rows of 3-inch spacing in 53 foot rows 36 inches apart for each block) encountered very heavy and prolonged rain with low temperatures. While laboratory germination of the seed under optimum conditions was high, 83%, field germination under these exceedingly adverse conditions was reduced to 5%. Sufficient data from all replications was salvaged to show a 72% increase in stand for Arasan treated seed, 26.5% increase for Spergon, and 13.9% increase for Ceresan treated seeds over untreated controls.

Other Laboratory Investigations

Preliminary mycological work on the agaric stage of *Omphalia* is in progress, as well as preliminary studies of a number of pathogenic *Fusaria*.

INTER-AMERICAN CACAO CENTER

George F. Bowman

Personnel

During the past year the staff has remained the same. George F. Bowman has remained as head, J. Harvey McLaughlin, plant pathologist, Leslie R. Holdridge, ecologist, and Carmen Dannelley, secretary. Dr. Holdridge is being transferred to other duties in the Institute very

shortly. It is planned to replace him with a physiologist and add an agronomist in the near future.

Students

Fourteen students have been graduated. Three finished the six months' course of practical training in cacao culture and the remaining eleven earned the title of "Especialista en Cacao". Of these eleven, four were awarded the degree of Magistri Agriculturae by the Institute. It is gratifying to us that twelve of these fourteen are now working directly on the advancement of the cacao industry.

Some changes have been made in the training program. We found that the division of students into three categories was unsatisfactory and now all students receive equal stipends. We still attempt to get men who have a Master of Science degree and want to work in cacao, but they are of no appreciable help to us in the training of other students and worth no extra stipend. The ones who would be in the old category three (foreman type) can be trained equally as well at home by our graduates and we can multiply the effect of the Center more rapidly by training men who are capable of training other men. If we do get a student who can assimilate only the training in cultural techniques, we pay him an equal stipend during the period we keep him because his incidental expenses are just as high as the other students.

For the title of "Especialista en Cacao" we require that a student spend at least one year in residence, pass three quarterly examinations on general cacao information, present two seminars, prepare a final report on plant performance work and training, conduct an individual research project, prepare an acceptable thesis, and pass a final oral examination given by at least two members of the staff. Students are classified by the staff during their first six months at the Institute, and if it is judged that they cannot fulfill these requirements, because of lack of training, interest, or ambition, they are given the six months' field course, and their fellowships are released for new students. Special students who do not want the training in research, like the three listed among the graduates, are accepted for this six months of general training and are not candidates for the title.

Students who have finished the requirements for "Especialista" may stay an additional period of six months, more or less, as candidates for the Magistri Agriculturae degree if the Graduate Study Council of the Institute accepts them as candidates for this degree. The Cacao Center may grant an extension of the fellowship if the student has shown sufficient interest in cacao and if we are convinced that he will be of more value to the industry with this further training. We are anxious to give all possible counsel and advice to any student working on a cacao project, but if his interest is purely academic and does not promise to advance the industry, we believe the fellowship aid should be passed on to a new student who is of more potential value.

Through the courtesy of the United Fruit Company, we are also able to give the students an opportunity to observe cacao culture on a large scale. Once each year we take all students to Quepos where the company is planting 16,000 acres of clonal cacao in a region with a severe dry season. Quepos has the world's largest installation for propagation of cacao cuttings. From time to time we take them also to the Zent farm on the Limón side of Costa Rica, where the company has large tests of spraying old cacao for disease control and is planting clonal cacao on a plantation scale. In Puerto Limón they are shown the large central fermenting and drying plant.

The present student body includes sixteen students from the following countries: Mexico, Ecuador, Colombia, Haiti, the United States, Surinam, and the Philippines. One student from Brazil has been due since January first and is expected momentarily. Since we accept students in January, April, July, and October, the number of students fluctuates from sixteen to twenty as new ones enter and older ones graduate. Applications from Brazil, Nicaragua, Peru, Venezuela, and Ecuador are now on hand and are being evaluated or processed.

The following is a list of cacao students and their thesis titles:

Santiago Porcella, III - 6 months U.S.A.	The Liberia Company Monrovia, Liberia Planting cacao
Alberto Hernández Silva - 6 months	Ministerio de Agricultura y Cría Venezuela Cacao Program
Jorge Alvarado Arroyo - 6 months Costa Rica	Ministerio de Agricultura e Industrias Limón, Costa Rica Cacao Program
Humberto Barquero Mora Costa Rica	Especialista en Cacao & Magistri Agricul- tural
	"FACTORES QUE AFECTAN LA CALIDAD DEL CACAO PRODUCIDO EN VARIAS FINCAS DE LA ZONA ATLANTICA DE COSTA RICA"
	Ministerio de Agricultura e Industrias Costa Rica Cacao Program (resigned)

- Leonardo Cabrera Villa
México
- Especialista en Cacao & Magistri Agriculturae
- "EFECTOS DE LA SOMBRA SOBRE LA CONCENTRACION DE ESTOMAS EN THEOBROMA CACAO L."
- Estación Central de Investigación y Propagación de Cacao
Tapachula, Chiapas, México
- Guadalupe Escamilla
México
- Especialista en Cacao & Magistri Agriculturae
- "PROPAGACION VEGETATIVA POR ESTACAS"
- Estación Central de Investigación y Propagación de Cacao
Tapachula, Chiapas, México
- Vicente Martínez V.
México
- Especialista en Cacao & Magistri Agriculturae
- "METODO PARA FERMENTAR PEQUENAS CANTIDADES DE CACAO"
- Estación Central de Investigación y Propagación de Cacao
Tapachula, Chiapas, México
- Monod Dejean
Haiti
- Especialista en Cacao
- "SOME OBSERVATIONS OF THE FLOWERING HABITS OF CACAO"
- Inspecteur del Departement du Sud Jérémie, Haiti
Leading cacao area
- Ulises Mejía Briceño
Honduras
- Especialista en Cacao
- "ESTUDIO DEL SISTEMA RADICULAR DE ARBOL DE CACAO" (Theobroma cacao L.)
- Leonel Murga
Guatemala
- Especialista en Cacao
- "LA REACCION DEL ARBOL DE CACAO A LA PODA"
- Ministerio de Agricultura y Cría
Venezuela
Cacao Program

Luis Alfredo Paredes
Ecuador

Especialista en Cacao

"EL INJERTO DEL CACAO"

Estación Experimental Agrícola del
Ecuador
Quevedo, Provincia de Los Ríos, Ecuador
Cacao

Manuel Salazar H.
Nicaragua

Especialista en Cacao

"EFECTO DE LA LLUVIA Y LA HUMEDAD DEL
AIRE EN LA TRANSMISION DEL
PHYTOPHTHORA PALMIVORA"

Inspector General de Agricultura
Managua, Nicaragua

Rosendo Velázquez B.
Guatemala

Especialista en Cacao

"INFLUENCIA DEL TIEMPO DE DECAPITACION
EN EL INJERTO DE CHUPONES CON YEMA"

Ministerio de Agricultura
Guatemala
Cacao Program

Angel G. von Buchwald
Ecuador

Especialista en Cacao

"METODOS DE MEJORAMIENTO DE PROPAGACION
DEL CACAO POR SEMILLAS"

Estación Experimental Agrícola del
Ecuador
Quevedo, Provincia de los Ríos, Ecuador
Cacao

Student Research

All students conduct studies on plant performance (the normal growth and development of the cacao tree) and participate in the departmental research as part of their training. They also assist, when necessary, and become well acquainted with the projects of other students. Each one selects and conducts his own research project. These projects are planned to train the student in the methods of scientific research. We emphasize, however, that the project should promise to contribute to the advancement of the cacao industry, since we believe that the most vital part of scientific research is the selection and appraisal of the problem to be investigated. A multitude of fascinating projects always present themselves, and the investigator of greatest value is the one who can most intelligently evaluate their order of precedence.

Projects of particular interest that have been terminated in the past year are listed below. These have been described in the Cacao Information Bulletin, and the results are shown here in very brief form.

1. Methods of dissemination of *Phytophthora* pod rot. It was shown that the fungus is spread almost entirely by water.
2. Reaction to pruning. Light pruning induced more vigorous growth and a higher proportion of branch growth rather than chupons. Regardless of season, pruning resulted in an additional flush without affecting the normal seasonal flush.
3. Effect of light on stomatal concentration. As light was decreased the number of stomata per unit area increased until light was less than 50% of full sunlight. Sudden reduction of light produced severe defoliation.
4. Vegetative propagation. A simpler and cheaper technique of rooting cuttings was developed. A budding technique was originated that gave a very high percentage of success and eliminated dormancy in buds.
5. Flowering and pollination. Thrips and midges were found to be involved in pollination. Pollen was viable for more than 36 hours.

As usual and as planned, the present projects are in some cases continuations of or sequels to earlier projects. Those now in progress are:

1. Reaction to pruning
2. Effect of fertilizers on cherelle wilt
3. Control of *Phytophthora palmivora* by chemical means
4. Methods to force production of basal chupons
5. Post treatment of budded seedlings
6. Post treatment of budded chupons
7. Disease control in nurseries
8. Evaluation of methods of selection

Staff Research

The amount of this research remains small, mainly because the training of students has occupied the time and efforts of the staff almost completely. Moreover, we have made an effort to shift most of the

work originated by staff members over into student projects, since we are convinced that the training of students is the most effective means for putting the results of research into actual practice in the cacao-producing regions.

Some research by staff members is necessary, however, in order to keep our training material fresh. We have installed and are operating the large experiment on renovation methods described last year, and we are already realizing some benefits. We found that more than 80% of low stumps produced buddable sprouts, but fungus diseases must be controlled if these are to be used. We found, also, that it was possible to select by single inspection and eliminate up to 20% of the old trees without lowering production appreciably.

In disease observation we have limited ourselves almost entirely to Phytophthora palmivora. The observations and studies made, however, will be of value in the control of other diseases in that they advance our ability to adapt the methods of plant pathology to tropical conditions in general and the cacao tree in particular. It must be emphasized, also, that this Phytophthora is found in every cacao-producing area of the world. It is analogous to the common cold in humans. The cold, while not so striking in its effects, reduces the total productivity of a population more than any other one disease. If Phytophthora palmivora could be eliminated, the total world production of cacao would probably be increased by 20%. This fungus is probably involved in the defoliation and stunting of nursery stock, the defoliation and dieback of old trees, and in the loss of some of the very young plants that we have formerly classified as cherelle wilt. At least these effects can be produced artificially by inoculation with Phytophthora palmivora.

Investigations of new and simpler methods of vegetative propagation are continuing.

Extension

The Cacao Information Bulletin has been published regularly and its circulation continues to increase. We now mail out 628 English and 595 Spanish copies per month. They go to all the countries in this hemisphere and to many parts of Europe, Africa, Asia, Australia, and the East Indies. We have received a very gratifying number of requests for the Bulletin from actual cacao producers. Personal contact included visits by staff members to other countries, visits to the Center by other people, and advice by correspondence. Following the visits to Brazil by Mr. Bowman and Mr. Oechsli we have worked more closely with that country and have received a number of applications for admission as students and a number of requests for advice. Dr. Holdridge's trip to Mexico and the Central American countries aroused considerable interest in cacao, particularly in Guatemala and El Salvador. After his trip to Peru we received applications for admission as students from two officials of the Department of Agriculture. Peru is potentially an important producer of cacao.

Visitors to Turrialba include a number of cacao workers who came to exchange views with us, for example, Dr. Fowler from the Pichilingue Station in Ecuador and Mr. Gillette from the Cadbury Company of England. Others, such as the Directors of Agriculture from Ecuador and Colombia, came here for other purposes but became interested in cacao while here. A number of others came here for advice in purchasing or planting cacao farms. One group from the United States purchased a farm of 700 acres in Costa Rica on our advice, and their manager is following our recommendations in renovating the plantation.

A valuable group of visitors was entertained in Turrialba last March when the Inter-American Technical Cacao Committee held its Conference here. The Cacao Center acts as permanent Secretariat for this Committee. A development of considerable interest is the recent signing of a contract with the United States Department of Agriculture Station in Puerto Rico to establish the clonal collection and quarantine station there. The Trinidad clones will be sent there in the near future, and we hope soon to have a germ plasm bank in Puerto Rico encompassing all of the best selections from this hemisphere, with facilities for transmitting budwood to all interested parties.

ANIMAL INDUSTRY DEPARTMENT

A. O. Rhoad

During the fiscal year 1948-49 the Animal Industry Department expanded its physical plant, increased its herds, and completed several research projects. During the same period the Head of the Department attended, by invitation, two scientific world conferences and was appointed head of a special commission that studied the veterinary and animal husbandry teaching programs in Latin America.

CONSTRUCTION PROGRAM

The physical plant of the Department is now developed to the extent that it has the proper facilities to conduct its livestock operations and carry out certain types of experiments. The beef cattle, dairy cattle, poultry, swine, and horse units are constructed and in operation. Likewise, the feed warehouse and implement sheds have been completed. The creamery is ready, but because of lack of sufficient electric current it has not been operating. (Since June 30, 1949, however, additional electric current has been connected to the creamery, and it is now operating.) The slaughter house is completed but requires installation of equipment before it can be placed in operation. The animal climatic laboratory is under construction and approximately 60 per cent completed. The cornerstone of this laboratory was laid with due ceremonies on 7 February 1949. This laboratory is a gift of the King Ranch of Texas.

ACQUISITION OF LIVESTOCK

The table that follows shows the comparative livestock inventories of the Department, as of June 30, for 1948 and 1949.

Comparative Livestock Inventories - June 30, 1948 and 1949

Class (all ages)	June 30 1948	June 30 1949	Increase or Decrease
Dairy Cattle	62	99	+ 37
Beef Cattle	125	187	+ 62
Steers	134	61	- 73
Horses	7	12	+ 5
Swine	0	50	+ 50
Poultry	459	417	- 42

Three additional experimental herds were added to the facilities of the Department during the year. Forty yearling heifers out of Brahman x Hereford cows and sired by Santa Gertrudis bulls were obtained from the King Ranch of Texas. Four purebred Santa Gertrudis bulls were imported with these heifers. The heifers are to be used in an experimental grading-up program using Santa Gertrudis bulls. The object is to test this breed to conditions of tropical rain forest climates. Also four purebred Quarter Horse fillies and one colt were imported from the King Ranch as the foundation stock for the Institute Quarter Horse stud and grading-up program using local type mares.

The experimental herd of swine was also added to the Department program. Fifty weanling pigs of local type hogs were purchased. From these will be selected about 12 females and two boars for use in the herd improvement program. These animals and their offspring will be used in feeding trials testing various root and tree crops for the growing and fattening of hogs.

RESEARCH

Control of Dermatobia hominis

A rather extensive experimental project on the control of Dermatobia hominis (known under local names as "tórvalo", "bierne", "nuche", or skin bot) was completed during the year covered by this report. This work was financed by the Esso Laboratories, Standard Oil Development Company, New Jersey. Dr. John Creighton, entomologist of the University of Florida, has been technical consultant. The experiments were carried out on a scholarship basis by Mr. William Neel, graduate assistant. Dr. Julio Mesa Salazar, DVM of the Ministry of Agriculture and Livestock of Colombia, assisted in these experiments during the period from October to February.

The series of investigations performed by William Neel at Turrialba have been of considerable value in studying the biology and life cycle of a severe tropical skin grub, Dermatobia hominis (Linn.), and in formulating means of successfully combating this destructive pest of cattle.

An intensive trapping survey revealed that out of a total of 1,041 dipterous insects collected only four specimens, Sarcopromisca arcuata (Town.), carried eggs, assumed to be those of the Dermatobia female, on their abdomen. The pupal stage of this insect was found to require from 39 to 57 days for completion. The average life span of the confined Dermatobia adult was found to be only four days.

Since the larval stage has been shown to require an average time of 50 days (Neiva and Gomes, 1930), the total life cycle from egg to adult stage appears to require approximately three and one-half months.

Experiments to induce oviposition on captive insects by the adult females in captivity were only partially successful.

In order to protect livestock from damaging infestations of this insect the periodic treatment of cattle with sprays and dusts for protective toxicity and repellency has been recommended. A high degree of control has been shown to result from the use of toxaphene, chlordane, and DDT sprays at one percent strength. In addition to these sprays, the use of a five percent gamma isomer (benzene hexachloride) dust has proved very effective in controlling this parasite.

The selection of an ideal "tórsalo" control agent is based on the ability of a substance to maintain an animal in a condition free or as nearly free of these pests as is possible. In this series of investigations parasite-free conditions were maintained only during the dry season. During the rainy season, or period of highest incidence, some degree of infestation was always encountered even when using some of the most promising products.

Toxaphene, one of the most effective control agents, was not tested during the months of peak infestation.

On a basis of the highest degree of repellency and residency the following products in order of their importance were found to be the most effective "tórsalo" control agents.

Ratings of relative effectiveness of products at concentration greater than one percent (active ingredients):

1. * Gamma isomer ----- 5 percent dust
(benzene hexachloride)
2. DDT ----- 5 percent spray
3. Chlordane ----- 3 percent spray

Ratings of relative effectiveness of products at concentration of one percent or less (active ingredients):

1. * Toxaphene ----- 1 percent spray
2. Chlordane ----- 1 percent spray
3. DDT ----- 1 percent spray

Feeding of Concentrate Mixtures to Native Type Dairy Cows

A question frequently asked is, to what extent is it practicable to feed high cost concentrates to Zebu native type dairy cows

* Toxaphene was not tested at concentrations higher than one percent; Gamma isomer (benzene hexachloride) was not tested as a spray or at concentrations less than five percent as a dust.

that are barn fed concentrates and roughage between the morning and afternoon milkings and turned out on pasture between the afternoon and morning milkings. A single reversal feeding trial over four 21-day periods using five native and one purebred Jersey cows was conducted. The results are given in Tables I and II that follow:

TABLE I - Average Production Costs

	Production 42 days average		Cost per lb.*		Liveweight	
	2 Basic Periods lbs.	2 Exp. Periods lbs.	Basic ¢	Exp. ¢	Start lbs.	End lbs.
Mulata	14.10	13.2	.20	.27	984	1050
Alondra	19.05	20.75	.175	.19	779	830
Bulla	10.45	10.15	.265	.317	680	756
Mansita	16.05	16.90	.175	.21	728	765
Nube	14.80	14.85	.19	.242	1089	1161
Guaria	15.55	15.60	.185	.245	1027	1040
Average	15.0	15.12	.196	.246	881	934

* Does not include interest on capital invested.

TABLE II - Total Consumption and Production

	Feed Consumed lbs.	Milk Produced lbs.	Ratio
Basic	504	3780	1:7.4
Experimental	1335	3811	1:2.8
Difference	831	31	

It was concluded from the above trial that with native type dairy cows of this experiment, with limited inherent productive capacity but with high adaptability to tropical climates, it was not economical to feed concentrates at the ratio of 1 pound for every 3 pounds of milk produced. The reason is that they did not increase their production sufficiently (15.0 to 15.12 pounds per day) to pay for the added costs of feeding at the original rate of

1 pound of concentrate to 7 pounds of milk produced. That this type of dairy cow does not efficiently use large amounts of concentrates for milk production is also evident in the increase in liveweight from an average of 881 to 934 pounds during the course of the experiment.

Study of Milk Production Records

on the Mindi Dairy Farms, Canal Zone, Panama

This study was carried out as the research project of Ing. Agr. G. Narváez, graduate assistant in the Department.

The outstanding results of the study of production records of milk cows including two breeds -- Jerseys and Holsteins -- and with two origins for each breed -- imported and raised at Mindi, were as follows:

1. Jerseys and Holsteins perform differently at Mindi Dairy Farms. This difference was significant at the 1% level, in an analysis of variance.
2. There was no significant difference between imported and home raised cows.
3. The breed by origin interaction was significant at the 1% level in an analysis of total production, and at the 5% level in an analysis of number of days lactating.
4. The Jerseys produced more milk during their lives at Mindi, and stayed in production much longer than the Holsteins.
5. The Jerseys (imported) were superior to the Jerseys (Mindi) in total production and length of all lactations. In this same analysis, the Holsteins (Mindi) were superior to the Holsteins (imported) in both concepts.
6. There is a high correlation between lifetime number of days in lactation and lifetime production within each group and within the whole population.

Average Production per Animal (1 milking)

	Jerseys	Holsteins	Totals	Average
Imported	13,883.85	9,331.11	23,214.96	11,607.48
Mindi	10,260.73	11,852.44	22,113.17	11,056.08
Totals	24,144.58	21,183.55	45,328.13	
Average	12,072.29	10,591.77		

Average Lactation per Animal

	Jerseys	Holsteins	Totals	Average
Imported	5.16	2.38	7.54	3.77
Mindi	4.48	3.51	7.99	3.99
Totals	9.64	5.89	15.53	
Average	4.82	2.94		

Average Production per Lactation (1 milking)

Imported	2,688.77	3,908.31	6,597.08	3,298.54
Mindi	2,289.91	3,371.36	5,661.30	2,830.65
Totals	4,978.78	7,279.67	12,268.38	
Average	2,489.39	3,639.83		

Average days of life-lactation per animal

Imported	1,638.61	829.32	2,467.93	1,233.96
Mindi	1,266.36	1,169.30	2,435.66	1,217.83
Totals	2,904.97	1,998.62	4,903.59	
Average	1,452.48	999.31		

Average length of each lactation (days)

Imported	317.30	347.40	664.70	332.40
Mindi	282.50	332.60	615.10	307.50
Totals	599.80	680.00	1,279.80	
Average	299.90	340.00		

PUBLICATIONS

Two manuscripts were prepared during the year. "The Adaptability of Breeds to New Environments", was written by A. O. Rhoad at the invitation of the Secretary General of the United Nations for the United Nations Scientific Conference on the Conservation and Utilization of Resources, Lake Success, New York. "The Development of New Dairy Breeds for the Tropics", was prepared by A. O. Rhoad at the invitation of the General Secretary of the XII World Dairy Congress, Stockholm, Sweden.

SURVEY OF ANIMAL HUSBANDRY AND VETERINARY CURRICULA IN LATIN AMERICA

In April 1949 the Head of the Department was appointed by the Director of the Institute to a special commission of two persons, Dr. I. D. Wilson and A. O. Rhoad, to study the veterinary and animal husbandry curricula in Latin America. This commission was appointed in partial fulfillment of Resolution LIX of the Third Inter-American Conference on Agriculture, Caracas, Venezuela, July 24 to August 7, 1945. Resolution LIX reads as follows:

"Res. LIX - Whereas:

The Agricultural and Veterinary professions are basic ones for the development of the agricultural industries of the Americas and it is advisable to establish a system of co-ordination of instruction in those professions, resolves:

1. To recommend that the Inter-American Institute of Agricultural Sciences promote studies or understandings in order to correlate the curricula in agricultural and veterinary schools and colleges, for the purpose of obtaining better cooperation among such centers."

This commission started its work in Mexico on June 15 and successively visited Honduras, Costa Rica, Colombia, Peru, Chile, Argentina, Uruguay, Brazil, Venezuela, and Cuba, terminating the study on August 17, 1949. The written report of the commission was submitted to the Director of the Institute on August 23, 1949.

ATTENDANCE AT MEETINGS

During July and August of 1948, A. O. Rhoad was invited to and attended the "1^o Congresso Internazionale di Fisiopatologia della Riproduzione Animale" in Milan, Italy and the Eighth International Congress of Genetics in Stockholm, Sweden. His attendance at these scientific congresses was at no cost to the Institute.

At the invitation of the "Asociación Colombiana de Criadores de Cebú", A. O. Rhoad visited Colombia in December 1948 to act as judge at the "Feria Nacional del Ganado Cebú" at Girardot. On the return trip a stop-over was made in Panama where Mr. Rhoad addressed the graduating class of the Escuela de Agricultura at Divisa.

AGRICULTURAL ENGINEERING DEPARTMENT

Norton C. Ives

RESEARCH PROGRAMS

Work has been continued and extended in grain drying and storage, with a new project in coffee drying and processing. Performance records of the erosion and tile drainage plots have been maintained. Noteworthy accomplishments or progress are listed and discussed briefly as follows:

Rice Drying

In cooperation with a rice grower just starting operation in a new area of the lowland tropics, the San Carlos Valley of Costa Rica, a set of six two-wheeled special rice-drying trailers was designed and built at the Institute and then taken cross country and put into operation for his first crop of rice in October 1949. Initial results were highly satisfactory.

The drying system design provides for air direction reversal through the column of rice and controlled recirculation. While further work is planned to determine ultimate possibilities, these first trials and experience with the first crop of rice showed that combined rice averaging 24% moisture content could be dried with a good degree of uniformity across the column to around 13% with a very small percentage of kernel checking by using 130°F. temperature entering air and changing the direction of the air flow through the one-foot thick column every two hours for a period of eight hours or two complete cycles of four hours each.

The system provides for the drying of two to six trailers at a time, the trailers being loaded directly by the combine elevator in the field, hauled by tractor, jeep or oxen to the drying unit, connected by short canvass connections to the air distribution ducts, dried, and then unloaded by dumping into a pit of a small elevator from where the grain is elevated at small power requirement into storage to be sold at will or when convenient.

The trailer proper is essentially a general purpose dump type two-wheeled trailer suited for hauling anything from bulk grain to sugar cane, with a 1-1/2 ton optimum capacity. It can be towed by tractor, jeep, or oxen singly or two or three in tandem. It is adapted for drying by the addition of the quickly removable roof and end sections and grain column support frames.

Dew-Point Moisture Tester

A simple, low-cost, quick method moisture tester has been developed to a point of good performance, which employs the air humidity measurement principle. However, thorough testing for different grains and materials awaits the necessary time of technical help to do it.

Seed or Food Grain Drier and Storage Unit

For laboratory and household use in humid regions a sealable storage cabinet or steel drum type unit in which a desiccant material is employed for the drying process has many desirable features for seed or food grain drying and storage.

Most grains or food products brought to equilibrium with less than 75% relative humidity air are safe from mold damage, and if brought to equilibrium with less than 50% relative humidity air they are safe from any insect damage. Also any living or respiratory process is held to a very low level in such dry grains, which helps maintain viability for long periods. And in view of the fact that moisture, quite in contrast to heat, can be sealed out with relative simplicity, special drying and storage cabinets or barrels would appear to have excellent application for many American tropical conditions.

Such type units have been designed, employing the use of a commercial desiccant, which can be regenerated in any expedient manner, such as placing it in the sun under a glass or in an oven. The advantages of such type drying are the elimination of exposing the grain to undesirable elements, such as high temperatures, moisture regain, and insect or other contamination, were it to be directly dried in the sun or oven. Each increment of drying can be conveniently held for long storage periods, and a high degree of dryness can be safely accomplished by use of the intermediate desiccant material. At this writing such a unit is in the process of construction.

Another angle of approach for such a method, that would eliminate certain of the disadvantages involved in the use of commercial desiccants, is the use of impregnated wooden drying blocks. Some exploratory work has been done on the use of wooden blocks or sticks impregnated with calcium chloride, a salt with low relative humidity hydration which will completely hydrate in air as low as 32% relative humidity. Four common local species or woods — Laurel, Cedro, Pelón, Lagarto and Balsa — were impregnated with different strength solutions of calcium chloride, and measurements were made of the salt absorption and the amount of moisture regain when exposed to 65 to 75% relative humidity air. This preliminary work has shown that balsa has good absorption capacity, absorbing

up to 28% water, by volume of the space occupied by the wood, in air at 65 to 70% relative humidity.

With a working capacity of 28% water absorption per charge of the re-dried wood sticks or blocks and placing 10% of the wood by volume into damp grain, around 5% (dry basis) of moisture would be removed per charge depending upon the original moisture content of the grain. Using a barrel or chest with removable top and using small balsa blocks glued to slender sticks as long as the barrel or chest is deep for protection and handling would permit recharging with regenerated sticks any number of times, which with the use of calcium chloride could accomplish moisture removal to a region somewhat below 32% equilibrium relative humidity, in which grains the germ plasma can live for many years, but any insects or pathogens definitely die or stay dormant. This whole avenue of approach needs further attention, development, and trial.

"Dry Process" Coffee Drying Project

Starting in December 1949 a series of drying runs were made in the laboratory to study the effect of temperature and drying possibilities of whole-cherry coffee. At this writing trial runs are in process for which purpose a small pilot plant has been designed and built. A reverse flow process is employed, where the heated air enters the bottom of the coffee-cherry column, at which point the dried cherries are removed. The air then passes upward through a column of successively higher moisture cherries, evaporating water on the way until becoming saturated and leaving the top of the column, at which point the fresh cherries enter. The dried cherries are removed from the bottom of the column by use of a simple fork-type inserted grate and a small clean-out door. Runs are still in process at this writing and data are not fully analyzed. However, experience to date prompts the following observations:

1. There is a relationship between the coffee moisture content and permissible drying air temperature. Final stages of drying should occur below temperatures in the region of 165 to 175°F. (71 to 80°C.), but somewhat higher temperatures can apparently be used with no apparent effect on coffee bean color when coffee cherries are at higher moisture.
2. With relative humidities below 20% and the average air velocity through the space occupied by the coffee of more than 300 FPM and with full exposure of the cherries to the air, drying of the fresh cherries "as picked", can be accomplished in about the following times:

<u>Temperature</u> <u>°C.</u>	<u>Required drying time to</u> <u>13 to 15% moisture</u>
50	2 plus days
60	30 to 36 hours
70	18 plus hours
80	8 to 10 hours
90	4 to 6 hours
100	3 to 4 hours

The table cannot be interpreted as the true effect of temperature on drying rate nor the time required for drying in a drier. It is of value as an indicator only and then with limitations. A batch of cherries dried in the sun during good Turrialba weather required approximately one month running time with 158 sun hours. Patio performance can be much better than this, as common practice indicates. Much time was lost in this trial during the latter stages due to some moisture regain each night and improper management of this small experimental batch.

3. Present knowledge is indefinite as to the proper moisture content for dry coffee. Assuming that coffee in equilibrium with 60 to 65% relative humidity air and normal room temperature has proper moisture content, it has been determined that such coffee has between 11-1/2 to 12% moisture in the "oro" or roasting bean stage. However, the moisture content of the dried whole cherry will average 3 to 4% above that of the shelled bean.
4. Almost two pounds of water must be removed from the fresh cherries to obtain one pound of the dried cherries, which in turn yield 50 to 52% by weight of "café oro" or roasting bean. This gives, as the drying load, about four pounds of water to be evaporated per pound of dried bean.
5. Broza, bean, pergamino, dry matter moisture content relationships. The data below are based on spot checks taken on small samples used in the tests:

Fresh cherry moisture content

Average of Turrialba coffee-----72%
Average of San José region coffee--69%

Fresh pergamino

Average of Turrialba-----67%
Average of San José-----60.5%

6. Using a standard weight per bushel tester, fresh cherries were found to vary between 50 and 53 pounds per bushel. At 52 pounds per bushel a fanega of fresh cherries would weigh 588 pounds, which at 69% moisture content would dry down to 213.5 pounds of 15% cherries, which when shelled at a yield of 52% would give 111 pounds of "café oro" at 12% moisture and 102.5 pounds of 18% skin and pulp.
7. Small lots of this skin and pulp from the dry-processed coffee cherries were offered to some milk cows to check their palatability, and they were eaten with apparent relish without exception. This is quite in contrast to the lack of palatability of the fermented or ensiled coffee pulp from the fermentation method. Furthermore, none of the original honey is washed away. The feeding value of this material, therefore, deserves detailed study.
8. Should this skin and pulp mixture not be an economical feed or where it is not needed for feed, it can be used for fuel for the drying process. At fair efficiencies, the dried pulp and skin would be able to furnish from one-half to three-quarters of the heat needed for drying.
9. The yields of fresh cherries, although varying between lots, averaged about as follows:

69%	water (by weight)
31%	dry matter
36.3%	dried cherries
18.9%	"oro" at 12% moisture
17.4%	all skin and hull at 18% moisture
63.7%	water to be evaporated
56.5%	fresh pergamino at 60.5% moisture
43.5%	fresh broza at 80% moisture

At 52.8 pounds per bushel or 596 pounds per fanega of fresh cherry, the yield of the dried "oro" at 18.9% would be 112.5 pounds per fanega. The water to be removed per fanega of cherries would be 380 pounds. If the coffee were pulped with only the fresh pergamino dried, only 179 pounds of water would have to be evaporated from the fresh pergamino from a fanega of fresh cherries. At 50% over-all heat use drying efficiency, a good drying efficiency, this would require 6.5 gallons and 3 gallons respectively of fuel oil to dry each fanega of fresh coffee.

10. The pilot plant trials have shown, among other things, that fresh cherries can be dried successfully in a batch-type (intermittent or continuous flow) reverse-flow column type drier, and that a plenum chamber pressure of 1-1/4 to 1-1/2 inches of water gauge will produce an air flow of 100 CFM per square foot through a 30-inch depth of coffee cherries in the drying column (dried cherries at the bottom to fresh cherries in the top layers), and that in this working column this depth of cherries will saturate the drying air entering at 165°F. (68 to 70 degree dew point) by the time it leaves the top of the column, thus obtaining maximum heat use of the air in one pass.

With these values known, it can be calculated and has been approximately checked in the experimental runs that 121 CFM per sq. ft. of 165°F. (68 d.p.) entering air that is saturated upon exit can remove 8 pounds of water per hour per square foot of column cross-sectional area. Since 63.7 pounds of water must be evaporated from each 100 pounds of fresh cherries, or 41.5 pounds per cubic foot of fresh cherries, the drying load will average around 2.2 pounds of water per square foot for each inch depth of fresh cherries, and it follows that 3-1/2 inches of fresh cherries can be added per hour to the top of the drying column, and due to the volume shrinkage of nearly 1/2, from 1-1/2 to 2 inches of dried cherries can be taken per hour from the bottom of the column.

At this rate a given cherry is in the column 12 to 15 hours, and the size of drier or total cross-sectional area of the drier for each fanega per hour capacity would be 48 to 50 square feet, or a 7 x 7 foot square, a size that could fit conveniently on a two-wheeled trailer.

A drier with maximum capacity of 24 fanegas per day would appear adequate for a 1,000-fanega farm or for each 1,000 fanegas of crop, or for each 100 pickers.

11. Fresh cherries in small lots did not deteriorate noticeably within the first 24 hours after picking, although severe pulp rotting occurred in any lot of cherries starting the second day. It appears, however, that the bean itself is quite resistant to visual change for several days and even weeks after picking if some constant drying is maintained for the cherry so as to prevent extreme rotting.

12. Quality of the "café oro". Of prime importance is the quality of the resultant roasting bean. There exists much opinion that drying the beans with the "miel", "honey" or "mucilage" intact, although the bulk of the world's coffee is dried in this manner, cannot produce a quality of coffee equal to that possible if this mucilage is washed off before drying. Fermentation is employed to more or less dissolve or loosen this mucilage so as to make washing easy. However, there is little information on the effect or possibilities of rapid drying and immediate shelling toward producing unwashed beans equal to or better in quality than those washed before drying.

A major objective of these experiments is to study the possibilities, but at this writing it is impossible to give any conclusions in this regard. It has been found, however, that (1) careful control of the drying conditions is necessary, especially in regard to the maximum temperature used for the latter stages of drying, to produce a bean of uniform green color; (2) there is a tendency for the silver skin to adhere to the bean upon shelling in a crude manner, but any such skin adhering appears easily removable through polishing or otherwise; (3) based on only one cup-testing to date, there is a quality difference between the washed and unwashed beans. At this writing samples have not yet been adequately cup tested.

13. It has been observed that the coffee in pulped or fresh pergamino form gives a much cleaner dry bean upon shelling.

Conclusions: The work to date has been largely exploratory in nature. Based upon this experience two phases merit intense study: (1) the effect of temperature and process form of unfermented, unwashed coffee when dried and the resultant quality as compared to washed coffee and sun-dried unwashed coffee; and (2) the feeding value of the unfermented, rapid dried coffee pulp.

Other aspects of the present study yet to be completed with this year's samples are: (1) quality tests by "cupping"; (2) storability in relation to process form and moisture content; (3) some additional exploratory work on fresh pergamino drying; (4) analysis of present data, the above being observations prepared at this time for review by the Administrative Committee.

SERVICE TO MEMBER COUNTRIES

Consultation work mostly in the field of grain drying and storage has been given to governmental organizations, companies, and private operators during special trips to the following countries during the year: Colombia, Panamá, Costa Rica, Honduras, El Salvador and Guatemala. Noteworthy of mention has been the work here in Costa Rica and the special trip to Guatemala. The work in Costa Rica has been largely direct assistance and advice to private operators in the rice and grain growing areas in the development of artificial drying equipment, of which one instance is described in this report. Close contact is maintained with the grain silo storage unit of the "Consejo Nacional de Producción", and just recently a detailed plan for an experimental recirculating gas fumigation system for one of the silos was designed in cooperation with Dr. R. A. Davis, Entomologist with the Food and Agriculture Organization stationed in San José for a year.

At the invitation of "Instituto de Fomento de la Producción" of Guatemala, the Head of the Department had the opportunity of acquainting this organization, as well as other operators within the country, with the latest engineering developments in grain production, drying, and storage.

A considerable proportion of the Department's energies is devoted to Institute service work, among which meriting mention are the design and plans for a dehumidification system and room for the library book stacks, design, and plans for a living quarters unit now under construction, and some drying facilities for the Animal Industry and Plant Industry Departments.

DEPARTMENT OF ECONOMICS AND RURAL LIFE

Julio O. Morales

The year 1949-50 has been devoted primarily to analyzing the data gathered during the previous year and to preparing these data for final publication. Our cooperative agreement with the Colombian Coffee Federation has been strengthened by carrying out our first cooperative project with them and by the exchange of visits of personnel. The cooperation established with a number of Costa Rican coffee farmers has made possible the initiation of tests of our suggested system of partial farm cost accounts.

Our experimental system of graduate training has been successfully carried, in one case, around practically the entire cycle. It has shown in two other cases certain minor deficiencies which we are trying to correct. Two five-week courses were given at the Facultad del Valle, Colombia in addition to the normal teaching load at the Institute. We were not able during the past months of the fiscal year to obtain the services of a Visiting Scientist to take Dr. W. E. Keepper's place.

RESEARCH PROGRAMS

Community Development Project

The analysis of the sociology data is being made at Michigan State College. Mr. Sakari Sariola has been using the town data, together with other information he has gathered, to study the standards of living among different social classes. Some preliminary results follow:

1. Using a four-class distribution (the upper, upper middle, lower middle, and lower class) and based on the rating of 445 families made by a number of persons from the various social classes in town, the social stratification of the town of Turrialba appears to be as follows:

<u>Class</u>	<u>Percent</u>
Upper	4
Upper Middle	7
Lower Middle	32
Lower	57

2. Substantial differences between social classes are found in respect to (a) commodities and services used, (b) social participation, (c) attitudes and interests, (d) interpersonal contacts, and (e) prestige held.
3. Commodities and services used by families in different social classes show evaluative differences connected with consumption. An item which appears as a rarity among lower class families might be luxury in the lower middle class, a necessity in the upper middle class, and an absolute necessity in the upper class.
4. People in the three upper classes are to a varying extent distinguished from the lower class by their more elaborate value-attitude systems. The value-attitude systems found within the lower class lacks greatly the more intensive goal orientation which can be traced within the other three classes.
5. The interpersonal relations show more intensity within the class than between classes. The upper class is the relatively most isolated group; on the other hand, the limit between lower class on the lower middle class in proportionally more seldom exceeded than that between the lower middle and uppermiddle classes.

The health data gathered and partially analyzed by Miss Marta Coll during 1948-49, will be ready for publication within the next two or three months.

Some results indicate that only 61 of every hundred children conceived by the 140 mothers interviewed lived long enough to reach 15 years of age. Pre-natal losses accounted for fourteen, 16 were lost during the first year of age, and 8 during the one- to seven-year age period. Only one in every hundred was lost during the eight-to fourteen-age period. The average number of conceptions per mother averaged 8.4, even though 49 percent of the mothers were less than 40 years old and half of these were less than thirty.

Only four percent of the mothers interviewed had their original complete set of teeth. Over two-fifths had lost all their front teeth but had all or some of the molars. An additional 37 percent had replaced their original teeth with false sets, but another seven percent had no teeth of any kind.

The situation of the mother and child described above is a product of the natural, social, and economic environment. We found, for example, that one-fourth of the families had no toilet or

latrine facilities, and an additional 17 percent had to share these facilities with other families. Some of the latrines had the human refuse fall directly in the river and creeks. On the other hand, the rivers and creeks served as a source of drinking water to over one-third of families. Washing was done by many families in the same rivers and creeks. Nearly half depend on this source of water for bathing. The Health Study has provided many other similar facts which will help us to determine how best to influence the social and economic environment so as to improve the human product.

Mrs. Ana Teresa Blanco de Sariola is conducting the field work on the Nutrition Study. She has developed a questionnaire which is outstanding in many respects. Copies of this questionnaire have been requested by a number of people working along these lines. Cooperative understandings have been tentatively outlined with the Nutrition Institute of Central America and Panama and with Dr. Robert E. Shank of Washington University, St. Louis, Missouri, to conduct medical and biochemical examinations of a sample of the members of the families surveyed.

We have continued to take weekly price information for food products in Turrialba. Dr. Paul C. Morrison is working on maps of the distribution of houses, people and livestock in the Turrialba Central District. The census information has been passed on to 15,400 IBM cards. These cards have been checked against the original information. The analysis of these data will be made during the next two or three months.

Coffee Project

The objective of this project is to develop methods that will enable economists and farmers to study the economic aspects of coffee production. During 1948-49 Drs. W. E. Keepper and Julio O. Morales and two graduate students worked on this project, studying in detail 5 Costa Rican and 28 Colombian farms. The Colombian farms were studied in cooperation with the Colombian Coffee Federation. Although the number of farms studied was too small, the following preliminary conclusions are possible:

1. Labor and management costs, hired or furnished by the farmer and his family, represented over two-thirds of the cost of producing a bag of coffee. Use of the land was the next most important cost, comprising approximately one-sixth of the total costs.
2. These data, as well as the relationships of yield to cost of production and bags per man (labor efficiency) and costs, indicate that efforts to

improve coffee farming would have better chances of success if concentrated on: (a) increasing yields, and (b) reducing the hours of human labor required to produce a bag of coffee.

3. Nearly all the gross income of the farms studied was derived from coffee, showing an extreme and possibly dangerous degree of specialization. This problem warrants a scientific effort to find complementary crop and/or livestock enterprises which can be advantageously incorporated into the coffee farm business.
4. During 1947-48, the period for which the data were obtained, in spite of above-average prices, the returns to labor, management, and capital invested on coffee farms were not sufficient to hold these resources in competition with other branches of economic activity. Migration or population data seem to check with this conclusion.
5. Enormous variations between farms were observed in most of the factors studied. The cost of production and processing (in parchment) of a kilogram of coffee on 15 Colombian farms varied from 33 to 83 cents, averaging 50 cents. This fact opens great possibilities for the study of causes for this variation.
6. The methods used in this project are being revised, as suggested by last year's experience. We are trying to increase the number of farms under study so as to obtain more varied and reliable information.
7. The first student, Mr. Francisco Gómez of Colombia, has just presented the first draft of his Magistri Agriculturae thesis. Two students will be working on this project during the next twelve months. Mr. Gómez will continue working on the project as an employee of the Colombian Coffee Federation under our cooperative agreement with them.

TRAINING

The following graduate students were registered in the Department during 1949-50:

- | | | |
|----------------------------|---|------------|
| 1. Francisco Gómez Quiroga | - | Colombia |
| 2. Hugo Castro Steinvorth | - | Costa Rica |
| 3. Pánfilo Rodríguez | - | México |
| 4. Romilio Rodríguez | - | Costa Rica |
| 5. Alvaro Chaparro | - | Colombia |

Three of these students are taking course work in United States colleges and universities, under cooperative agreements with the United States Department of Agriculture and Pennsylvania and Montana State Colleges. They will return to the Institute after completion of their courses to start a piece of research for their Magistri Agriculturae.

Two five-week courses were given at the Facultad del Valle, Colombia on the Economics of Agricultural Production and a Socio-Economic Approach to Community Problems.

Arrangements have been completed for the translation into Spanish of Dr. John Hopkins' Elements of Farm Management text, with adaptations to Latin America. It is hoped that this translation will be of considerable influence in the teaching of farm management in Spanish-speaking countries of this hemisphere.

OTHER COOPERATION WITH INTERNATIONAL AND NATIONAL INSTITUTIONS

During the early part of the year the Department cooperated closely with the Costa Rican Census Office in drafting the plans for the 1950 Agricultural Census. Professor Zambrano, who will teach social sciences at the Facultad del Valle in Colombia during the coming year, is spending a month at the Institute becoming familiar with our research methods.

The Department contributed to the program of the Extension Conference held at the Institute last August and is cooperating in the student training program with the United States Department of Agriculture, Pennsylvania and Montana State Colleges, and the Colombian Coffee Federation.

PAPERS AND PUBLICATIONS

1. Boletín Técnico No. 1 -- Cultivos Intercalados en Plantaciones de Hule by Julio O. Morales, Walter N. Bangham and Dr. Mortier F. Barrus.
2. Algunas consideraciones sobre el mejoramiento de los niveles de vida de los pueblos americanos, by Julio O. Morales.
3. Bases económicas para la investigación en café y cacao, por Julio O. Morales y L. Paul Oechslí.

EXTENSION EDUCATION SERVICE

D. Spencer Hatch

PROGRESS OF EXTENSION SERVICES

Community Work

In what is called our Extension Area Laboratory (20 to 30 miles around Turrialba in all directions) the Extension Education Service has been able to start work in certain communities, even though we have not yet had any permanent staff member for Extension. Most of the Extension Education budget has been for the basic training of Applied Rural Science students to qualify them for our training in Extension Methods.

We have gone out with our students. During July, August, and until the middle of September, we had Miss Nancy Hatch (half time) who worked in the somewhat isolated communities of San Juan Sur, San Juan Norte, and Jesús María. Part of her work was with groups of school children, trying to carry this service over to their homes.

Especially noteworthy has been the work of our four second-year students, Evelio Tovar, Froilán Romero, Adolfo Medina, and Enrique Pinto. Tovar and Romero have taken responsibility for San Juan Sur and San Juan Norte. Using some of the information in surveys already made there by the Department of Economics and Rural Life, and themselves making two other specialized ones necessary for their work, they have stimulated the people to try to answer some of their felt needs. They have an excellent manner of approach and have built up a cordial and remarkably good relationship with these small-farm families. They go on horseback to these communities two days a week.

Medina and Pinto go on horseback two days a week to Jesús María, where fifty-six families cultivate 400 manzanas of land without a single ox or plow --- all by hand digging. Medina and Pinto have made a complete house-to-house survey of this community. They are doing various kinds of teaching in this entirely schoolless area. They have given assistance with seeds and crops, pest control, diseases in livestock, and have started the improvement of poultry.

These students are still only partially trained; but they are making an encouraging indication of how useful to member countries graduates of our Extension courses are eventually going to be.

Noche Buena Rural Center

The Noche Buena Rural Center, which is to be the base for our extension activities, has not yet found the grant needed for its development. Yet, we have already started to use it. The beginning demonstrations on it already make it capable of giving lessons and suggestions to rural people who visit it. We are initiating a series of Sunday lessons. The rural people come into Turrialba to market early Sunday mornings; and we invite them over to the Center for a two-hour lesson before they go back to their homes.

To double the area put into gardens by the students last year, the present students have laid out and fenced the level section along the other brook on the far side of the Center. Now many varieties of vegetables are growing there.

We never found the \$450 for the little house we planned for the working family which would guard the property at night. The need was so great that we have made a rustic house from poles, rough slabs, tiles made in the Center, and without a carpenter. It is a demonstration of what can be done. A small storehouse for tools and products has been built by the students from poles, swamp-cane, and Noche Buena tiles.

After a considerable amount of experimenting with mixtures of local clays, we are making excellent tiles and bricks as an illustration of what rural communities can do out of their own earth. Tiles and bricks had not been made before in this part of Costa Rica. We have the foundation which will lead on to finer earthenware.

Trees have been planted, budding is being done, and transplanting has begun in the orchard areas of the Center. Fencing is nearly completed to keep the demonstration animals (which we shall have) from the crop and orchard areas.

The apiary of twenty-three colonies is in excellent condition ready to move to the Center as soon as we have supervision there. Indications are that this wetter area is better for bee-keeping than was thought, and that we have flowers over more months than the dry areas called the bee-keeping areas.

We shall continue to develop the features of the Center plan as fast as means are available.

Turrialba Extension Meeting

At this Institute, from August 23 to September 3, representatives of nineteen countries took part in a meeting on Agricultural Extension. The meeting was held under the joint auspices of the Food and Agriculture Organization of the United Nations and the Institute. The busy workshop produced valuable results, we feel, for

the underdeveloped extension services of the American Republic and other territories.

Among the resolutions passed were these:

"That each member country consider the possibility of establishing a pilot project for rural community improvement, and that UNESCO and FAO be asked to render assistance, on request, in the establishment of such projects; moreover that IAIAS be asked to provide training of personnel for these projects as well as consulting services pertaining to basic socioeconomic studies and evaluation."

"That the Inter-American Institute of Agricultural Sciences give consideration to the possibility of further developing its facilities to provide training in the principles and methods of extension."

APPLIED RURAL SCIENCE TRAINING

One of the most valuable types of technical assistance our Extension Education here will give to member countries will be through our training in Applied Rural Science Extension Methods.

Four, out of more than twenty American International Association scholarship students who came in the first year, were selected as having the general characteristics and abilities to warrant a second year of study here in Extension Methods.

Of the thirteen others who finished (or almost finished) the first-year course and returned home, nearly all promptly found employment:

Two are on their home farms.

One is establishing a poultry farm.

One has entered college in the United States.

Eight are employed by the Venezuelan Government of the AIA in improvement of agriculture or extension.

Only one is not yet reported as definitely placed.

The five Costa Rican teachers, who joined this course for part of the year, were all placed in schools; one is in charge of a rural demonstration school with 200 pupils.

On September 15 the second year began with the four second-year students, fifteen new AIA ones, one sent separately on scholarship from the State of Zulia, Venezuela. A bit later another student from Washington, D. C., U. S. A. joined our course.

Our students come to us with different backgrounds, and with school preparation ranging anywhere from the sixth grade to two years of higher studies after high school; from no rural experience to some years of it. From experience gained our first year, we planned a re-orientation course which would put the students on a better level for their course studies here. This re-orientation was crystallized in the prerequisite or General Science Course developed by Professor Juvenal Valerio.

We are very satisfied with this prerequisite study. The students have responded well, been interested, and have worked consistently. The work-books for this, written since September by Professor Valerio, have involved a great amount of work. We feel that they are very practical, perhaps the best in existence for tropical and sub-tropical areas, and that they may eventually be useful for other educators in the Americas. Along with the prerequisite courses, an elementary course in diseases of plants was given by Dr. Albert Muller.

Our students began the second quarter of the course on a sufficiently leveled basis and are pursuing the afternoon courses for this quarter — Horticulture, Propagation and Growing of Plants Soils and Fertilizers, Animal Industry, Elementary Agricultural Engineering and Building Construction, and Methods of Extension. English is given in three different grades.

All the students go to practical work forenoons from 7 A. M. to 11:15 A. M. They rotate in this training so that every student will have practice with plants (including fruits), animals, and poultry, elements of agricultural engineering (including some soil conservation, building construction, mechanics, repairs, carpentry), some rural life and extension practices. We continue to pay our students (including second-year ones) for each hour of productive practice and give them no other stipend.

Second-Year Students

It is with satisfaction that we review the work of the four second-year students. It was a new experience and at first a difficult assignment for them to realize that within a general skeleton outline they must accept the responsibility for making their programs, utilizing their time fully to prepare for their field work and to fill in any gaps in their general knowledge. Although we had no Extension staff member to be out in the field with them, they were under guidance all the time, and, after a period of feeling around for many tasks, they fell into the "attitude of a graduate student" and have worked encouragingly well.

In the isolated areas to which they go on horseback they are working on surveys, questionnaires for which they have made and adapted with the Departments of Animal Industry and Economics and Rural Life, and are working with the campesinos as described above.

These second-year students also have completed the basic pre-requisite work-books of Professor Valerio, as we did not have them last year and we felt this would be valuable to them as a review, a discipline, and for knowledge of another teaching method.

The development in these boys is what pleases us most. To help their more mature judgments and attitudes and abilities to be able leaders, a Friday night "supper seminar" is a regular feature. The four students, and such guests as will contribute to the subject for the evening, meet at our home. Dessert and coffee are served while conversation on the subject is carried on. After the service is removed, we get down to deeper discussions. Topics for discussion are selected by the boys from needs arising in their work; Cooperative Societies, How to Teach, Extension Methods and Attitudes, Young People's Clubs, Literacy, are some we have studied. I believe we are accomplishing several things by these seminars: a social ease, ability to express ideas simply and naturally, ability to carry on an interesting conversation, ability to listen to another's ideas and evaluate them as applied to the problem, a goodly store of knowledge and comradeship.

PERSONNEL

Since July 1st we have had the following on the Extension Education staff:

Professor Valerio with students, half time from July 1 until September 15 and after that full time.

Señor Otón Páez, as Field Superintendent with the students.

Dr. Albert Muller on a temporary basis during the month of November to December 26.

Miss Nancy Hatch from July 1 to September 15, organizing the Institute - F. A. O. International Extension Meeting and doing Extension Field Service.

Dr. Emily G. Hatch was in charge as Honorary Chairman of the staff, work, and training, from September 15 to December 15, while the Head of the Service was on the Asian Mission with UNESCO.

For the afternoon classes, considerable much appreciated help was drawn from Staff Members of the four Institute Departments.

Fernando del Rfo of the University of Puerto Rico, who was engaged as Associate Educationist, was needed at the University and did not come. He is expected in June 1950.)

WIDER ASSISTANCE

In August the Head of the Service was urged by UNESCO to represent this Institute at the UNESCO Seminar on Literacy at Rio de Janeiro, Brazil. Our own International Extension Meeting here, and our almost total lack of staff, prevented him from accepting.

In September, when UNESCO was committed to furnish a Chairman for the Asian Seminar on Rural Adult Education, they chose the Head of the Service. He briefed at UNESCO Headquarters in Paris, made a two weeks' survey of the most successful present-day Rural Reconstruction Projects in India, then chaired the Section of Economic Aspects of Rural Adult Education for six weeks, and reported with final consultations in Paris. This Asian Seminar, participated in by nineteen Asian, European, and African countries, and having representation from the Western Hemisphere also was the most successful yet held by UNESCO. So great is the need and the demand for trained Extension personnel in many countries, Director General Torres Bodet is desirous that a cooperative plan be formed with this Institute for training students here in Comprehensive Extension Methods with the community approach. UNESCO would sponsor and finance these students.

Wider contacts were also made through correspondence and answering questions from several countries and through some publications. The Food and Agriculture Organization published in Education Approaches to Rural Welfare our paper "The Rural Center Approach to Rural Betterment" (in English); "Concepto sobre el Centro Rural", in Spanish. In mimeograph form we put out the "Area Laboratory of Extension Methods" and "Laboratorio del Area para Métodos de Extensión", outlining our extension services and training plan for the Turrialba area.

SCIENTIFIC COMMUNICATIONS SERVICE*

Armando Samper

ORGANIZATION OF THE SERVICE

At the request of Director Allee and with financial cooperation from The Rockefeller Foundation, Ralph R. Shaw, Librarian of the United States Department of Agriculture, made in the latter part of 1948 a survey of the status of scientific and technical communication in Mexico, Central America, and Colombia. On December 12, 1948, he submitted to Director Allee a report of his survey in which he concluded that "improvement in scientific communications is an essential prerequisite for an effective program for advancing scientific and technical research in the tropics" and recommended that the Inter-American Institute of Agricultural Sciences experiment with methods for improving scientific communication.

Dr. Shaw felt that the Institute was in an ideal position to initiate a program of experimentation in the improvement of scientific communications and concluded that "an adequate communications service would require capital investment of some \$30,000 plus a program of service at about three times the amount now spent for library, abstracting, and publishing by the Institute." He considered that "the need for publishing, abstracting, bibliographic and copying services is urgent and it is therefore recommended that the Institute make every effort to obtain additional funds, outside of country quotas, for the next eight or ten years in order to start immediately on a program of experimentation in the improvement of scientific communication." He further added that such program "should be considered an experimental program with emphasis on techniques of communication rather than merely expansion of the Institute's own library services. It is recommended that regardless of whether additional funds are obtained for this purpose the Institute should give this program of improvement of communication top priority and should do everything it possibly can to carry out this program as the only means of insuring continuing usefulness of the training and research work done not only at the Institute, but also through the national institutions of each country and by fellowship grants."

At the invitation of Director Allee, Armando Samper visited Turrialba in April 1949 and discussed with him the possible organization to carry into practice the program proposed by Dr. Shaw.

* From July 1, 1949 until the February 1950 meeting of the Administrative Committee this Service was called the "Interchange and Information Service."

He submitted a memorandum to Director Allee in which he concluded that "by organizing a scientific communications and editing service the Institute would certainly be in better capacity to fulfill the objectives for which it was organized and would be in a position to promote the advancement of agricultural sciences in the Americas and increase the research potential by means of better scientific communications." The following lines of work were tentatively suggested for the new service: (a) library and auxiliary services, (b) publications, (c) research in scientific communications, (d) scientific agricultural cooperation, and (e) information and public relations.

On May 20, 1949, The Rockefeller Foundation made a grant to the Institute providing up to \$60,000 "for the purpose of strengthening the library resources and making possible the development of a scientific communications program, during the period ending June 30, 1955." Effective July 1, 1949 Mr. Samper accepted the position as head of the new service, temporarily called Interchange and Information Service.

PRESENT STATUS OF SCIENTIFIC COMMUNICATIONS IN THE AMERICAS

Dr. Shaw visited some eighty libraries of various types in Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, and Colombia. He found that, although there were several large libraries in the area, not more than four could be considered good, quick-reference or working collections for the scientist or technologist. These included the libraries of the Oficina de Estudios Especiales, in Mexico; the Inter-American Institute of Agricultural Sciences in Costa Rica; the Facultad Nacional de Agronomía, at Medellín, and the Instituto Geofísico de los Andes, at Bogotá, in Colombia. He considered it doubtful that the potential for research service, even if all the libraries visited could pool their resources through a cooperative scheme, would approximate as much as 15% or 20% of what might be found in current abstracting journals on any given subject.

He discussed the problems with more than 200 scientists, research and extension workers. These discussions indicated almost invariably that they rarely had access to as much as 5% or 6% of the literature which they might find listed in the abstracting journals in any subject. The highest estimate made to Dr. Shaw by any one was 10%.

In addition to the problems studied by Dr. Shaw on his trip, there are others directly affecting the scientific communications program that arise from the function the Institute has to promote the advancement of the agricultural sciences in the American Republics by means of research, teaching, and extension. The objectives of the new service were therefore summarized by Mr. Samper as follows:

1. More and better agricultural library services and methods in Latin America.
2. Wider exchange of scientific knowledge and information among nations, national and international institutions, scientists and technicians.
3. Development of new or better techniques in the field of scientific communications through experimentation.
4. Better understanding of the methodological aspects of the agricultural sciences and wider usefulness for research.
5. Coordination of efforts, individual and collective, for the advancement of the agricultural sciences, by pooling of knowledge, promotion of exchange and solidarity, etc.
6. Spreading of adequate terminology for the agricultural sciences and its correct interpretation in the different languages.
7. Better understanding of the aims and accomplishments of the Institute.
8. Easier and better exchange and cooperation between the Institute and other international, national, and private organizations and institutions.

PROGRESS MADE IN THE IMPROVEMENT OF SCIENTIFIC COMMUNICATIONS IN THE AMERICAS

A considerable part of the work of the service since July 1949 has dealt with the centralization of functions previously handled by other departments of the Institute and the determination of methods and procedures to best organize the routine aspects of the work. Considerable time has been dedicated as well to background studies of the problems involved and the formulation of policy. They cover problems such as the establishment of routines involved in the handling of manuscripts, the mailing list, the photocopies: studies of the printing facilities available in San José and of the units of equipment needed for a gradual establishment of the publications on a sound basis; acquaintance with the work and past publications of the Institute; and obtention of basic information concerning the organizations that may contribute to the program, etc.

Scientific Information

Strengthening of the Library Resources

Of The Rockefeller Foundation Grant up to \$6,000 have been set aside for moisture-proofing and conditioning of the stack room that will be moved to the north wing. The dehumidifying equipment ordered from the United States has arrived, and work to reinforce the floor and condition the room will be started soon. Moisture-proof space will be conditioned for the photostatic laboratory. The Rockefeller Foundation Grant has also made it possible to triple the annual acquisitions of books, journals, and past issues of journals for which the expenses budgeted for 1949-50 are \$3,980.

Photocopying Service

Due to the inadequacy of many of the agricultural libraries in the member countries and the fact that the isolated scientist who does research in a small center is the one mainly handicapped because he does not have access to the research literature he needs, an experimental program of supplying photocopies has been initiated. Even though microfilms can be produced at a lower cost than photocopies, the lack of good, inexpensive microfilm readers limits their usefulness, while a full-size photocopy can be read without any aid.

The Rockefeller Foundation Grant provides up to \$6,000 for the establishment of a photocopying laboratory in Turrialba. We expect to proceed with the establishment of the laboratory as soon as the library stacks are moisture-proofed and the volume of requests for photocopies makes it economical to operate directly. Meanwhile we have an agreement with the United States Department of Agriculture Library by which they furnish us up to 5,000 photocopies per year at ten cents each. Up to the present time, we have handled 103 photocopy orders for scientists in Colombia, Costa Rica, Venezuela, and the Philippines. Some of the orders have been for our foreign students to facilitate their research work at the Institute.

Bibliographies and Abstracts

One of the main difficulties encountered by Latin American agricultural scientists is the lack of access to bibliographical reference material. Due to incapacity to strengthen their holdings of this type of material, because of difficulties in obtaining dollars to pay for the subscriptions and to the high price of this type of publication, the libraries of the Latin American countries, with few exceptions, are very weak in their holdings of abstract journals and bibliographies.

On November 10, 1949, The Rockefeller Foundation gave us an additional grant, up to \$5,000, for a three-year period terminating December 31, 1952, "for bibliographic and abstract journals and similar materials for location in Latin American countries in

connection with the scientific communications program". We are now finishing a study we have made of the actual holdings of these materials in Latin America. Directly from the publishers of each abstract journal and bibliography we have received a list of all their subscribers in Latin America; from each of the Latin American colleges of agriculture we have obtained information concerning their holdings and immediate needs for such material. Preliminary tabulation of the results indicate, for example, that there are no subscribers to Biological Abstracts in El Salvador, Honduras, Nicaragua, Panama, and Paraguay. There are a total of 19 subscriptions in all of Latin America to one of the leading bibliographies of agriculture, and the Bibliography of Agriculture issued by the United States Department of Agriculture is sent to 101 subscribers in Latin America.

We are preparing now the final plan for distribution of this type of material, giving emphasis in the first stage of the program to the libraries of the agricultural colleges, as strategic locations, with a view to supplementing the existing collections.

Publications

Publications Committee

On December 29, 1949 a new Publications Committee was organized with the following functions:

1. Determine series of publications to be established; prepare the annual publications program; and set up an annual calendar schedule for publications.
2. Determine the suitability of material submitted for publication; approve or reject manuscripts; and consult with subject matter specialists, when considered desirable, regarding the originality and soundness of the material.
3. Standardize the size and format of publications in each series and approve the layout, cover design, etc., of each publication.
4. Determine the number of copies of each publication to be printed and approve the plan for distribution.
5. Determine the effectiveness of the publications.
6. Make recommendations on matters of fiscal policy relative to publications.
7. Act as Editorial Board for the Turrialba journal.

The Committee has been meeting actively. It reviewed the policy concerning the Information Bulletin and the plans for the journal Turrialba.

Agricultural Texts.

There is great need for agricultural texts in Latin America at all levels. At the college level it will be a few years before there is an abundance of good, original material written by Latin American professors, at least in the tropical areas and in some of the fields. A partial solution to the problem, therefore, lies in the preparation of translations of good texts prepared in the United States, for example, but sufficiently revised to make them useful to Latin American students.

On December 6, 1949 a grant was received from the United States Department of State, through the Science Service, for \$5,000 for the translation into Spanish of Elements of Farm Management by John A. Hopkins. Dr. Hopkins has revised more than sixty percent of the text based on his experience in Argentina, Colombia, and Mexico. Our Department of Economics and Rural Life has been assisting Dr. Hopkins in the preparation of adequate Spanish farm management terminology. We are now making the final arrangements for the publication of the book in Mexico.

Information Bulletin

The Information Bulletin is an important medium to furnish interested persons in the member countries with scientific information concerning the activities of the Institute. It was decided to publish it in Spanish as well as in English to better accomplish this end. One Spanish edition has been published since July (No. 14) and another one is in print (No. 15). Beginning this year, it will be published monthly. The mailing list has been increasing constantly.

Technical Bulletins

We have reached the stage where final results of full research projects are becoming available. To meet the need for adequately supplying the research men in the Americas and other regions with full and technical information about the results of our research projects, the Technical Bulletin Series was started. Since July we have published two: No. 1 -- "Cultivos intercalados en plantaciones de hevea," by Julio O. Morales, Walter N. Bangham, and Mortier F. Barrus; and No. 2 -- "Una especie nueva de theobroma," by Jorge León. We are now studying the possibility of including in this series research work done elsewhere in the Americas and of interest to a wide audience to partially fill the need for suitable publication outlets, for the results of research.

Turrialba Journal

Plans have been completed for the publication in San José beginning in April, of a quarterly scientific journal, Turrialba. The publication of such journal has been considered an essential part of a program for the improvement of scientific communications. Many scientists in the Latin American countries do not find in their own countries scientific and technical journals of international circulation. We propose to publish a journal of interest to the "Ingenieros Agrónomos" and other professionals working in the agricultural sciences in the Americas and of sufficient scope to include material on the related sciences and be of interest to scientists in other tropical areas. Sections of the journal will be devoted to scientific information and to research developments in the Americas.

Other Publications

In the past the "Technical Publications" have been a very useful means of information concerning our work. The series consists of reprints of articles published originally in various professional journals and popular agricultural magazines. Since July the following have been published:

- No. 30 -- "The Santa Gertrudis Breed" by A. O. Rhoad.
- No. 31 -- "Graneros para la América Tropical," by Norton C. Ives
- No. 32 -- "Nuevos Sistemas para el Secamiento de Granos en la América Tropical," by Norton C. Ives.
- No. 33 -- "Development of Dairy Breeds for the Tropics" by A. O. Rhoad.

A revised edition of the 1948 Announcement of Study Program was published in December. The Proceedings of the Second Cacao Conference are at the printer's and will be ready this week. The Annual Report for 1948-49 was submitted in December by the Heads of Departments and is being assembled and arranged for publication.

Personal Exchange among Scientists

Personal exchange is one of the most effective means of improving scientific communications. One of the functions of this office is to promote and facilitate that exchange, not only between agricultural scientists in the Americas and our staff at the Institute, but among themselves as well. It is expected that, as funds permit, this office will be in a position to contribute more directly to such personal exchange and that better coordination can be established. This involves participation and coordination in such matters as technical meetings and symposia held in Turrialba, international meetings attended by members of our staff as our delegates, handling requests for scientific information, exchange of information with national and international agencies, and technical assistance.

Extension Meeting

In July this office gave assistance in the reporting of the Technical Meeting on Agricultural Extension, held in Turrialba in cooperation with the Food and Agriculture Organization of the United Nations, from August 23 to September 3. As one of the conclusions of this meeting, it was recommended that the Interchange and Information Service assist the member countries in the exchange of information on extension. Pressure of work along other lines has prevented us from complying with that request.

Tropical Plant Pathologists' Meeting

Plans are under way for a meeting of tropical plant pathologists, tentatively scheduled to take place in Turrialba during the latter part of August 1950. A list is being prepared of the plant pathologists in the Latin American countries. An exploratory letter will be sent to these plant pathologists prior to entering the active phase of preparation of this meeting.

Agricultural Educators' Meeting

Preliminary plans are under way in relation to the prospective meeting of agricultural educators, also to be held in Turrialba. Director Allee's paper to the United Nations Scientific Conference on the Conservation and Utilization of Resources on the "Preparation of Scientific and Technical Personnel for the American Tropics" has been sent to all the Deans of the Colleges of Agriculture in Latin America and to some in the United States to get their views on this problem. The first replies have come in; a summary will be made later on all of the replies. An up-to-date list has been compiled of all the agricultural colleges and schools in Latin America. As soon as the date is fixed for this meeting and the scope for it determined, the active phase of the preparation of the meeting will be started.

Direct Scientific Information

A considerable part of the work of this office is involved in the routing of requests for information and in maintaining direct correspondence with Latin American scientists who need information on specific subjects. In this respect this office operates mainly as a coordinating force since, in each case, the requests are referred to the specialist concerned.

IMMEDIATE PROGRAM CONTEMPLATED FOR THE DEVELOPMENT OF SCIENTIFIC COMMUNICATIONS IN THE AMERICAS

It is expected that with some additional stenographical and clerical help reasonable progress can be made in the programs already started. An effort will be made to keep the service as an

active form of direct service to countries that could not profit directly from other aspects of the work at Turrialba. Some of the immediate developments in the program are indicated below.

Advisory Board

From the beginning it has been considered essential for the success of the program to organize an Advisory Board. This Board would be integrated by men who have had a prominent part in the different phases of the field of scientific communications. Preliminary inquiries have been made in this respect, and it is hoped that the Board may be integrated by the end of the year.

Scientific Information

In addition to the programs already under way, it is hoped that the following programs may be initiated:

1. A further survey of the status of scientific communication in South America. An additional grant has been made by The Rockefeller Foundation to allow Dr. Shaw and the Head of the Service to make this survey.
2. Installation of the photostatic laboratory in Turrialba.
3. Arrangements for the part-time services of a bibliographer in Washington to supplement the reference services of our own Library.
4. Organization of the revolving fund to partially solve the currency exchange problems involved in the purchase of photocopies by agricultural scientists, payment of subscriptions to the Journal, etc.

Publications

No further developments in the publications program are expected because of the limitations of personnel and operating expenses. If at all possible, an effort would be made to:

1. Expand the sections of the Turrialba journal pertaining to abstracts, bibliographical reviews, and scientific information in general.
2. Preparation of popular articles on the scientific aspects of research in the agricultural sciences.
3. Publication of a directory of personnel of the agricultural experiment stations in Latin America.

4. Preparation of a comprehensive study to appraise the present status of research in one of the major crops in Latin America, such as coffee, cacao, or corn.

Personal Exchange

In addition to the programs already initiated, or for which preliminary plans have been made, the following programs are contemplated:

1. Initiation of a selective information file on technicians and agricultural institutions in the Americas.
2. Preliminary studies concerning the proposed tropical soil scientists symposium.
3. Cooperation to re-activate the American Society of Agricultural Scientists.
4. Studies on the techniques involved in the work-shop type of technical meetings and symposia.

The traditional functions of research, teaching and extension, usually considered in relation to institutions of this type, are not fully efficient unless an active program of scientific communications extends such services to the technicians and scientists. The Institute has assumed leadership in this field of scientific communications. If it hopes to maintain such leadership, it must keep the program as an active, growing service.

TEACHING PROGRAM

Armando Samper, Registrar

GENERAL STATISTICS ON STUDENTS REGISTERED

From January 1946, when the first seven students were accepted until January 1950, the Institute has given training to 115 students from 18 countries, as follows:

Bolivia	1
Canada	1
Colombia	8
Costa Rica	9
Dominican Republic	2
Ecuador	5
Finland	1
Guatemala	4
Haiti	5
Honduras	1
Mexico	13
Nicaragua	2
Panama	1
Peru	1
Philippines	1
Surinam	1
United States	16
Venezuela	42

These students have received training in the following fields:

Agricultural Engineering	2
Animal Industry	6
Applied Rural Science	42
Cacao	34
Economics and Rural Life	9
Library Science	1
Plant Industry	21

During the present quarter 52 students from 13 countries are registered.

The following degrees and titles have been granted:

<u>Magistri Agriculturae</u>	12
Certificates**	3
<u>Especialista en Cacao*</u>	11
Certificate of Studies and Practices	14

* Four students have received both the Magistri Agriculturae and Especialista en Cacao.

** Granted for studies and experimental work in special

GRADUATE STUDY COUNCIL

On 15 November, 1949 Director Allee organized the Graduate Study Council with the following functions:

1. To review all requests for permission to stand for a Magistri Agriculturae degree.
2. To review and make recommendations on research projects and study programs previous to selection of a committee by the student and his chief advisor.
3. To make recommendations on the members of student committees and approve final selection.
4. To recommend changes in Institute policy on student selection, graduate study, and student "follow-up" to the Executive Committee of the staff.
5. To prepare the Announcement of Study Program annually.

The members of the Council, comprising Manuel Elgueta, Chairman, Norton C. Ives, J. Harvey McLaughlin, and Armando Samper, Secretary, have met six times to consider several applications for admissions as candidates for the Magistri Agriculturae degree and to study the policy concerning admissions and study programs. The Council has approved the following statement on policy concerning degrees and titles:

Selection of Advisory Committee

1. At the time a student is accepted, a temporary adviser is named.
2. A permanent adviser is appointed by the Graduate Study Council within the first month after the arrival of the student, based on the subject of study chosen by the student and approved by the Head of the Department.
3. At the end of the first quarter the Graduate Study Council appoints the Graduate Committee for the student based on the selection made by the student and approved by the Head of the Department.
4. Each quarter the adviser records the status of the student's work on two cards provided by the Registrar. While it is the student's responsibility

to see that his record is kept up-to-date, the adviser is expected to check on this periodically.

Policy on Granting of the Magistri Agriculturae Degree

1. The candidate must hold the Bachelor of Science in Agriculture or Ingeniero Agrónomo degree or its equivalent. A minimum residence of twelve months is required. It is believed that the majority of the students will require eighteen months.
2. The student must present at least one seminar on the research work carried out. This shall take place during the regular Monday or Tuesday Seminar Series by previous arrangement and announcement by the Chairman on Seminars.
3. The draft of a thesis on the research work carried out must be presented to the Graduate Committee at least two weeks in advance of the date of the final oral examination. The thesis must be prepared in accordance with the instructions available at the Registrar's office, and the approved typewritten original copy must be submitted to the Registrar three days prior to the examination.
4. A final oral examination is taken by the student as the last requirement. The date and hour must be registered at least two days in advance with the Registrar. Besides the Graduate Committee, the Department Head concerned or, in his absence, a person chosen by the Director also attends. The adviser acts as Chairman of the Examination Board, and writes a report to the Director on the results.*

* The policy concerning research projects for graduate assistants is yet to be studied.

SEMINARS - 1949

<u>Date</u>	<u>Subject</u>	<u>Leader</u>
January 17	Agricultural and Population Census Program	Julio O. Morales
January 24	Some Morphological and Physio- logical Aspects of Climatic Stress and Adaptability of Cattle	Albert O. Rhoad
January 25	Application of Sociometric Techniques	Reed M. Powell
January 31	Sack Drying Experiments of Rice and Corn	Norton C. Ives
February 1	Development of Agricultural Rural Education in Costa Rica	Carlos L. Valle
February 7	Status of Hevea Research and Plantation Development in the Western Hemisphere	Russel J. Seibert
February 14	Sugar Cane Variety Trials with and without Fertilization	Manuel Elgueta
February 21	Physiological Studies of the Factors Affecting Toxicity of 2,4-D	Ora Smith
February 22	Agricultural Price Structure in Costa Rica	Roger Perreault
February 28	The Helminthosporium Disease of Rice	Lucy Hastings
March 1	Destruction of the Effective- ness of 2,4-D in the Soil	Joseph Orsenigo
March 7	Plant Growth Regulators	Luis E. Gregory
March 15	Rosellinia Root Rot in the Tropics	Raphael H. Segall
March 21	Discussion on a Suggested List of Texts for the Use of Agricultural Students in the American Tropics	Frederick Wellman
March 22	Study of the Fungus <u>Cercospora</u> <u>Coffeicola</u>	Rodolfo Quesada G.

<u>Date</u>	<u>Subject</u>	<u>Leader</u>
March 29	Family Health Problems in the Turrialba Community	Marta Coll-Camález
March 31	Nomenclature in Plants	R. E. Buchanan
April 5	Propagation of Cacao	Luis Alfredo Paredes
May 3	Biennial Production of Coffee in Costa Rica	Jorge León A.
May 3	Analysis of Pedigrees	Guillermo Narváez
May 9	Geography of Jamaica	Paul Morrison
May 10	Vegetative Multiplication	G. Escamilla
May 16	Relation of Feeding Concentrates to Milk Production with Native Cows	Hernán Sobrado H.
May 17	Stomas in <u>Theobroma cacao</u> , L.	Leonardo Cabrera
May 23	Superior Varieties of Vegetables	E. H. Casseres
May 23	Fiber Plants	Brittain Robinson
June 6	Progress of Coffee Research	Guillermo Bonilla
June 20	Classification of Plant Formations in the World	Leslie Holdridge
June 27	Control of Banana Diseases	Geo. F. Bowman
July 18	Interchange and Information Service of the Institute	Armando Samper
July 25	Asia and Central America	J. J. Ochse
August 1	Rancidity in Milk	Hernán Sobrado H.
August 8	The Occurrence of Pythium in Soil as Related to Temperature and Moisture at Various Seasons of the Year	J. H. McLaughlin
August 9	Chemical Weed Control	Joseph Orsenigo
August 15	A Tomato Breeding Program	Florence Thomas
August 16	Climatic Effects on Growth and Yield of Coffee	W. Lee McFarlane

<u>Date</u>	<u>Subject</u>	<u>Leader</u>
August 22	Studies on the Human Vitamin A Requirements	Ana Teresa Sariola
September 5	Agriculture of Formosa	Pierre G. Sylvain
September 5	Oil Palm	J. J. Ochse
September 12	Why a Herbarium?	Rafael A. Toro
September 13	Vegetative Propagation by Means of Grafting	J. J. Ochse
September 19	Coffee Program	Manuel Elgueta
September 27	Rooting System of Cacao and Factors Affecting its Development	Ulises Mejía
-----	Apiculture	Otón Paéz Castro
October 14	History and Economic Development of Cacao in Bahia, Brazil	L. Paul Oechsli
October 18	Contribution to the Development of Tomato Varieties for Conditions of High Temperature and High Humidity	Pedro Linares
October 24	Plant Breeders' Meeting Held in Mexico City (September 26 to October 8, 1949)	Manuel Elgueta and Mario Gutiérrez
October 25	The Productive Performance of Permanently Stabled Jerseys and Holsteins under a Humid Tropical Climate	Guillermo Narváez
October 31	Cinchona Cultivation in the Americas	Leslie Holdridge
November 7	Genetic System Affecting Self- and Cross-Compatibility in <u>Melilotus Officinalis</u> LAM	Mario Gutiérrez
November 8	Studies on <u>Cercospora Coffeicola</u>	Rodolfo Quesada
November 14	The U. S. Department of Agriculture Rubber Program	Ernest P. Imle
November 21	Determination of the Efficiency of Nurseries under Different Types of Shade, Stages of Growth of the Seedlings and	Guillermo Bonilla

<u>Date</u>	<u>Subject</u>	<u>Leader</u>
December 5	Potato Improvement through Resistant Varieties and Better Cultural Practices	Ernest H. Casseres
December 12	Productivity of Poultry at the Institute	Albert O. Rhoad
December 19	Variability and Association of Plant and Ear Characters in the Variety of Corn I-452	Mario Gutiérrez

ORTON MEMORIAL LIBRARY

Angelina Martínez

All the library routines have proceeded as usual and we can report an encouraging increase in the circulation of library materials and a definite tendency on the part of both students and staff members to make better use of the available resources.

PERSONNEL

Miss Catherine Noel James joined the Library staff last August to perform the duties of Assistant to the Librarian. So far Miss James has only been working with us part time, but it is hoped that something will be arranged in the very near future to relieve her of her job in the Central Office files.

ACQUISITIONS

A total of 126 books acquired by purchase from the States have been received. A collection of books and pamphlets including 43 titles on agriculture and botany was purchased from the widow of the late Sr. Alberto M. Brenes, Costa Rica's foremost botanist. This collection includes some rare and valuable items. A collection of 24 volumes on American cooperation was received from the Pan American Union and about 10 books were received as gifts. Over 500 pamphlets have been added to the collection of official agricultural publications from the United States and Latin America, and almost 50 photostatic copies have been acquired.

CLASSIFICATION AND CATALOGING

210 sets of Library of Congress cards were ordered, some of these to be incorporated in the Library of the United States Department of Agriculture Rubber Station in Turrialba. 106 books have been cataloged and more than 100 have had the author's number revised according to Cutter's tables.

CIRCULATION AND REFERENCE

As indicated in the following table, circulation statistics up to the month of January 1950 (2,241 items) definitely show an appreciable increase over the previous year.

Circulation Statistics

Calendar Years

	1946	1947	1948	1949	1950	
January	---	83	132	274	540	
February	15	102	87	262	543	
March	8	171	120	354	557	
April	2	50	194	371	553	
May	4	142	178	361	745	
June	7	169	280	367	682	
July	---	169	246	272		
August	11	194	248	216		
September	22	103	261	269		
October	67	157	301	303		
November	56	217	284	341		
December	65	104	251	300		
TOTALS	257	1661	2582	3690	3620	11,810

Fiscal Years

Feb. 1946	-	June 1947	-	974
July 1947	-	June 1948	-	1,935
July 1948	-	June 1949	-	3,580
July 1949	-	June 1950	-	5,321
TOTAL				11,810

(Publications used in the Library are not included in these figures.)

The Reference collection has been consulted rather frequently, and 165 questions were answered, including some "search" questions.

PERIODICALS AND BINDING

A total of 290 journals are checked in regularly. Of these, 82 are paid subscriptions, and the others are either received on exchange or on a complimentary basis.

For the 1950 calendar year 37 paid subscriptions will be added, bringing the total number of paid subscriptions to 119, and the total of periodicals received to 327. We hope to raise this figure considerably by means of exchanges as soon as the Turrialba journal is published.

IN-SERVICE TRAINING

A student from Guatemala spent seven months in the Library learning the routine necessary to organize a working collection.

GENERAL

The Library Committee, composed of five members and the Librarian, has met twice this year to discuss subscriptions for the current year.

The Librarian has circulated several lists under the heading Library News for the information of the members of the staff. Among these were the following lists: journals received in the Library, abstract journals available for consultation (annotated), publications on agriculture put out by the Pan American Union, items included in Brenes' collection, and recent book acquisitions. Pamphlets and articles of interest have also been circulated to the staff members.

The Librarian is working on a list of journals to be requested in exchange for the Turrialba journal. A section devoted to Library want lists, etc., will also be incorporated in the Turrialba journal. We hope, in this way, to be able to fill in many gaps in our present collection.

It is hoped that the work on the air conditioning of the stack room can be started very soon. This has unfortunately been delayed awaiting the necessary materials and equipment from the United States.

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Inter-American Institute
of Agricultural Science.

Annual report.

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